FINAL ◦ AUGUST 2019

Environmental Impact Report for the Prospect Island Tidal Habitat Restoration Project





Final Environmental Impact Report for the Prospect Island Tidal Habitat Restoration Project

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August 2019

Suggested Citation:
DWR and CDFW (California Department of Water Resources and California Department of Fish and Wildlife). 2019. Prospect Island Tidal Habitat Restoration Project Final Environmental Impact Report. Prepared by DWR, Fish Restoration Program, Division of Environmental Services, West Sacramento, CA and CDFW, Fish Restoration Program, Bay Delta Region (Region 3), Stockton, CA.

Table of Contents

ACRONYMS AND ABBREVIATIONS xv
EXECUTIVE SUMMARY xv
Project Area xv
Project Goals and Objectives xv
Proposed Project xvi
Summary of Impacts and Mitigation Measures, including Significant and Unavoidable Impacts xvii
Alternatives to the Proposed Project xl
Coordination with the Public and Agencies xlii
Issues to be Resolved xlii
Areas of Controversy xlii
1 INTRODUCTION 1-1
1.1 Overview of the Proposed Project and Alternatives 1-1
1.2 Proposed Project Objectives 1-3
1.3 Proposed Project Background and History 1-4
1.4 Public Involvement and Environmental Issues Raised 1-5
1.4.1 Project scoping 1-5
1.4.2 DEIR circulation 1-7
1.4.3 Property purchase 1-7
1.4.4 DEIR recirculation 1-7
1.4.5 EIR terminology 1-9
1.5 Purpose and Uses of the EIR 1-9
1.6 Agency Approvals and Permits 1-10
1.7 Availability and Public Review of the EIR 1-12
1.8 Report Organization 1-13
2 PROPOSED PROJECT DESCRIPTION 2-1
2.1 Proposed Project 2-1
2.1.1 Proposed Project location 2-1
2.1.2 Site history 2-4
2.1.3 Current land use and ownership 2-5
2.1.4 Surrounding properties 2-8
2.1.5 Proposed Project context within Delta regional restoration efforts 2-9
2.2 Proposed Project Actions 2-11
2.2.1 Summary 2-11
2.2.2 Anticipated future habitat conditions, Proposed Project 2-16
2.2.3 Description of Proposed Project components and construction activities 2-20

3 ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION MEASURES 3-1
ENVIRONMENTAL BASLINE AND SIGNIFICANCE DETERMINATIONS...3-1
BIOPHYSICAL RESOURCES 3-2
3.1 Hydrology.....3-2
3.1.1 Setting.....3-2
3.1.2 Significance criteria 3-22
3.1.3 Impacts and mitigation 3-23
3.2 Water Quality 3-42
3.2.1 Setting.....3-42
3.2.2 Significance criteria 3-70
3.2.3 Impacts and mitigation 3-71
3.3 Aquatic Biological Resources 3-97
3.3.1 Setting.....3-98
3.3.2 Significance criteria 3-122
3.3.3 Impacts and mitigation 3-122
3.4 Wetland and Terrestrial Biological Resources 3-143
3.4.1 Setting.....3-143
3.4.2 Significance criteria 3-210
3.4.3 Impacts and mitigation 3-211
3.5 Geology and Soils.....3-228
3.5.1 Setting.....3-229
3.5.2 Significance criteria 3-244
3.5.3 Impacts and mitigation 3-245
3.6 Hazards and Hazardous Materials.....3-247
3.6.1 Setting.....3-247
3.6.2 Significance criteria 3-256
3.6.3 Impacts and mitigation 3-257
3.7 Air Quality 3-265
3.7.1 Setting.....3-266
3.7.2 Significance criteria 3-279
3.7.3 Impacts and mitigation 3-281
3.8 Greenhouse Gases.....3-292
3.8.1 Setting.....3-292
3.8.2 Impacts and mitigation 3-293
3.9 Mineral and Gas Resources 3-294
3.9.1 Setting.....3-295
3.9.2 Significance criteria 3-299
3.9.3 Impacts and mitigation 3-300

3.10 Noise....3-300
3.10.1 Setting....3-302
3.10.2 Significance criteria....3-306
3.10.3 Impacts and mitigation....3-307
HUMAN RESOURCES....3-312
3.11 Aesthetics....3-312
3.11.1 Setting....3-312
3.11.2 Significance criteria....3-317
3.11.3 Impacts and mitigation....3-318
3.12 Agricultural Resources....3-320
3.12.1 Setting....3-320
3.12.2 Significance criteria....3-326
3.12.3 Impacts and mitigation....3-327
3.13 Cultural Resources....3-328
3.13.1 Setting....3-328
3.13.2 Significance criteria....3-334
3.13.3 Impacts and mitigation....3-334
3.14 Land Use and Planning/Population and Housing....3-338
3.14.1 Setting....3-338
3.14.2 Significance criteria....3-345
3.14.3 Impacts and mitigation....3-345
3.15 Public Services....3-346
3.15.1 Setting....3-347
3.15.2 Significance criteria....3-348
3.15.3 Impacts and mitigation....3-349
3.16 Recreation....3-349
3.16.1 Setting....3-349
3.16.2 Significance criteria....3-358
3.16.3 Impacts and mitigation....3-358
3.17 Transportation and Traffic....3-361
3.17.1 Setting....3-361
3.17.2 Significance criteria....3-363
3.17.3 Impacts and mitigation....3-363
3.18 Utilities....3-366
3.18.1 Setting....3-367
3.18.2 Significance criteria....3-373
3.18.3 Impacts and mitigation....3-373

3.19 Cumulative Impacts 3-375
3.19.1 Approach....3-375
3.19.2 Cumulative projects considered in this EIR....3-376
3.19.3 Summary of cumulative impacts 3-387
3.20 Other CEQA Considerations....3-402
3.20.1 Growth inducement....3-402
3.20.2 Significant unavoidable adverse impacts 3-403
4 ALTERNATIVES....4-1
4.1 Introduction....4-1
4.2 Development of Alternatives Considered in this EIR 4-2
4.2.1 Phase 1 screening of conceptual alternatives....4-2
4.2.2 DRERIP technical review, October 2012 4-3
4.2.3 Phase 2 screening of conceptual alternatives....4-3
4.2.4 Selection of Proposed Project and EIR alternatives....4-3
4.2.5 Alternatives considered and rejected 4-4
4.3 Alternatives Considered in this EIR 4-5
4.4 Alternative 1: No Project 4-6
4.4.1 Description 4-6
4.4.2 Environmental impacts....4-6
4.5 Alternative 2: Two Breaches and Weir....4-11
4.5.1 Description 4-11
4.5.2 Environmental impacts....4-15
4.6 Alternative 3: Three Breaches 4-28
4.6.1 Description 4-28
4.6.2 Environmental impacts....4-30
4.7 Comparison of Alternatives and Identification of Environmentally Superior Alternative 4-37
5 REPORT PREPARERS 5-1
6 REFERENCES....6-1

List of Tables

Table ES-1. Summary of Impacts and Mitigation Measures xviii
Table 1.6-1. List of the Identified Responsible Agencies, Permit, Approval, or Notification Types, and Their Status....1-11
Table 2.2-1. Restoration Activities and Features of the Proposed Project....2-13
Table 2.2-2. Prospect Island Natural Communities: Existing, As-Built, and Future—Proposed Project 2-19
Table 2.2-3. Estimated Material Quantities and Dimensions 2-24

Table 2.2-4. Removal Techniques for Aquatic and Terrestrial Non-native Invasive Plant Species....2-33
Table 2.2-5. Timeline of Invasive Terrestrial Plant Species Removal Techniques....2-35
Table 2.2-6. Estimated Construction Implementation Timing....2-52
Table 3.1-1. Tidal Datums in the Vicinity of Prospect Island....3-15
Table 3.1-2. Rio Vista Minimum Monthly Flow Requirements....3-22
Table 3.1-3. Change in Summer, Strong Neap-Spring Tidal Range from Base Conditions....3-25
Table 3.1-4. Modeled Velocities in Miner Slough by Flow Period for Baseline Conditions and Under the Proposed Project....3-38
Table 3.2-1. Key Water Quality Monitoring Stations....3-43
Table 3.2-2. Monthly Mean Electrical Conductivity and Salinity for Water Year 2012....3-47
Table 3.2-3. Monthly Mean Water Temperature for Water Year 2012....3-48
Table 3.2-4. Exceedance Frequency of Basin Plan Methylmercury Objectives, per Trophic Level, for Fish Sampled in the Vicinity of Prospect Island....3-52
Table 3.2-5. Mean Monthly *In Situ* Water Quality Parameters for the Proposed Project Site during 1997–1998 and 2011–2014....3-54
Table 3.2-6. Well Depths and Estimates of Total Dissolved Solids at the Proposed Project Site....3-55
Table 3.2-7. Beneficial Uses of Water....3-58
Table 3.2-8. Water Quality Objectives Applicable to Waterbodies at or Near the Proposed Project Site....3-59
Table 3.2-9. Selected SWRCB-Division of Drinking Water Maximum Contaminant Levels for Drinking Water....3-64
Table 3.2-10. Pollutants Included on the 2008–2010 CWA Section 303(d) List of Water Quality Limited Segments for the North Delta....3-66
Table 3.2-11. Water Rights D-1641 Electrical Conductivity Standards for Agricultural, and Fish and Wildlife Beneficial Uses....3-69
Table 3.2-12. Water Rights D-1641 Chloride Standards for Municipal and Industrial Beneficial Uses....3-69
Table 3.2-13. Aquatic-approved Herbicides, Application Method, Frequency, and Amount, Which May Be Used for Control of Invasive Emergent Vegetation on Prospect Island....3-78
Table 3.2-14. USEPA Aquatic Toxicity Characterizations Based on Results of Acute Aquatic Toxicity Test Results for Fish, Invertebrate, and Plant Species....3-79

Table 3.2-15. Monthly Measured Water Temperatures in Miner Slough and Prospect Island 2011–2013 3-83
Table 3.2-16. SWRCB D-1641 Compliance Monitoring Stations Used to Evaluate the Possibility of Increased Salinity Under the Proposed Project 3-88
Table 3.2-17. Numbers of Actual and Modeled Days Exhibiting Sub-optimal Water Temperatures for Selected Waterbodies near Prospect Island 3-92
Table 3.2-18. Numbers of Modeled Days with Sub-optimal Water Temperatures for Selected Habitats on Prospect Island 3-93
Table 3.3-1. Fishes Occurring in the Sacramento-San Joaquin Delta and Potentially Occurring at the Proposed Project Site 3-99
Table 3.3-2. Representative Fish Species Collected Using Electrofishing in Prospect Island During August 2013 and January 2014 3-101
Table 3.3-3. Adult and Juvenile Sacramento Splittail at Stations in the Vicinity of Prospect Island 2011–2013 3-105
Table 3.3-4. Adult and Juvenile Delta Smelt at Stations in the Vicinity of Prospect Island 2011–2013 3-107
Table 3.3-5. Average Monthly Catch of Adult and Juvenile Longfin Smelt at Stations Within and Near Miner Slough, 2011–2013 3-108
Table 3.3-6. Monthly Catch of Central Valley Steelhead at Stations Along the Sacramento River and Near Miner Slough, 2011–2013 3-110
Table 3.3-7. Average Monthly Catch of Juvenile Chinook Salmon of All Runs at Stations Along the Sacramento River and Near Miner Slough, 2011–2013 3-112
Table 3.3-8. Average Zooplankton Density in Prospect Island and Adjacent Water Bodies During March–July 2012 3-116
Table 3.3-9. DWR Environmental Monitoring Program Catch of Asian Clam During 2011 3-117
Table 3.3-10. Solano County General Plan: Goals and Policies Relevant to Aquatic Biological Resources 3-121
Table 3.3-11. Acute and Chronic Exposure Scenarios for Glyphosate for Special-status Fish in a Reference Study Using an Application Rate of 3.75 Pounds Acid-Equivalent/Acre 3-134
Table 3.3-12. Acute and Chronic Exposure Scenarios for Imazapyr for Special-status Fish in a Reference Study Using an Application Rate of 1.5 Pounds Acid Equivalent/Acre 3-135

Table 3.3-13. Monthly Measured Daytime Average and Post-construction Modeled Water Temperatures for Miner Slough and Prospect Island 3-139
Table 3.4-1. USACE Jurisdictional Waters and Wetlands in the Proposed Project Site 3-149
Table 3.4-2. Special-status Plant Species with the Potential to Occur in the Proposed Project Vicinity 3-153
Table 3.4-3. Special-status Wildlife Species in the Proposed Project Vicinity 3-174
Table 3.6-1. Solano County Mosquito Abatement District: Mosquito Breeding Habitats 3-251
Table 3.7-1. Physical Characteristics and Health Effects of Criteria Air Pollutants 3-267
Table 3.7-2. National and California Ambient Air Quality Standards 2016 3-268
Table 3.7-3. Solano County General Plan Policies Related to Air Quality 3-274
Table 3.7-4. Annual Air Quality Monitoring Data 2011–2017 3-276
Table 3.7-5. Federal and State Attainment Status for the YSAQMD 2016 3-278
Table 3.7-6. YSAQMD Thresholds of Significance 3-281
Table 3.7-7. Estimated Construction Emissions for Material Delivery Using Barges or Trucks and Corresponding YSAQMD Significance Thresholds 3-283
Table 3.7-8. Techniques for Reducing Construction Equipment Exhaust 3-286
Table 3.7-9. Techniques for Reducing Fugitive Dust 3-287
Table 3.10-1. Solano County General Plan, Land Use Noise Compatibility Guidelines 3-305
Table 3.10-2. Typical Noise Levels from Proposed Construction Equipment 3-307
Table 3.10-3. Schedule of Estimated Daily Traffic 3-310
Table 3.10-4. Human Response to Transient Vibration 3-312
Table 3.19-1. List of Related Projects Utilized in Conducting the Cumulative Impacts Analysis for the Proposed Project 3-378
Table 4.3-1. Comparison of Features—Proposed Project and Alternatives 4-5
Table 4.5-1. Prospect Island Natural Communities: Existing, As-Built, and Future Areas Of Habitat Communities for Alternative 2 4-14

Table 4.5-2. Analysis of Inundation Frequency and Duration for the Overflow Weir Under Alternative 2 Based on Stage Data from Miner Slough at Hwy 84 Bridge 4-25
Table 4.7-1. Comparison of Proposed Project Effects to Those Under the Alternatives 4-39

List of Figures

Figure 2.1-1. Proposed Project Location....2-2
Figure 2.1-2. Prospect Island Site Easements and Surrounding Features 2-3
Figure 2.1-3. Land Ownership at Prospect Island 2-7
Figure 2.1-4. Restoration Efforts in the Cache-Yolo Region 2-10
Figure 2.2-1. Prospect Island Natural Communities: Existing, As-Built, and Future—Proposed Project 2-17
Figure 2.2-2. Proposed Project 2-21
Figure 2.2-3. Site Preparation 2-22
Figure 2.2-4. Site Clearing and Invasive Species Control....2-23
Figure 2.2-5. Typical Constructed Channel Cross Sections....2-38
Figure 2.2-6. Eastern Toe Berm Typical Cross Section 2-41
Figure 2.2-7. Eastern Intertidal Bench Typical Cross Section 2-43
Figure 2.2-8. Internal Cross-Levee Excavation Cross Section....2-45
Figure 2.2-9. Breach Velocity Dissipation Feature 2-47
Figure 2.2-10. Miner Slough Levee Breach Cross Section 2-51
Figure 3.1-1. Diagram of Mixed, Semi-Diurnal Tides of the San Francisco Estuary....3-3
Figure 3.1-2. Diversions and Drains in the Cache Slough Complex 3-7
Figure 3.1-3. Regional Hydrology—Summer. 3-10
Figure 3.1-4. Regional Hydrology—Winter....3-11
Figure 3.1-5. Comparison of Regional Flow Changes during March 2011 Storm Event. 3-12
Figure 3.1-6. Sacramento Valley Groundwater Basin, Solano Subbasin 3-14
Figure 3.1-7. Prospect Island Groundwater Monitoring Wells and Ryer Island Seepage Areas 3-18
Figure 3.1-8. Hydrodynamic Model Tide Station Locations....3-26
Figure 3.1-9. Miner Slough Breach and Velocity Reference Locations 3-35
Figure 3.1-10. Peak Ebb Current Velocities for Baseline and Alternative Similar to Proposed Project 3-36
Figure 3.1-11. Peak Ebb Current Velocities for Baseline and Alternative Similar to Proposed Project 3-37
Figure 3.2-1. Water Quality Monitoring Stations In and Near Prospect Island 3-44

Figure 3.2-2. Distances from the Golden Gate Bridge to Various Points in the Bay-Delta. 3-46
Figure 3.2-3 Hourly Dissolved Oxygen Measured at the Sacramento River at the Highway-12 Bridge in Rio Vista Monitoring Station in Water Year 2012....3-49
Figure 3.2-4. Turbidity Measured in Miner Slough at Hwy 84 Bridge during Water Year 2012....3-50
Figure 3.2-5. Turbidity Measured in Cache Slough at Ryer Island during Water Year 2012....3-50
Figure 3.2-6. SWRCB D-1641 Compliance Locations Used for Salinity Impacts Modeling....3-85
Figure 3.2-7. Base Electrical Conductivity for CCWD Intakes at Rock Slough, Old River, Victoria Canal, and Mallard Slough; Modeled Change in EC at CCWD Intakes Following Implementation of the Proposed Project. 3-89
Figure 3.4-1. Vegetation Communities 2012 and 2014 at Prospect Island 3-145
Figure 3.4-2. Waters and Wetlands of the U.S. at Prospect Island. 3-150
Figure 3.5-1. Geology of the Proposed Project Region and Site....3-231
Figure 3.5-2. Soil Units Underlying the Proposed Project Site. 3-235
Figure 3.5-3. Hydrologic Soil Groups Underlying the Proposed Project Site. 3-238
Figure 3.5-4. Land Subsidence throughout the Delta....3-240
Figure 3.5-5. Percent Soil Organic Matter of the Proposed Project Site. 3-241
Figure 3.9-1. Gas Fields and Wells in Vicinity of the Proposed Project Site. 3-296
Figure 3.10-1. Noise Levels from Common Activities. 3-302
Figure 3.10-2. Noise Produced by Various Pieces of Construction Equipment....3-308
Figure 3.11-1. Westerly Views of South End of Prospect Island from State Route 84. 3-314
Figure 3.11-2. View of Miner Slough Looking West from Ryer Island Levee. 3-314
Figure 3.11-3. View of Miner Slough and Prospect Island from State Route 84. 3-315
Figure 3.11-4. View of Prospect Island from Arrowhead Harbor Marina. 3-315
Figure 3.18-1. View of Spliced Wooden Poles, Looking North from Within Miner Slough....3-368
Figure 4.5-1. Restoration Alternative 2....4-13
Figure 4.6-1. Restoration Alternative 3....4-29

List of Appendices

Appendix A. Summary of Technical Terms
Appendix B. List of Technical Reports
Appendix C. Notice of Preparation and Scoping Report
Appendix D Response to Comments on the 2016 DEIR
Appendix E. Response to Comments on the 2019 Partial Recirculated DEIR
Appendix F. Supplemental Comments on the 2016 DEIR and 2019 Partial Recirculated DEIR
Appendix G. Air Quality Calculations
Appendix H. DWR GHG Emissions Reduction Plan Consistency Determination Form

ACRONYMS AND ABBREVIATIONS

Acronym	Definition
ac	acre
AQAP	air quality attainment plan
BiOps	Biological Opinions
BMP	Best Management Practice
°C	Degrees Celsius
CAAQS	California Ambient Air Quality Standards
CALFED	CALFED Bay-Delta Program
CAL FIRE	California Department of Forestry and Fire Prevention
CalRecycle	California Department of Resources Recycling and Recovery
CARB	California Air Resources Board
CCR	California Code of Regulation
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CDPR	California Department of Pesticide Regulation
CEQA	California Environmental Quality Act
CERLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGS	California Geological Survey
CNDDB	California Natural Diversity Database
CNEL	Community Noise Equivalent Level
CNPS	California Native Plant Society
CO	carbon monoxide
CRHR	California Register of Historical Resources
CRPR	California Rare Plant Ranks
CSC	Cache Slough Complex
CSLC	California State Lands Commission
CVFPB	Central Valley Flood Protection Board
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
DBW	Division of Boating and Waterways
DCC	Delta Cross Channel

Acronym	Definition
Delta	Sacramento-San Joaquin River Delta
DOC	dissolved organic carbon
DOGGR	Division of Oil, Gas, and Geothermal Resources
DPC	Delta Protection Commission
DPM	diesel particulate matter
DPR	Department of Parks and Recreation
DPS	distinct population segments
DRERIP	Delta Regional Ecosystem Restoration Implementation Plan
DRMS	Delta Risk Management Strategy
DSC	Delta Stewardship Council
DTSC	Department of Toxic Substances Control
DWR	California Department of Water Resources
DWSC	Sacramento Deep Water Ship Channel
EC	electrical conductivity
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ERP	Ecosystem Restoration Program
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
°F	Degrees Fahrenheit
FCAA	Federal Clean Air Act
FEMA	Federal Emergency Management Agency
FGC	Fish and Game Code
FHWA	Federal Highway Administration
fps	Foot or feet per second
FRP	Fish Restoration Plan
ft	feet
GGERP	Greenhouse Gas Emissions Reduction Plan
GHG	greenhouse gas
IEP	Interagency Ecological Program
H_2S	Hydrogen Sulfide
HAP	Hazardous Air Pollutant
HSC	Health and Safety Code
HU	hydrogeologic unit
in	inch
LGP	low ground pressure
LURMP	Land Use and Resource Management Plan
MBTA	Migratory Bird Treaty Act

Acronym	Definition
MCL	maximum contaminant level
MeHg	methylmercury
MHW	mean high water
MHHW	mean higher high water
mi	mile
MLW	mean low water
MLLW	mean lower low water
MPH	miles per hour
MTL	mean tide level
MSDS	material safety data sheets
NAAQS	National Ambient Air Quality Standards
NAHC	Native American Heritage Commission
NBA	North Bay Aqueduct
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NOP	Notice of Preparation
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NPPA	Native Plant Protection Act
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
NWIC	Northwest Information Center
O_3	ozone
OCAP	Operations Criteria and Plan
OHP	Office of Historic Preservation
OPR	Office of Planning and Research
OSHA	Occupational Safety and Health Administration
Pb	lead
PCB	polychlorinated biphenyls
PCE	Primary Constituent Element
PG&E	Pacific Gas and Electric Company
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter

Acronym	Definition
Port	Port of West Sacramento
ppt	parts per thousand water
PRC	Public Resources Code
RCRA	Resource Conservation and Recovery Act
RD	Reclamation District
RIAR	Ryer Island Agricultural Region
RHA	Rivers and Harbors Act
RM	River mile
ROG	Reactive Organic Gases
RV	recreational vehicle
RWQCB	Regional Water Quality Control Board
SDWA	Safe Drinking Water Act
SFCWA	State and Federal Contractors Water Agency
SIP	State Implementation Plan
SHPO	California State Historic Preservation Officer
SMARA	Surface Mining and Reclamation Act
SO_2	sulfur dioxide
SR	state route
SRA	shaded riverine aquatic
SRFCP	Sacramento River Flood Control Project
SVAB	Sacramento Valley Air Basin
SWA	State Wildlife Area
SWP	State Water Project
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
SWS	Stillwater Sciences
TAC	Toxic Air Contaminant
TDS	total dissolved solids
TMDL	Total Maximum Daily Load
TSCA	Toxic Substances Control Act of 1976
TTLC	total threshold limit concentration
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Acronym	Definition
WDR	Waste Discharge Requirement
WWR	Wetlands and Water Resources
YSAQMD	Yolo-Solano Air Quality Management District

EXECUTIVE SUMMARY

The Prospect Island Tidal Habitat Restoration Project (Project) is an approximately 1,600 acre (ac) tidal restoration Project located in southeastern Solano County proposed by the California Department of Water Resources (DWR). DWR is the California Environmental Quality Act (CEQA) Lead Agency for this Project.

Project Area

Prospect Island is located immediately east of, and technically is still an element of, the southern end of the Yolo Bypass Floodway (Yolo Bypass) in the Sacramento-San Joaquin River Delta (Delta). The site is bounded on the east by Miner Slough, on the west by the Sacramento Deep Water Ship Channel (DWSC), on the south by the confluence of the DWSC and Miner Slough, and on the north by an east-west levee that runs from Arrowhead Harbor Marina to the DWSC. Both the northern 1,300 ac portion, and the southern 300 ac portion, of Prospect Island are owned by DWR.

Project Goals and Objectives

The overarching goal of the Project is to restore tidal action to the interior of Prospect Island. The Project is intended to partially fulfill the 8,000 ac tidal habitat restoration obligations of DWR contained within Reasonable and Prudent Alternative (RPA) 4 of the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion (BiOp) for long-term coordinated operations of the State Water Project (SWP) and the federal Central Valley Project (CVP) (USFWS 2008). Because restoration of tidal habitat would provide access for salmonid rearing at Prospect Island, the Proposed Project would also be consistent with RPA I.6.1 of the National Marine Fisheries Service (NMFS) Salmonid BiOp for SWP/CVP operations (NMFS 2009a).

The Notice of Preparation (NOP) identified the following six objectives for the Project (DWR 2013a):

1. Enhance primary and secondary productivity and food availability for Delta Smelt and other native fishes within Prospect Island and surrounding Delta waterways.
2. Increase the quantity and quality of salmonid rearing habitat within and in the areas surrounding Prospect Island.

3. Increase the amount and quality of habitats to support other listed species, to the extent they can be supported by site conditions and natural processes.
4. Provide other ecosystem benefits associated with increased Delta freshwater tidal marsh habitat, including water quality enhancement, recreation, and carbon sequestration.
5. To the greatest extent practical, promote habitat resiliency to changes in future Delta conditions, such as land use conversions, climate change, sea level rise, and invasive species.
6. Avoid promoting conditions adverse to Project biological objectives, such as those that would favor establishment or spread of invasive exotic species.

Proposed Project

Under the Proposed Project, the Miner Slough levee would be breached in two locations: on the north property approximately 0.5 miles (mi) south of Arrowhead Harbor Marina, and on the south property at the location of the formerly repaired breach connecting to the Miner Slough spur channel. A portion of the internal cross-levee separating the north and the south properties would also be removed. Once these breaches are completed, the north and south properties would be subject to daily tidal inundation. Briefly, the Proposed Project would include the following actions:

1. South property levee repairs;
2. Pre-construction-site preparation;
3. Invasive plant species control;
4. Debris and old infrastructure removal;
5. Excavate constructed channel network;
6. Block or fill remnant agricultural ditches (using excavated soils);
7. Construct interior topographic features (using excavated soils);
8. Construct eastern toe berm (using excavated soils);
9. Construct eastern intertidal bench (using excavated soils);
10. Excavate internal cross-levee;
11. Construct breach velocity dissipation feature;
12. Dredge Miner Slough spur channel (between Miner Slough and the south property, with placement of dredged material within Prospect Island);
13. Planting and revegetation;

14. Remove access road and ramps; and
15. Breach Miner Slough levee and the internal cross-levee on Prospect Island between the north and south properties.

Note that **Appendix A** includes a summary of technical terms used throughout the EIR, and **Appendix B** contains a list of relevant technical reports.

Summary of Impacts and Mitigation Measures, including Significant and Unavoidable Impacts

The primary impacts under the Proposed Project would be short-term impacts due to construction-related activities. These include potential impacts to water quality, special status species and their habitat, recreational boating activities, the public and/or the environment from hazardous substances, cultural resources from discoveries, and neighbors due to noise, air quality, and traffic. All but one of these short-term impacts would be *no impact, less than significant,* or *less than significant with mitigation*. Short-term impacts to perennial aquatic habitats and wetland communities from site preparation would be *significant and unavoidable*. In the long-term, the Proposed Project would have *beneficial* effects on water temperature, aquatic species and habitat, western pond turtle, foraging and migratory birds, and subsidence within Prospect Island due to sediment deposition, and would also remove existing hazards. There would be no *significant and unavoidable* long-term impacts (Table ES-1).

Note that short-term air quality impacts (Impacts 3.7-1 and 3.7-2) were originally assessed as *significant and unavoidable* in the 2016 DEIR; however, these significance determinations were revised as part of the 2019 Partial Recirculated DEIR, following coordination with the Yolo-Solano Air Quality Management District (YSAQMD) and the addition of a mitigation measure requiring an offset mitigation fee.

Table ES-1. Summary of Impacts and Mitigation Measures. Significance abbreviations are: B — *beneficial*; NI — *no impact*; LTS — *less than significant*; LTSM — *less than significant with mitigation*; SU — *significant and unavoidable*.

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
		HYDROLOGY	
3.1-1	Potential changes in agricultural water supply and drainage due to changes in tidal range	LTS	None required
3.1-2	Potential impacts to Sacramento River Flood Control Project and Yolo Bypass Floodway flood conveyance	NI	None required
3.1-3	Groundwater seepage impacts from Prospect Island to adjacent areas	LTS	None required
3.1-4	Potential wind-wave erosion of the interior side of Prospect Island levees	LTS	None required
3.1-5	Potential toe-scour and erosion of Miner Slough levees affecting Ryer Island levee stability	LTS	None required
3.1-6	Potential increase in seepage on adjacent lands due to Miner Slough bed scour	LTS	None required
3.1-7	Potential impacts to regional flow resulting in non-compliance with D-1641 flow requirements on the Sacramento River at Rio Vista	NI	None required
3.1-8	Potential scour impacting stability of nearby bridges, trestles, culverts or other structures	NI	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.1-9	Potential impacts to water rights from diversion of surface water	NI	None required
3.1-10	Potential construction related impacts to groundwater supplies and third-party wells	NI	None required
			WATER QUALITY
3.2-1	Short-term construction-related water quality impacts	LTSM	**Mitigation Measure 3.2-1.1** A site dewatering plan shall be developed by the construction contractor and submitted to DWR for approval prior to commencement of construction activities. The site dewatering plan shall include items such as the following: 1. Detailed description of work to be performed to control surface water at the Project site. 2. Detailed description of methods, installation and details of the dewatering systems proposed to be used. 3. Drawings showing the detailed layout of dewatering systems including pumps, ditches, berms, discharge lines, Best Management Practices (BMPs), and barriers to shield or divert flow. 4. Supporting design information including design calculations prepared by a California Registered Civil Engineer, type of systems, sizes, capacities, proposed number and layout of pumps, depths, filters, other needed equipment, and power supply. 5. Information related to backup pumping systems, backup power systems, and warning systems to protect against power failure, system failure, and high groundwater. 6. Information related to operation, maintenance, monitoring, removal, decommissioning pumps, and system abandonment procedures. 7. Information related to discharge, including methods to monitor turbidity and water treatment if necessary. 8. Provisions for handling significant rainfall events (greater than 0.5 in predicted in a 24-hour period as described in the Stormwater Pollution Prevention Plan [SWPPP]). This shall also include procedures to be followed prior to the forecasted significant rain events. 9. Provisions for handling emergency situations such as power outages, equipment failures, pumping system shutdowns and the proposed response.

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
			10. Information on schedule and sequencing of dewatering activities. 11. Information on dewatering operations shall be coordinated with other construction operations including placement of compacted soil, removal and placement of pipe, and other miscellaneous items. **Mitigation Measure 3.2-1.2** Upland areas of the Project associated with staging activities shall be covered by a Stormwater Pollution Prevention Plan (SWPPP). All contractors working in a capacity that could increase the potential for adverse water quality impacts would receive training regarding the need to minimize impacts. Contractors would also be familiar with general storm water construction-site BMPs for the protection of water quality. The SWPPP may include, but would not be limited to, the following: 1. Use of vegetated buffers, hay wattles or bales, sandbags, silt screens, or other erosion control measures to intercept runoff from construction, excavation, or staging areas to adjacent waterbodies. 2. BMPs for staging of construction supplies and waste management. **Mitigation Measure 3.2-1.3** A Spill Prevention, Control, and Response Plan shall be developed by the construction contractor and submitted to DWR for approval prior to commencement of construction activities. Spill prevention and cleanup kits, equipment, and materials shall always be in close proximity to locations of hazardous materials (e.g., at fueling and staging areas) and conveniently located to allow rapid response. Prior to entering the work site, all field personnel would be informed of the location of the spill prevention and cleanup kits and appropriately trained in spill prevention, hazardous material control, and spill cleanup. The work site would be routinely inspected to verify that the Plan is properly implemented. The Plan would include: 1. A vehicle inspection and fueling plan. 2. BMPs for spill prevention and containment. 3. Locations and uses of spill prevention materials, cleanup kits, and equipment. 4. Qualification and reporting requirements for a federal reportable spill (CFR, Title 40, Section 110) including contact information for the RWQCB and the California Department of Toxic Substances Control (DTSC).

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.2-2	Short-term construction-related increases in turbidity and/or mobilization of contaminants from dredging and excavation of levee breaches	LTSM	**Mitigation Measure 3.2-2.1** 1. Appropriate turbidity control measures (e.g., silt curtains) shall be required during all dredging operations. Selection of appropriate turbidity control measures would consider tidal forces in Miner Slough and would be designed to be robust and effective. Turbidity measures would be in place 1–2 days prior to commencement of dredging operations and would be positioned slightly above the bottom sediments allowing aquatic species to escape entrapment. 2. The cycle time of the ascending loaded dredging bucket shall be limited to a velocity that reduces the potential to wash sediment out of the bucket. 3. The number of bites performed per cycle shall be limited to one to reduce sediment re-suspension from opening and closing the dredging bucket.
3.2-3	Short-term construction-related effects from application of aquatic herbicides	LTSM	**Mitigation Measure 3.2-3.1** Best Management Practices (BMPs) shall be employed in order to minimize potential impacts to water quality from accidental spills. All contractors working shall receive training regarding the need to minimize impacts. Contractors shall be experienced and compliant in the environmentally safe application of herbicides. BMPs shall include, but not be limited to, the following: 1. Areas for storage, mixing, and loading of herbicides shall be located where accidental spills to nearby waterbodies cannot occur. 2. Applicators shall be trained in proper spill response, and rapidly report any spill to the appropriate agencies. 3. Applicators shall maintain on-site (near herbicide storage and loading equipment) appropriate initial spill-response items (e.g., absorbent materials). **Mitigation Measure 3.2-3.2** In order to minimize off-target spray drift and impacts to water quality from herbicide application, aerial pesticide application by helicopter shall be preferred (over fixed wing aircraft). In addition, all appropriate, standard BMPs for aerial application of pesticides shall be followed, including but not limited to, the following: 1. Applicators shall develop an application plan--including maps of the Project site showing general spotter and flight plans with application areas clearly indicated--to be approved by the Lead Agency, before any application of herbicides.

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
			2. Applicators shall adhere strictly to proper mixing and application guidelines as presented on herbicide labels and in product instructions. 3. Application of herbicides on levee vegetation shall not take place by air and otherwise avoided unless necessary, when it would be executed using spot application techniques. 4. Herbicide application by air shall only take place during the in-water work window from July 1 to October 31 of any one year, in order to reduce potential impacts to migrating fish species of concern. 5. Applicators shall maintain records of herbicide applications—including dates, times, weather conditions, amount of herbicide applied, problems experienced, etc.—in addition to or as required by federal, state, and/or local agencies. 6. Spraying shall at all times be halted when flying over levees, adjacent waterbodies (e.g., Miner Slough, DWSC), and agricultural fields. 7. Aerial application would occur only during light winds, non-gusty, relatively cool weather conditions. 8. Application would involve the use of appropriate spray nozzles, nozzle configurations, and nozzle orientations that minimize atomization of herbicide mixtures and production of fine droplets that tend to drift. 9. Herbicide tanks would not be operated at excessively high pressures. 10. If conditions require the use of aerial spray by fixed-wing aircraft, pilots shall be instructed to include an appropriate spray buffer (in addition to the width of the levee) where, to the extent possible, no herbicides would be directly applied (subject to overriding safety concerns).

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.2-4	Short-term construction-related effects on water temperature in adjacent waterbodies due to dewatering activities	NI	None required
3.2-5	Long-term effects on salinity in waterbodies near Prospect Island	LTS	None required
3.2-6	Long-term effects on water temperature within Prospect Island and in nearby waterbodies	B	None required
3.2-7	Long-term effects on primary productivity and dissolved organic carbon (DOC) within and near Prospect Island	LTS	None required
3.2-8	Long-term effects on methylmercury production, bioaccumulation, and export	LTS	None required
3.2-9	Long-term effects on groundwater quality	NI	None required
AQUATIC BIOLOGICAL RESOURCES			
3.3-1	Short-term loss and degradation of aquatic habitat from construction-related activities	LTS	None required
3.3-2	Long-term conversion and enhancement of aquatic habitat	B	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.3-3	Short-term direct construction-related injury or mortality of fish	LTSM	**Mitigation Measure 3.3-3.1** Pile driving activities shall be conducted using vibratory hammers, where feasible, to minimize sound attenuation from pile driving activities. If in-water pile driving activities become necessary, underwater sound monitoring shall be performed to ensure that peak sound pressure does not exceed 206 decibels and accumulated sound exposure level does not exceed 187 decibels at 10 meters. If work is performed at a time when special-status fish less than 2 grams are expected near the Project site, accumulated sound exposure levels shall not exceed 183 decibels at 10 meters. Underwater sound reduction measures shall be implemented as needed to ensure that sound levels do not exceed the above thresholds. Sound reduction measures may include impact cushions, pipe caissons, bubble curtains, fabric barriers, and limiting operational hours and impact frequency. **Mitigation Measure 3.3-3.2** DWR shall consult with CDFW and USFWS before conducting any in-water work during the month of July. DWR shall determine the extent of Delta Smelt presence in the CSC and Miner Slough by evaluating catch and distribution data from CDFW's 20 mm Survey[1] and Summer Townet Survey[2]. The results shall be sent to USFWS and CDFW representatives to determine the extent of allowable in-water work. 20 mm Survey Stations 724 and 726 are located in Miner Slough at the lower and upper ends of Prospect Island and shall be used to determine Delta Smelt abundance in Miner Slough during July construction activities. Summer Townet Survey Station 715, just downstream of Miner Slough in Cache Slough; Station 723, just upstream from Miner Slough in the DWSC; and Station 716, just upstream from Miner Slough in Lindsey Slough, shall be used to determine Delta Smelt abundance in the vicinity of Miner Slough when the 20 mm Survey is not active.

[1] The 20 mm Survey is an annual survey conducted by CDFW that monitors post-larval to juvenile Delta Smelt throughout the Delta from March through July. Surveys run every two weeks and include stations in Cache Slough, Lindsey Slough, the DWSC, and Miner Slough.

[2] The Summer Townet Survey is an annual survey that monitors young of the year fish throughout the Delta from June through August. Surveys run every two weeks and include stations in Cache Slough, Lindsey Slough, and the DWSC.

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.3-4	Short-term construction-related noise impediments to fish migration	LTSM	**Mitigation Measure 3.3-3.1** *(described above in Aquatic Biological Resources)*
3.3-5	Short-term impairment of essential fish behaviors due to potential increases in turbidity during underwater sediment sampling activities	Impact deleted as sampling is complete	None required
3.3-6	Short-term impairment of essential fish behaviors due to construction-related increases in turbidity	LTSM	**Mitigation Measure 3.2-2.1** *(described above in Water Quality)*
3.3-7	Short-term fish injury or mortality during dewatering	LTSM	**Mitigation Measure 3.3-7.1:** To minimize mortality due to the dewatering process, a Fish Rescue Plan shall be prepared by DWR for approval by state and federal fish agencies (CDFW, USFWS, NMFS). Development of the Fish Rescue Plan shall include consideration of numerous sampling methods (seines, electrofishing, traps) and events, performed during and potentially after initial site dewatering. Fish would be captured alive and transported to nearby suitable habitat for release. The fish rescue would occur under the direction of CDFW.
3.3-8	Fish Injury or mortality due to herbicide application	NI	None required
3.3-9	Post-construction increased predation on native fish	LTS	None required
3.3-10	Long-term impacts to fish in Prospect Island and adjacent water bodies from changes in water temperature	B	None required
3.3-11	Altered habitat and food web from invasion by Asian Clam	LTS	None required
3.3-12	Food web impacts from increased levels of methylmercury bioaccumulation	LTS	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
WETLAND AND TERRESTRIAL BIOLOGICAL RESOURCES			
3.4-1	Short-term impacts to perennial aquatic habitats and wetland communities from site preparation	SU	None
3.4-2	Short-term impacts to tidal aquatic habitats and wetland communities from dredging in the Miner Slough spur channel	NI	None required
3.4-3	Short-term loss of valley/foothill riparian habitat	LTSM	**Mitigation Measure 3.4-3.1** Potential short-term impacts to individual high value trees for nesting and roosting would be minimized during final design by avoidance and protection measures, as specified in Mitigation Measures 3.4-14.1 and 3.4-17.1. A map of high value trees for nesting to be protected will be made available to on-site construction management.
3.4-4	Short-term construction-related mortality or detrimental effects to sensitive plants	LTSM	**Mitigation Measure 3.4-4.1** Mitigation shall include conducting pre-construction surveys for special-status plants. If special-status plants are found within the affected footprint, preservation methods such as transplantation, salvage, or seed collection and dispersal would be considered and shall be implemented if deemed necessary to avoid a significant impact to the local population through consultation with CDFW. Herbicide application practices shall include following all application recommendations for the herbicide to be applied, and refraining from applying product under wind conditions which would increase the likelihood for drift.
3.4-5	Long-term conversion of perennial aquatic habitats and wetland communities to tidal habitat types	LTS	None required
3.4-6	Long-term loss of valley/foothill riparian habitat	LTSM	**Mitigation Measure 3.4-3.1** *(described above in Wetland and Terrestrial Biological Resources)*
3.4-7	Reduction in available habitat for special-status plant species adapted to existing conditions	LTS	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.4-8	Short-term construction-related impacts to valley elderberry longhorn beetle	LTSM	**Mitigation Measures 3.2-3.1 and 3.2-3.2** *(described above in Water Quality)*
3.4-9	Long-term impacts to valley elderberry longhorn beetle	NI	None required
3.4-10	Short-term construction-related injury or mortality and loss of habitat for giant garter snakes	LTSM	**Mitigation Measure 3.4-10.1** This mitigation measure includes the following: 1. Require construction personnel to receive USFWS and CDFW-approved worker environmental awareness training to recognize giant garter snake and its habitat. 2. Install exclusion fencing around all staging areas. 3. Survey the site at least 24 hours prior to the initiation of ground-disturbing activities in suitable giant garter snake habitat. This survey shall be conducted by a USFWS and CDFW-approved biologist in suitable giant garter snake habitat. Surveys shall be repeated if a lapse in construction activity of two weeks or greater occurs. If giant garter snake is encountered during ground-disturbing activities, activities at that specific location shall cease until appropriate corrective measures, in concurrence with USFWS and CDFW coordination, have been completed or it has been determined that individual giant garter snakes would not be harmed. Sightings shall be reported to USFWS and CDFW. 4. Implement ground disturbing construction activity within giant garter snake habitat between May 1 and October 1. This is the active period for giant garter snake and direct mortality is lessened, because giant garter snakes are expected to actively move and avoid danger. DWR would contact the USFWS and CDFW to determine if additional measures are necessary to minimize and avoid take for work between October 2 and April 30. 5. Vehicle speeds shall not exceed 15 miles per hour (MPH) to avoid hitting giant garter snakes and other special-status wildlife. 6. Remove temporary fill and construction debris after construction completion, and, wherever feasible, restore disturbed areas to pre- Project conditions.
3.4-11	Long-term conversion of giant garter snake habitat	LTS	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.4-12	Short-term construction-related habitat loss and injury or mortality of individual western pond turtles	LTSM	**Mitigation Measure 3.4-12.1** Prior to implementing restoration activities and/or scheduled dewatering, a qualified biologist would survey areas in or adjacent to suitable western pond turtle aquatic habitat. Western pond turtles found in harm's way would be moved by a qualified biologist to a safe location outside of the work area in a manner consistent with applicable CDFW regulations. A qualified biologist would conduct periodic monitoring of suitable western pond turtle aquatic habitat until ground-disturbing/dewatering activities have ceased in those areas. **Mitigation Measure 3.2-1.2** *(described above in Water Quality)*
3.4-13	Long-term conversion of western pond turtle habitat	B	None required
3.4-14	Short-term, construction-related injury or mortality, take of nests, and loss of nesting and foraging habitat of special-status and migratory birds	LTSM	**Mitigation Measure 3.4-14.1** In order to minimize potential construction related impacts to special-status and migratory birds over the construction period, this mitigation measure includes the following: 1. Site preparation and construction activities should take place outside of nesting season (February 15–August 15) to avoid take via disturbance or destruction of nests or mortality of individuals. If work begins before this period and continues uninterrupted throughout the nesting season, the consistent disturbance may deter birds from nesting at the site and prevent take. 2. If work must take place during March 15 – August 15, a pre-construction survey would be conducted within 14 days prior to the initiation of construction activity by a qualified biologist to identify nesting Swainson's Hawks within 0.5 mi of the construction footprint. If active Swainson's Hawk nests are found, appropriate non-disturbance buffers and avoidance measures would be developed in coordination with CDFW to avoid disturbance of nesting Swainson's Hawks based on individual bird behavior and construction-related disturbance that occurs. Surveys shall be repeated if a lapse in construction of 14 days or greater occurs. Surveys would be repeated annually if work takes place during subsequent nesting seasons. 3. If work must take place during April 1–August 31, a pre-construction survey would be conducted within 14 days prior to the initiation of construction activity to identify nesting raptors within 500 ft, and other nesting birds within 100 ft of the construction footprint. Appropriate non-disturbance buffers would be established until nestlings have fledged. Surveys shall be repeated if a lapse in construction

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
			of 14 days or greater occurs during the nesting season. Surveys would be repeated annually if work takes place during subsequent nesting seasons. 4. If work must take place during March 15–August 15 and use of non-disturbance buffers is infeasible, a qualified biologist shall be on-site to monitor active nests. Monitoring requirements would be established in coordination with CDFW. Monitors would have authority to stop work if it appears that Swainson's Hawk nests are disturbed by construction activity, and CDFW would be contacted for further guidance. 5. Remove or trim the minimal number of trees to satisfy the Project design. Trimming and removal would take place August 15 to February 15, outside of nesting season. 6. If construction activity results in take of individual birds or their nests, appropriate mitigation would be determined in coordination with CDFW. 7. Vehicle speed limits shall not exceed 15 MPH to avoid striking birds. 8. Remove temporary fill and construction debris after construction completion, and, wherever feasible, restore disturbed areas to pre-project conditions. **Mitigation Measure 3.4-3.1** *(described above in Wetland and Terrestrial Biological Resources)*
3.4-15	Long-term conversion of nesting and foraging habitat for special-status and migratory birds	LTSM	**Mitigation Measure 3.4-3.1** *(described above in Wetland and Terrestrial Biological Resources)*
3.4-16	Post-construction conversion to tidal habitat suitable for foraging migratory birds	B	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.4-17	Short-term, construction-related injury or mortality and loss of roosting and foraging habitat for western red bats	LTSM	**Mitigation Measure 3.4-17.1** In order to minimize potential construction related impacts to western red bats over the construction period, this mitigation measure includes the following: 1. Confine clearing of vegetation to only those areas necessary to facilitate construction activities and no greater. 2. A pre-construction survey shall be conducted by a qualified biologist to identify roosting western red bats during the maternity season (May through August). If roosting bats are present, construction activities that involve the removal of mature riparian trees, snags, and remnant structures suitable for roosting shall be timed to avoid bat maternity season (May through August). 3. Wherever feasible the Project design and implementation would avoid potential roosting habitat especially large mature trees like cottonwood and sycamore. 4. Coordinate with CDFW on measures to minimize impacts to individuals. **Mitigation Measure 3.4-3.1** *(described above in Wetland and Terrestrial Biological Resources)*
3.4-18	Long-term removal of western red bat roosting and foraging habitat	LTSM	**Mitigation Measure 3.4-3.1** *(described above in Wetland and Terrestrial Biological Resources)*
			GEOLOGY AND SOILS
3.5-1	Long-term effect on exposure of people and structures to seismic- and landslide-related hazards	B	None required
3.5-2	Long-term effect on sediment deposition and erosion in Prospect Island	B	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
			HAZARDS AND HAZARDOUS MATERIALS
3.6-1	Potential effects from abandoned gas wells	LTSM	**Mitigation Measure 3.6-1.1** Final construction plans shall be revised to avoid existing conflicts between grading and excavation areas and well locations. Once site dewatering is complete and prior to construction work, a geophysical survey shall be conducted to confirm locations of all known abandoned gas wells (DOGGR 2014), which shall be marked and avoided during construction. Also prior to construction, DWR shall file an application under the DOGGR Well Review Program and the site would be inspected.
3.6-2	Potential effects from contaminant migration via existing groundwater monitoring wells	LTSM	**Mitigation Measure 3.6-2.1** The Project design shall incorporate the groundwater monitoring well locations into the grading and access plans and design any construction at those locations to avoid adversely affecting the wells. If any of the existing groundwater wells are located at planned breach sites, they shall be properly destroyed and capped. Wells shall be avoided or properly destroyed and/or replaced as required by Section 13750 through 13755 (Article 2, Chapter 7, Division 7) of the California Water Code.
3.6-3	Potential mobilization of contaminants from levee breaching and/or sediment dredging and re-use	LTS	None required
3.6-4	Hazards associated with the Prospect Island houses on the north property	B	None required
3.6-5	Potential hazards associated with the abandoned house on the south property	B	None required
3.6-6	Potential soil or water contamination from on-site equipment storage and fueling	LTSM	**Mitigation Measure 3.6-6.1** DWR's standard construction contract Section 01570 requires contractors to conduct fueling and lubrication of equipment in a manner that affords maximum protection against spills and evaporation. Consistent with this standard, the contractor for the Project shall be required to prepare an environmental protection plan, which shall include spill control and contaminant prevention components. The contractor shall be required to have spill kits on-site and to clean up any spill as soon as reasonably possible.

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.6-7	Potential effects on human health due to the short-term use of aquatic-approved herbicides prior to site construction	LTSM	**Mitigation Measure 3.6-7.1** Herbicides shall be applied under the supervision of a certified pesticide applicator. Certified pesticide applicators are trained to ensure that algaecides and aquatic herbicides are applied at rates consistent with label requirements and in a manner that avoids potential adverse effects including, effects to human health. Prior to herbicide application, DWR or its contractor will obtain all relevant permits required by the federal, state, and local agencies.
3.6-8	Potential effects on human health due to changes in the extent of mosquito breeding habitat	B	None required
			AIR QUALITY
3.7-1	Generation of criteria pollutant emissions that could contribute to air quality violations	LTSM	**Mitigation Measure 3.7-1.1** The Project contractors shall implement the techniques listed in Table 3.7-8, below, to reduce impacts of ozone precursors such as NO_x and ROG, and PM_{10} and $PM_{2.5}$ emissions. **Mitigation Measure 3.7-1.2** Section 6.1 of the YSAQMD CEQA Handbook (YSAQMD 2007) presents a list of feasible measures to control fugitive dust from construction-sites. Common techniques for controlling dust (PM_{10}) focus on minimizing dispersal of earth materials during excavation, transport, and disposal activities. Watering and covering (e.g., tarps, surfactants, and vegetation) are frequently relied on to minimize dust at construction-sites. The Project contractors shall implement the following techniques for controlling dust (Table 3.7-9). The implementation details of these techniques shall be adjusted based on field conditions. **Mitigation Measure 3.7-1.3** DWR and/or its contractor shall monitor construction activities throughout the construction period and pay an off-site mitigation fee. Construction activities data will be collected, emissions associated with construction activities will be calculated, and these data will be reported to Yolo Solano Air Quality Management District (YSAQMD). The specific details of construction monitoring and reporting will be determined in consultation with the YSAQMD. Construction activities data will include, but are not limited to the following items: 1. Barges – distance traveled by loaded and unloaded vessels, horsepower, idling time, fuel use and fuel type.

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
			2. Construction equipment – type and number, horsepower, hours of operation. 3. Haul trucks (heavy-duty trucks) – number of trips, and total trip distance. 4. Construction workers—number of construction workers per day. YSAQMD shall collect the construction activity and emissions reports for record keeping and monitoring purposes. The total offset mitigation fee will be calculated based on actual construction activities. DWR will work in coordination with YSAQMD to assess the specific mechanisms associated with construction monitoring, emission calculations, and payment logistics.
3.7-2	Conflict with or obstruct applicable general plans or regional air quality plans	LTSM	**Mitigation Measures 3.7-1.1 and 3.7-1.3** *(described above)*
3.7-3	Expose sensitive receptors to air pollutants and cause higher health risks	LTS	None required
3.7-4	Expose sensitive receptors to objectionable odors	LTS	None required
			GREENHOUSE GASES
3.8-1	Proposed Project-related GHG emissions	LTS	None required
			MINERAL RESOURCES
3.9-1	Loss of a known mineral resource that would be of value to the region and residents of the state	NI	None required
3.9-2	Loss of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan	NI	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
			NOISE
3.10-1	Potential for short-term noise disturbance to nearby residents	LTSM	**Mitigation Measure 3.10-1.1** The following mitigation measure would reduce the noise impact to residences in the Project area to a less-than-significant level: 1. The construction contractor shall locate stationary noise sources as far from existing residences as possible. 2. The DWR shall identify a disturbance coordinator, and the name and phone number of this person shall be conspicuously be posted at the Project site in an area that can be accessed by the general public. If noise complaints are received, the disturbance coordinator shall respond to the complaints and shall take the steps necessary to mitigate the problem.
3.10-2	Potential for long-term increases in ambient noise levels in the Proposed Project vicinity	LTS	None required
3.10-3	Potential for sensitive receptors to be exposed to excessive ground-borne vibrations during construction-related activities	NI	None required
			AESTHETICS
3.11-1	Temporary change in views during construction	LTS	None required
3.11-2	Long-term change in views from State Route 84	LTS	None required
3.11-3	Long-term change in views from Arrowhead Harbor Marina	LTS	None required
3.11-4	Long-term change in views from boats in Miner Slough	LTS	None required
3.11-5	Long-term change in views from boats in the Deep Water Ship Channel	LTS	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.11-6	Long-term change in views from nearby residences	LTS	None required
3.11-7	Long-term light and glare	NI	None required
		AGRICULTURAL RESOURCES	
3.12-1	Loss or conversion of prime, unique, or important agricultural lands	LTS	None required
3.12-2	Conflicts with Williamson Act contracted lands	NI	None required
3.12-3	Potential effects to agricultural uses on adjacent lands	LTS	None required
		CULTURAL RESOURCES	
3.13-1	Impacts to historical resources on land	NI	None required
3.13-2	Inadvertent discovery of a shipwreck during in-water construction	LTSM	**Mitigation Measure 3.13-2.1** The title to all abandoned shipwrecks, archaeological sites, and historic or cultural resources on or in the tide and submerged lands of California is vested in the state and under the jurisdiction of the CSLC (PRC Section 6313[a]). In the case of an inadvertent discovery of a submerged shipwreck or related artifacts, all work must cease in the immediate vicinity of the find and DWR cultural resources staff and the USACE archaeologist shall be notified immediately in order to initiate consultation with the CSLC staff within two business days of such discovery pursuant to CFR Title 36 *Parks, Forests, and Public Property*, Chapter VIII *Advisory Council on Historic Preservation,* Part 800.13 (b)(3). PRC 6313 (c) states any submerged historic resource remaining in state waters for more than 50 years shall be presumed to be archaeologically or historically significant. If the DWR and U.S. Army Corps of Engineers (USACE) archaeologist, in consultation with the CSLC staff, determine that a historical resource may be present within the Project site, DWR shall retain the services of a qualified maritime archaeological consultant. The maritime archaeological consultant would recommend whether the discovery is an historical/archaeological resource that retains sufficient integrity and is of potential historical or scientific significance. The maritime archaeological consultant also would recommend as to what action, if any, is warranted and would document

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
			all recommendations in writing. Based on this information, the USACE, in consultation with the CSLC, may require additional measures to be implemented by DWR. Measures might include preservation *in situ* of the historical resource or a data recovery program. The Project maritime archaeological consultant shall submit a Final Historical Resources Report to DWR, the USACE, and the CSLC staff. This report shall include an evaluation of the historical significance, with a description of the archaeological and historical research methods employed in any archaeological data recovery program undertaken.
3.13-3	Impacts to unknown archaeological resources	LTSM	**Mitigation Measure 3.13-3.1** To reduce potential impacts to unknown archaeological resources, the following measures shall be implemented before the start of ground-disturbing activities: 1. An archaeologist shall conduct cultural resources awareness training for contractors and staff prior to the start of construction. 2. If historical or unique archaeological resources are discovered during construction, work must be halted within 100 ft of the find until a qualified archaeologist meeting the Secretary of the Interior's Standards for archaeologists (NPS 1997) visits the site and assess the significance of the resource. Work may continue on other parts of the Project while evaluation and mitigation takes place (CEQA Guidelines Section 15064.5(f)). After the assessment is completed, the archaeologist shall submit a report describing the significance of the discovery with treatment recommendations. If the find is determined to be an historical or unique archaeological resource, time allotment and funding sufficient to allow for implementation of avoidance measures or appropriate mitigation must be available. 3. Should unique archaeological resources be found, the resources shall be treated in compliance with Public Resources Code Section 21083.2. If the Project can be modified to accommodate avoidance, preservation of the resource is preferred. Data recovery of the damaged portion of the resource also shall be performed pursuant to PRC Section 21083.2(d).

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
3.13-4	Impacts to unknown human burials	LTSM	**Mitigation Measure 3.13-4.1** If human remains are found, such remains are subject to the provisions of California HSC Section 7050.5-7055. The requirements and procedures shall be implemented, including immediately stopping work in the vicinity of the find and notification of the Solano County Coroner. The process for notification of the California NAHC and consultation with the individual(s) identified by the NAHC as the "most likely descendant" is set forth in Section 5097.98 of the California Public Resources Code. Work can restart after the remains have been investigated and appropriate recommendations have been made for the treatment and disposition of the remains.
3.13-5	Impacts to paleontological resources	NI	None required
LAND USE AND PLANNING/POPULATION AND HOUSING			
3.14-1	Potential conflicts with adjacent land uses	LTS	None required
3.14-2	Potential conflict with plans and policies	NI	None required
3.14-3	Population and housing effects	NI	None required
PUBLIC SERVICES			
3.15-1	Potential conflict with existing police and fire protection services	LTSM	**Mitigation Measures 3.17-1.1** *(described below in Transportation and Traffic)*
RECREATION			
3.16-1	Short-term construction-related impacts to recreational boating in Miner Slough and Arrowhead Harbor Marina	LTSM	**Mitigation Measure 3.16-1.1** Speed limit zones or channel closure shall be established by DWR during in-water construction along Miner Slough. The construction contractor shall post and distribute notifications at Arrowhead Harbor Marina and other local boating access sites of any scheduled imposition of boating safety speed limits or channel closure 14–30 days in advance of water-based construction work.
3.16-2	Long-term impacts to recreational boating in Miner Slough and Arrowhead Harbor Marina	LTS	None required
3.16-3	Long-term Impacts on recreational use of Prospect Island	NI	None required
3.16-4	Consistency with existing plans	LTS	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
			TRANSPORTATION AND TRAFFIC
3.17-1	Potential Traffic Impacts During Construction	LTSM	**Mitigation Measure 3.17-1.1** The construction contractor shall submit a traffic control plan to the California DWR for review and approval that shall limit impacts to affected land owners and businesses. The control plan shall include temporary measures, such as the following: 1. Advance public notification signage at areas that might be affected by traffic going to the Project site prior to the start of construction activities, to alert drivers to pending construction work and traffic restrictions. 2. Notification to Arrowhead Harbor Marina, the Port of West Sacramento, and property owners adjacent to haul routes used for site access during construction, 10 days prior to initiation of construction traffic. 3. Temporary railing, barricades, crash cushions, signage, lighting and flashing lights, pavement markings, and the service of qualified flaggers; all as required to provide for the safe passage of public traffic. 4. Other safety measures as required to control vehicular and pedestrian traffic. **Mitigation Measure 3.17-1.2** Before- and after-Project construction an assessment of road surface conditions, and photographic or videographic documentation, will be conducted by DWR and its contractor at the following locations, if used for site access during construction: segments of Courtland Road and/or Teal Road, Road 107, Holland Road, as well as the DWSC levee. If local road conditions deteriorate during construction, DWR or its construction contractor will implement necessary repairs to bring the road up to pre-Project construction conditions.
3.17-2	Potential Long-Term Loss of Access to Miner Slough Levee	LTS	None required

Impact No.	Impact Title	Significance	Proposed Mitigation Measures
			UTILITIES
3.18-1	Solid waste disposal impacts	LTS	None required
3.18-2	Potential for adverse effects on existing utilities	LTSM	**Mitigation Measure 3.18-2.1** In order to reduce the potential for adverse effects to existing utilities, the following actions will be taken by DWR and its contractor prior to any ground disturbing activities: 1. Coordinate with local utility owners to discuss the potential for the existence of underground utilities within the Project area. 2. If utility owners verify the potential for underground utilities, a qualified person shall perform a subsurface survey to identify the exact location of underground utilities within the Project area, so those utilities may be avoided. If the utilities cannot be avoided, they shall be removed in a manner consistent with CalOSHA Title 8, Sections 1539 through 1541.1.
3.18-3	Potential for adverse effects to easement holders	LTS	None required

Alternatives to the Proposed Project

Two “build” alternatives and the No Project Alternative were selected to be analyzed in this EIR based on a rigorous alternatives screening and selection process (refer to Section 4 *Alternatives*). These alternatives vary in the location and type of breaching of the levees, as well as inclusion (or not) of the south property. For all the alternatives, the U.S. Army Corps (USACE) would continue to maintain the DWSC levee as a Navigation Project Levee.

Alternative 1 represents the No Project Alternative to be evaluated under CEQA. Under this alternative, current management practices would continue.

Alternative 2 would include two breaches in the Miner Slough levee; one in the central portion of Prospect Island, just north of the existing internal cross-levee, and the second would be constructed at the location of the formerly repaired breach connecting the Miner Slough spur channel to the south property. In addition, a high stage overflow weir would be constructed near the entrance to Arrowhead Marina, near the overflow weir in the far northeast corner of Prospect Island. A portion of the internal cross-levee separating the north and south properties would also be removed under this alternative. Once breached, the north and south properties would be subject to daily tidal inundation, with periodic overtopping of the weir at high tide during spring tide conditions. No dredging of the Miner Slough spur channel would be required for the Alternative 2 or 3 design configurations.

Under Alternative 3, three breaches would be created on the Miner Slough levee: two in the north property, the first approximately 0.5 mi south of Arrowhead Harbor Marina, the second in the central portion of the Miner Slough levee. On the south property, the third breach would be constructed at the location of the formerly repaired breach connecting to the Miner Slough spur channel to the south property. Under this alternative, the internal cross-levee separating the north and the south properties would remain intact, and the levee road and portions of the Miner Slough levee south of the central breach would be maintained. DWR would protect the cross-levee from potential impacts by raising, reinforcing, and/or widening the 0.5 mi cross-levee on Prospect Island. Because the north and south properties would not be hydraulically connected, except via tidal exchanges with Miner Slough, no dredging of the Miner Slough spur channel would be required under Alternative 3. Once the Miner Slough levee is breached, the north and south properties would be subject to daily tidal inundation.

CEQA (Section 15126.6(e)(2)) requires that the EIR identify an environmentally superior alternative other than the No Project Alternative. Environmental analysis generally showed that environmental effects for most of the resources would be similar among the "build" alternatives. Alternatives 2 and 3 are both environmentally superior compared with the Proposed Project because neither would require dredging of the Miner Slough spur channel, resulting in reduced short-term construction-related impacts to water quality and aquatic species in Miner Slough. However, Alternative 2 is slightly more beneficial than Alternative 3 due to the replacement of the northern Miner Slough breach, which requires full excavation of the levee during construction, with a weir, which requires only partial excavation. The weir would result in slightly lower export of primary productivity to surrounding Delta waterways as compared to a breach in this location under the Proposed Project and Alternative 3; this would be a reduced benefit. However, the weir would also result in lower potential export of water quality constituents of concern (e.g., DOC, methylmercury), to adjacent waterways relative to the Proposed Project and Alternative 3. Although Alternative 2 would result in the greatest potential impact to valley/foothill riparian habitat, increased amounts of freshwater tidal emergent marsh would be relatively more beneficial to wetland-associated species (e.g., giant garter snakes, western pond turtles, special-status and migratory birds, and western red bats) than the other alternatives. Other impacts identified for Alternative 2 are the same as, or less than, those identified for the Proposed Project.

The Proposed Project was DWR's Preferred Alternative during the DEIR process. After reviewing public comments on the 2016 DEIR and 2019 Partial Recirculated DEIR, meeting with neighbors, and considering the impacts and benefits of the Alternatives, DWR is considering moving forward with Alternative 2 (two breaches of the Miner Slough–Prospect Island levee at central and southern locations, and a northern weir) instead of the Proposed Project (two breaches at northern and southern locations). Except for mitigation relating to dredging activities (Mitigation Measure 3.2-2.1), the mitigation measures that were developed for the Proposed Project also apply to Alternative 2. If DWR moves forward with Alternative 2, DWR will adopt all the relevant mitigation measures developed for the Proposed Project as part of Alternative 2.

Except where differences are specified in Section 4 *Alternatives*, or elsewhere in this 2019 FEIR, where the "Proposed Project" is referred to, this includes the Proposed Project and all "build" Alternatives.

Coordination with Agencies and the Public

A NOP for the Project was circulated on May 17, 2013 (**Appendix C**). DWR has held numerous discussions with affected landowners to promote collaboration in development of the proposed tidal habitat restoration on Prospect Island, in order to more thoroughly and successfully identify potential impacts, as well as to design the Proposed Project and Alternative 2 in a way that minimizes or avoids any potential impacts to neighbors. At least five meetings have been held with neighbors, in addition to the formal consultation process (see General Response D in **Appendix D**). The formal consultation process has involved issuance of the 2013 NOP and consideration of NOP comments in preparing the 2016 DEIR; circulation of the 2016 DEIR and consideration of comments (**Appendix D**); and circulation of the 2019 Partial Recirculated DEIR and consideration of comments (**Appendix E**). In addition, DWR received comments after the comment period for the 2019 Partial Recirculated DEIR had closed (**Appendix F**). Due consideration has been given to comments received during both the informal and formal consultation processes in preparing this 2019 FEIR.

Issues to be Resolved

Issues to be resolved related to the Proposed Project include the following:

- Obtaining environmental regulatory permits in a timely fashion to begin construction in spring 2020.

Areas of Controversy

Based on agency and stakeholder input, including responses to the NOP, potential areas of controversy are listed below and relevant 2019 FEIR sections that discuss those concerns follow in the parentheses. As indicated elsewhere in the 2019 FEIR, these potential areas of controversy were determined to result in either *no impact* or to be *less than significant* or *less than significant with mitigation*, based on substantial evidence.

- Potential groundwater seepage impacts from Prospect Island to adjacent areas (Impact 3.1-3 in Section 3.1 *Hydrology*; **Appendix E**);
- Potential erosion impacts to Miner Slough levees due to wind-driven waves (Impact 3.1-4 in Section 3.1 *Hydrology*; **Appendix E**);

- Potential scour impacts to Miner Slough levees due to increased velocities associated with increased tidal prism[3] (Impact 3.1-5 in Section 3.1 Hydrology; **Appendix E**);
- Potential impacts to water rights for downstream water users from diversion of surface water (Impact 3.1-9 in Section 3.1 *Hydrology*; **Appendices D** and **E**).
- Potential contaminant mobilization impacts and agency responsibilities (Section 3.2.1 *[Water Quality (Surface and Groundwater)] Setting*; Impact 3.2-2 in Section 3.2 *Water Quality*; Impact 3.6-3 in Section 3.6 *Hazards and Hazardous Materials*; **Appendix D**);
- Potential salinity impacts to drinking-water intakes (Impact 3.2-5 in Section 3.2 *Water Quality*; Section 3.19-3 *[Cumulative Impacts, Hydrology] Salinity*; **Appendix E**);
- Traffic impacts (Impact 3.17-1 in Section 3.17 *Transportation and Traffic*; **Appendix E**); and
- Air quality impacts (Impact 3.7-3 in Section 3.7 *Air Quality*; **Appendix E**).

[3] Volume of water differential between mean low tide and mean high tide.

1 INTRODUCTION

1.1 Overview of the Proposed Project and Alternatives

The Proposed Project is an approximately 1,600 ac tidal restoration project in southeastern Solano County proposed by the California Department of Water Resources (DWR). Prospect Island is located immediately east of, and technically is still an element of, the southern end of the Yolo Bypass Floodway (Yolo Bypass). Prospect Island became separated from the Bypass with construction of the Sacramento Deep Water Ship Channel (DWSC) in the 1960s. The site is bounded on the east by Miner Slough, on the west by the DWSC, on the south by the confluence of the DWSC and Miner Slough, and on the north by an east-west levee that runs from Arrowhead Harbor Marina to the DWSC. DWR is the California Environmental Quality Act (CEQA) Lead Agency for this Proposed Project. Both the northern 1,300 ac portion, and the southern 300 ac portion, of Prospect Island are owned by DWR.

The Proposed Project would include a suite of actions necessary for site preparation, restoration, minimizing or avoiding potential adverse impacts, post-restoration monitoring, and maintenance. Some activities are incorporated in the Proposed Project description, while others are mitigation measures resulting from the Section 3 impact analyses. Proposed Project elements are listed below and described in detail in Section 2 *Proposed Project Description*. Mitigation measures are described in Section 3 *Environmental Setting, Impacts, and Mitigation Measures*.

The Proposed Project would include:

1. South property levee repairs – to enable site dewatering, excavation, and construction of internal features, prior to levee breaching;
2. Pre-construction-site preparation – dewatering, clearing, construction if access roads and ramps, and preparation of staging areas;
3. Invasive plant species control – to reduce the potential for ecological or other invasive species impairments within the restoration-site and surrounding areas;
4. Debris and old infrastructure removal – to reduce non-native fish predator habitat on the restored site;
5. Excavate constructed channel network – for the purpose of facilitating internal tidal circulation and external connectivity;

6. Block or fill remnant agricultural ditches (using excavated soils) – for the purpose of promoting tidal circulation and tidal channel formation;
7. Construct interior topographic features (using excavated soils) – for the purpose of creating internal ecological variability;
8. Construct eastern toe berm (using excavated soils) –to improve levee erosion protection;
9. Construct eastern intertidal bench (using excavated soils) –to improve levee erosion protection;
10. Excavate internal cross-levee on Prospect Island between the north and south properties – for the purpose of connecting the north and south properties hydrologically, thus promoting tidal circulation and external connectivity;
11. Construct breach velocity dissipation feature – to test an experimental design intended to minimize strong velocity gradients where predatory fishes are known to congregate and prey on smaller fishes;
12. Dredge Miner Slough spur channel (between Miner Slough and the south property, with placement of dredged material within Prospect Island) – to provide unimpeded tidal exchange;
13. Planting and revegetation – for the purpose of restoring habitat;
14. Remove access road and ramps – for the purposes of minimizing construction impacts and restoring habitat; and
15. Breach Miner Slough levee – to promote tidal connectivity.

Under the Proposed Project, the Miner Slough levee would be breached in two locations: one in the north property approximately 0.5 mi south of Arrowhead Harbor Marina and one in the south property at the location of the formerly repaired breach connecting to the Miner Slough spur channel. A portion of the internal cross-levee separating the north and the south properties would also be removed. With these breaches completed, the north and south portions of the site would be subject to daily tidal inundation.

In addition to the Proposed Project, two other “build” alternatives, including Alternative 2: Two Breaches and Weir and Alternative 3: Three Breaches, and the No Project Alternative were selected to be analyzed in this EIR based on a rigorous alternatives screening and selection process (refer to Section 4 *Alternatives*). These alternatives vary in the locations and types of levee breaches, and whether a weir is included. After reviewing public comments and considering the impacts and benefits of the Alternatives, DWR is considering moving forward with Alternative 2, instead of the Proposed Project. As discussed

in Section 4.7 *Comparison of Alternatives and Identification of Environmentally Superior Alternative*, environmental analysis generally showed that environmental effects for most of the resources would be similar among the "build" alternatives. However, Alternatives 2 and 3 are both environmentally superior compared with the Proposed Project because neither would require dredging of the Miner Slough spur channel, resulting in reduced short-term construction-related impacts to water quality and aquatic species in Miner Slough. Alternative 2 is preferred over Alternative 3 because: the weir under Alternative 2 only requires partial excavation of the levee, instead of full excavation of the northern Miner Slough Breach; the weir would result in lower potential export of water quality constituents of concern (e.g., dissolved organic carbon (DOC), methylmercury) to adjacent waterways (Section 4.6.2); and increased amounts of freshwater tidal emergent marsh created by Alternative 2 would be relatively more beneficial to wetland-associated species (e.g., giant garter snakes, western pond turtles, special-status and migratory birds, and western red bats). The trade-off with lower export of water quality constituents of concern is that the weir would result in slightly lower export of primary productivity to surrounding Sacramento-San Joaquin River Delta (Delta) waterways as compared to a breach in this location, which would be a reduced benefit of Alternative 2. Additionally, increasing the area to tidal wetlands, including emergent marsh, means that Alternative 2 would result in the greatest potential impact to valley/foothill riparian habitat. Other impacts are the same, or similar to, the Proposed Project.

1.2 Proposed Project Objectives

The Proposed Project is intended to partially fulfill the 8,000-ac tidal habitat restoration obligations of DWR contained within the Reasonable and Prudent Alternative (RPA) of the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion (BiOp) for long-term coordinated operations of the State Water Project (SWP) and the federal Central Valley Project (CVP) (USFWS 2008). Because restoration of tidal habitat would provide access for salmonid rearing at Prospect Island, the Proposed Project would also be consistent with RPA I.6.1 of the National Marine Fisheries Service (NMFS) Salmonid BiOp for SWP/CVP operations (NMFS 2009a).

The overarching goal of the Proposed Project is to restore tidal action to the interior of Prospect Island. The six objectives are to:

1. Enhance primary and secondary productivity and food availability for Delta Smelt and other native fishes within Prospect Island and surrounding Delta waterways.
2. Increase the quantity and quality of salmonid rearing habitat within and in the areas surrounding Prospect Island.
3. Increase the amount and quality of habitats to support other listed species, to the extent they can be supported by site conditions and natural processes.
4. Provide other ecosystem benefits associated with increased Delta freshwater tidal marsh habitat, including water quality enhancement, recreation, and carbon sequestration.
5. To the greatest extent practical, promote habitat resiliency to changes in future Delta conditions, such as land use conversions, climate change, sea level rise, and invasive species.
6. Avoid promoting conditions adverse to Project biological objectives, such as those that would favor establishment or spread of invasive exotic species.

1.3 Proposed Project Background and History

Historically, the Proposed Project area was tidal marshland, with Prospect Slough to the west and north, and Miner Slough to the east and south. Levees were constructed during the later 19th century and the land was converted to agricultural uses. Prospect Island is part of the Yolo Bypass floodplain; however, construction of the DWSC in the 1960s isolated Prospect Island from the main reach of the Yolo Bypass.

The 1,300-ac northern portion of Prospect Island was purchased by the U.S. Bureau of Reclamation (USBR) in 1994 to be part of a proposed North Delta National Wildlife Refuge. Agriculture on the island ceased, but efforts to establish a refuge were not successful. Without near-term implementation of a restoration project that had been planned by the U.S. Army Corps of Engineers (USACE) and DWR, USBR initiated the process to transfer or sell the island to another entity. DWR acquired the northern portion of Prospect Island from USBR in January 2010.

The DWR land is mostly inundated. The southern portion of Prospect Island is subject to limited tidal exchange through a levee breach that was repaired with very large rock (approximately 3–5 ft diameter), and remains permeable but not navigable. The internal cross-levee that separates the two parcels is intact.

1.4 Public Involvement and Environmental Issues Raised

1.4.1 Project scoping

During the planning phase, a Notice of Preparation (NOP) was prepared and processed to indicate that an EIR would be prepared for the Proposed Project (in compliance with CEQA Guidelines Section 15082). The NOP was distributed for a 30-day public review period that included distribution to agencies, the public and affected stakeholders, beginning on May 17, 2013. The NOP and associated documents are attached at **Appendix C**.

The availability of the NOP was publicized locally (*Sacramento Bee* and *Rio Vista Beacon*) and distributed to a wide array of government agencies both directly by DWR and through the Governor's Office of Planning and Research, State Clearinghouse (**Appendix C**).

A public scoping meeting was held for the Proposed Project on June 10, 2013, in West Sacramento. A Scoping Report summarizing the scoping process and comments received is included in **Appendix C**.

Information was gathered via the NOP, public meetings, and outreach. DWR coordinated with many agencies and interested parties, including adjacent property owners that submitted comments in response to the NOP. Because of this ongoing collaborative effort with regulatory agencies and input from the public, aspects of the Proposed Project (e.g., tidal channel configuration and levee breach locations) were modified following release of the NOP.

Major issues identified in the scoping phase include:

- Proposed Project description should address all phases of the Proposed Project, equipment to be used, access roads, staging areas, construction procedures, construction schedule, and long-term monitoring of mitigated lands and biological resources.
- The EIR should include a cumulative impacts section to determine all past, present, and probable future projects in the area that may contribute to a greater level of environmental impacts.
- In order to avoid the improper deferral of mitigation, mitigation measures should either be presented as specific, feasible, or enforceable obligations, or should be presented as formulas containing performance standards.

- Concern about visual effects of vegetation removal along the road on Prospect Island.
- The effect of global warming and associated potential rise in sea levels along the California coast and associated effects on local hydrology, water quality, and perimeter levee stability, including effects on local facilities and infrastructure.
- A greenhouse gas emission (GHG) analysis consistent with the California Global Warming Solutions Act should be developed. If impacts are significant, the commenter asked that mitigation measures that would reduce the impacts to the extent feasible be identified in the EIR.
- DWR should work closely with California Department of Fish and Wildlife (CDFW), USFWS, and NMFS during development of the EIR to identify any special-status plants or wildlife species occurring in the Proposed Project area that may be affected by the Proposed Project. Cumulative impacts should be considered.
- If new habitat for endangered species is created, nearby Ryer Island Reclamation District (RD 501) operations could be negatively impacted.
- The geologic and hydrologic structure of Prospect Island should be analyzed to identify potential linkages with surrounding areas (such as sand lenses shared with Ryer Island), and consider the effects that permanent flooding of Prospect Island would have based on any linkages identified
- The potential for bass to enter the restoration area should be studied.
- DWR should verify that the stated objectives in the NOP are consistent with Delta Plan Recommendations ER R2 *Prioritize and Implement Projects that Restore Delta Habitat* and ER P5 *Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species* (DSC 2013).
- Proposed Project-level activities related to habitat restoration and management should be done in coordination with local and regional Habitat Conservation Plans, and DWR should coordinate with California Department of Transportation (CalTrans) in instances where DWR and CalTrans programs share stewardship responsibilities for habitats, species, and/or migration routes.
- The EIR should consider the Proposed Project's potential to encourage the establishment or proliferation of aquatic invasive species such as the quagga mussel, or other nonindigenous, invasive species including aquatic and terrestrial plants.
- The EIR should include a complete assessment of the habitats, flora and fauna within and adjacent to the Proposed Project area, including endangered, threatened, and locally unique species and sensitive habitats.

- Because the Proposed Project's intent is to create rearing habitat for endangered or threatened species, the EIR should consider the potential for additional safeguards to reduce the risk of harm from intake pumps used to divert surface water for irrigation on adjacent islands.
- Concern about beavers in the Proposed Project area.

1.4.2 DEIR circulation

Circulation of the 2016 Draft EIR (DEIR) is described in Section 1.7 *Availability and Public Review of the EIR* below. Since public circulation of the 2016 DEIR, DWR has reviewed comments and considered impacts of the Proposed Project (**Appendix D**). DWR purchased the land that was identified as the Stringer property in the 2016 DEIR on March 9, 2017, and plans to develop it as part of the Proposed Project, which has lessened access issues originally discussed in the 2016 DEIR. DWR has also reviewed sediment contaminant sampling analyses, which show that potential for contamination from construction of the Proposed Project is not significant (Kinnetic Laboratories, 2016a,b). The Proposed Project was DWR's Preferred Alternative during the DEIR process. After reviewing public comments and considering the impacts and benefits of the Alternatives, DWR is considering moving forward with Alternative 2 (two breaches, at a central and southern location and a weir) instead of the Proposed Project (two breaches at northern and southern locations). Except for mitigation measures relating to dredging activities, the mitigation measures that were developed for the Proposed Project also apply to Alternative 2. DWR will adopt all the relevant mitigation measures developed for the Proposed Project in this 2019 FEIR as part of Alternative 2 if it decides to move forward with Alternative 2.

1.4.3 Property purchase

Since circulation of the 2016 DEIR, DWR acquired a formerly privately-owned parcel adjacent to Miner Slough in the central part of the Prospect Island north property (previously identified as the 'Stringer Property'). DWR may enter into other purchase or lease agreements with private property owners for site access, construction, and/or storage, although the environmental success of the Project does not depend on any additional purchases or agreements.

1.4.4 DEIR recirculation

A lead agency is required to recirculate an EIR when significant new information is added to the EIR after public notice is given of the availability of the DEIR for public review, but before certification (PRC Section 21092.1; CEQA Guidelines

Section 15088.5). CEQA's definition of significant new information includes: a new significant environmental impact; a substantial increase in the severity of an environmental impact; and a feasible project alternative or mitigation measure considerably different from others previously analyzed that would lessen environmental impacts.

After public circulation of the 2016 DEIR, land acquisition and advances in construction specifications resulted in modifications to the *Proposed Project Description*. Comments received on the 2016 DEIR and additional technical reports also provided information that resulted in modifications and additions to the *Hydrology* and *Water Quality* impact analyses. Although there were no increases in the severity of *Hydrology* or *Water Quality* impacts, additional technical information was available on which the public previously did not have opportunity to comment.

Transportation and Traffic impacts were also considered further as the Proposed Project design progressed, and ultimately revised to more comprehensively assess the impacts of trucking materials to and from the site, as an alternative to material transportation by barges. Minor changes to the *Noise* and *Air Quality* assessments were made to ensure that potential impacts from trucking materials to the site were consistently assessed throughout the EIR. The consideration of truck-related transportation may have constituted an increase in the severity of the impacts, and resulted in a mitigation measure different from others previously analyzed being included in the EIR to lessen the impact (see Mitigation Measure 3.17-1.2). Short-term air quality impacts (Impacts 3.7-1 and 3.7-2) were originally assessed as *significant and unavoidable* in the 2016 DEIR; however, these significance determinations were revised following coordination with the Yolo-Solano Air Quality Management District (YSAQMD) and the addition of a mitigation measure requiring an offset mitigation fee (see Mitigation Measure 3.7-1.3).

In 2019 DWR gave the public a meaningful opportunity to comment on the revised sections of the EIR. The information presented in the 2019 Partial Recirculated DEIR was limited to changes to the *Proposed Project Description*, and changes to the *Hydrology*, *Water Quality*, *Transportation and Traffic*, *Noise*, and *Air Quality* impact analyses sections, as well as changes to the corresponding *Alternatives* analyses. Since public circulation of the 2019 Partial Recirculated DEIR, DWR has reviewed comments and considered impacts of the Proposed Project (**Appendix E**).

1.4.5 EIR terminology

Throughout this document, 2016 DEIR is used to refer specifically to the 2016 DEIR, 2019 Partial Recirculated DEIR is used to refer specifically to the portions of the DEIR that were recirculated in 2019, 2019 FEIR is used to refer specifically to this document (the 2019 FEIR), and EIR is used to refer generally to the 2016 DEIR, 2019 Partial Recirculated DEIR, and/or 2019 FEIR.

The original impact and mitigation numbering from the 2016 DEIR is consistent with the 2019 Partial Recirculated DEIR and the 2019 FEIR, with the exception of one additional mitigation measure in each of the *Transportation and Traffic* and *Air Quality* sections of the EIR. If an impact has become redundant since the 2016 DEIR, the title is still included, and redundancy noted.

Note that **Appendix A** includes a summary of technical terms used throughout the EIR, and **Appendix B** contains a list of relevant technical reports.

1.5 Purpose and Uses of the EIR

DWR is the CEQA Lead Agency and has the principal responsibility for carrying out or approving the Prospect Island Tidal Habitat Restoration Project. As lead agency, DWR has primary responsibility for CEQA compliance when preparing the EIR (PRC Section 21067).

In accordance with the PRC (Section 21000 *et seq.*), and the California Code of Regulations [CCR] (Section 15000 *et seq.*), DWR would utilize the information contained in the EIR in deciding whether to approve the Project. The EIR may also be considered by other public agencies in the exercise of their statutory authority to grant permits and provide approvals.

In accordance with the CEQA Guidelines Section 15064 and PRC Division 13 *Environmental Quality*, Sections 21080(d) and 21082.2(d), this project-level EIR addresses those impacts that could be potentially significant, as identified through a collaborative process. An EIR is a detailed informational document prepared by the lead agency that analyzes a project's potential significant effects and identifies mitigation measures and reasonable alternatives to avoid or reduce those significant effects (CEQA Guidelines Section 15121(a), 15362).

1.6 Agency Approvals and Permits

Pursuant to the CEQA Guidelines (Section 15124[d]), a number of responsible, trustee, and other affected agencies are anticipated to rely on this 2019 FEIR and related documentation for discretionary actions they may take in conjunction with the Proposed Project. A list of the expected permit or approval types, identified responsible agencies for each permit or approval, and their status is presented in Table 1.6-1.

Additionally, the EIR may be used by federal permitting agencies to support Project decisions and to inform their review under the National Environmental Policy Act (NEPA), as applicable. Federal permitting agencies with anticipated jurisdiction over the Project are listed below.

- USACE. A CWA Section 404 permit would be required to authorize the discharge of fill material to waters of the United States. A Rivers and Harbors Act Section 10 permit would be required for construction activities in navigable waters (i.e., all tidally influenced waters in the legal Delta).
- U.S. Environmental Protection Agency (USEPA). USEPA has oversight responsibility for all federal CWA permits.
- NMFS. National Oceanic and Atmospheric Administration (NOAA) Fisheries has jurisdiction over all anadromous fish species listed as threatened or endangered under the federal ESA and issued a BiOp on the Project. NOAA Fisheries also regulates EFH in accordance with the Magnuson-Stevens Fishery Conservation and Management Act.
- USFWS. USFWS has jurisdiction over all resident fish and terrestrial species listed as threatened or endangered under the federal ESA and will issue a BiOp on the Project and a Section 7 ESA permit. USFWS also implements the Migratory Bird Treaty Act (MBTA).

Table 1.6-1. List of the Identified Responsible Agencies, Permit, Approval, or Notification Types, and Their Status

Application/Permit	Agency	Status
Federal		
Clean Water Act (CWA) Section 404/Rivers and Harbors Act (RHA) Section 10 Permit	U.S. Army Corps of Engineers (USACE), Sacramento District	Submitted
National Environmental Policy Act (NEPA) Section 408 Permit (Environmental Assessment and Finding of No Significant Impact)	USACE, Sacramento District	Submitted
Endangered Species Act (ESA) Section 7 Biological Opinion	U.S. Fish and Wildlife Service (USFWS)	BO issued May 07, 2018
ESA Section 7(a)(2) Concurrence Letter and Magnuson Stevens Act (MSA) Essential Fish Habitat (EFH) Conservation Recommendations	National Marine Fisheries Service (NMFS)	Consultation letter issued June 29, 2018
National Historic Places Act (NHPA) Section 106 Consultation	State Historic Preservation Officer (SHPO)	Concurrence letter received October 28, 2018
Local Notice to Mariners for work in navigable waterways	U.S. Coast Guard	In Progress
State		
CWA Section 401 Water Quality Certification (WQC)[1] Porter-Cologne Water Quality Control Act (PCWQCA) Waste Discharge Requirement (WDR)	Central Valley Regional Water Quality Control Board (CVRWQCB)	Submitted
CWA Section 402 Permit Registration Documents	Central Valley Regional Water Quality Control Board (CVRWQCB)	To be prepared and submitted by the construction contractor
California Code of Regulations (CCR) Title 23 Division 1 Encroachment Permit	Central Valley Flood Protection Board (CVFPB)	Submitted
Fish and Game Code (FGC) Section 1602 Lake or Streambed Alteration Agreement	California Department of Fish and Wildlife (CDFW)	Submitted
California Endangered Species Act (CESA) Section 2081 Incidental Take Permit	California Department of Fish and Wildlife (CDFW)	Submitted
State Lands Lease Amendment	California State Lands Commission (CSLC)	In Preparation
State Highway Right-of-Way-Encroachment Permit	California Department of Transportation (CalTrans)	In Preparation

Application/Permit	Agency	Status
Regional/Local		
Consistency Determination with the Delta Plan	Delta Stewardship Council (DSC)	In Preparation

1. CVRWQCB has confirmed that no project-specific methylmercury monitoring will be required for the 401 Water Quality Certification, because Prospect Island was included in the DWR's August 2018 Delta Regional Monitoring Program (see CVRWQCB-3 in **Appendix E**).

Other public agencies with a non-permitting and non-approval interest in the Project may include, but not be limited to: California Air Resources Board, California Department of Food and Agriculture, California Department of Boating and Waterways, California Department of Conservation – Division of Land Resource Protection, California Department of Parks and Recreation, California Farm Bureau Federation, California State Lands Commission, Central Delta Water Agency, Contra Costa County, Contra Costa Water District, Delta Protection Commission, Delta Stewardship Council, Napa County, NOAA Fisheries, North Delta Water Agency, Port of West Sacramento, Sacramento County, Solano County Department of Resource Management, Solano County Mosquito Abatement District, Solano County Water Agency, Solano Transportation Authority, The Delta Conservancy, U.S. Bureau of Reclamation, West Sacramento Area Flood Control Agency, Yolo County Planning Division, and Yolo-Solano Air Quality Management District.

1.7 Availability and Public Review of the EIR

This 2016 DEIR was distributed to the public and affected government agencies for review and comment during a 45-day public review period (in compliance with CCR Section 15087 of the CEQA Guidelines Section 15105), starting on Tuesday, August 23, 2016 and ending on Friday, October 7, 2016. A Public Open House was held on September 27, 2016, from 7−9 pm at the Suisun City Nelson Community Center.

The 2019 Partial Recirculated DEIR was also distributed to the public and affected government agencies for review and comment during a 45-day review period, starting on March 1, 2019 and ending on April 15, 2019. In accordance with CEQA Guidelines (Section 15088.5(f)(2)), the public was asked to limit their comments to revised portions of the Partial Recirculated DEIR, which included revisions to the *Proposed Project Description*; *Hydrology, Water Quality, Transportation and Traffic, Noise,* and *Air Quality* impact analyses chapters, as well as changes to the corresponding *Alternatives* analyses.

DWR evaluated comments on environmental issues received from the public and agencies that reviewed the 2016 DEIR and 2019 Partial Recirculated DEIR, and has prepared written responses (**Appendices D**, **E**, and **F**). Some of the responses state that changes have been made to the 2016 DEIR or 2019 Partial Recirculated DEIR and incorporated into this 2019 FEIR.

In compliance with CEQA (Section 15090), prior to approving the Project, DWR shall certify that (1) the 2019 FEIR has been completed in compliance with CEQA; (2) the 2019 FEIR was presented to the decision-making body of DWR and that the decision-making body reviewed and considered the information contained in the 2019 FEIR prior to approving the Project; and (3) the 2019 FEIR reflects the lead agency's independent judgment and analysis.

1.8 Report Organization

The 2019 FEIR is organized as follows:

Table of Contents. Location of chapters/sections, tables, figures, and technical appendices.

Acronyms and Abbreviations. List of acronyms and abbreviations used in the EIR.

Summary. Summary of Proposed Project description, impacts, mitigation measures, alternatives, public consultation, issues to be resolved, and areas of controversy.

Section 1: Introduction. Project overview and objectives, background and history, public consultation, other agency permits required, public comments, and report organization.

Section 2: Proposed Project Description. Background, previous restoration proposals and environmental reviews, Proposed Project context within Delta regional planning efforts and water operations, and Proposed Project, including location, objectives, description of Proposed Project components and construction activities, and current land uses.

Section 3: Environmental Setting, Impacts, and Mitigation Measures. Existing conditions, significance criteria, effects analyses, proposed mitigation measures,

and residual impacts following application of mitigation measures. Environmental topics in the 2019 FEIR are:

Biophysical Resources

- Hydrology (Section 3.1)
- Water Quality (Section 3.2)
- Aquatic Biological Resources (Section 3.3)
- Wetland and Terrestrial Biological Resources (Section 3.4)
- Geology and Soils (Section 3.5)
- Hazards and Hazardous Materials (Section 3.6)
- Air Quality (Section 3.7)
- Greenhouse Gases (Section 3.8)
- Mineral and Gas Resources (Section 3.9)
- Noise (Section 3.10)

Human Resources

- Aesthetics (Section 3.11)
- Agricultural Resources (Section 3.12)
- Cultural Resources (Section 3.13)
- Land Use and Planning/Population and Housing (Section 3.14)
- Public Services (Section 3.15)
- Recreation (Section 3.16)
- Transportation and Traffic (Section 3.17)
- Utilities (Section 3.18)
- Cumulative Impacts (Section 3.19)

Section 4: Alternatives. This section presents a range of potentially feasible alternatives, including the No Project alternative, two “build” alternatives, one of which is identified as the environmentally superior alternative. Alternatives considered and rejected also are presented and discussed in this section.

Section 5: Report Preparers. List of preparers and contributors to the EIR.

Section 6: References.

2 PROPOSED PROJECT DESCRIPTION

2.1 Proposed Project

This Proposed Project includes a series of proposed actions to restore up to 1,528 ac of diked lands to tidal wetlands. The Proposed Project location, site history, and Proposed Project context are described below.

2.1.1 Proposed Project location

Prospect Island (38°15'12.30"N, 121°39'24.90"W) is located in Solano County, in the northern Sacramento-San Joaquin River Delta (Delta) (Figure 2.1-1). It is located within Township 5 North, Range 3, east of the Liberty Island and Rio Vista, California USGS 7.5-minute topographic map.

Prospect Island is part of the Sacramento River Flood Control Project (SRFCP). It was separated from the southern end of the 59,000 ac Yolo Bypass by the Sacramento Deep Water Ship Channel (DWSC), constructed by U.S. Army Corps of Engineers (USACE) in the 1960s. The entire site is enclosed by a levee system with lower (‘restricted’) heights, designed to allow overtopping in large flood events. Prospect Island has one internal cross-levee that separates the north property and the south property (Figure 2.1-2).

For the purposes of the California Environmental Quality Act (CEQA) analysis, the Proposed Project site includes all areas bounded by the perimeter levees of Prospect Island, as well as potential in-water work areas at planned breach locations. The Proposed Project site is bounded on the east by Miner Slough, on the west by the DWSC, on the south by the 37 ac Miner Slough Wildlife Area, managed by California Department of Fish and Wildlife (CDFW), and on the north by a levee that runs from Arrowhead Harbor Marina to the DWSC (Figure 2.1-2). In addition, up to 17.7 ac of existing agricultural land north of the northern cross-levee (Table 2.2-2 and Figure 2.2-3) would potentially be converted to a temporary staging area.

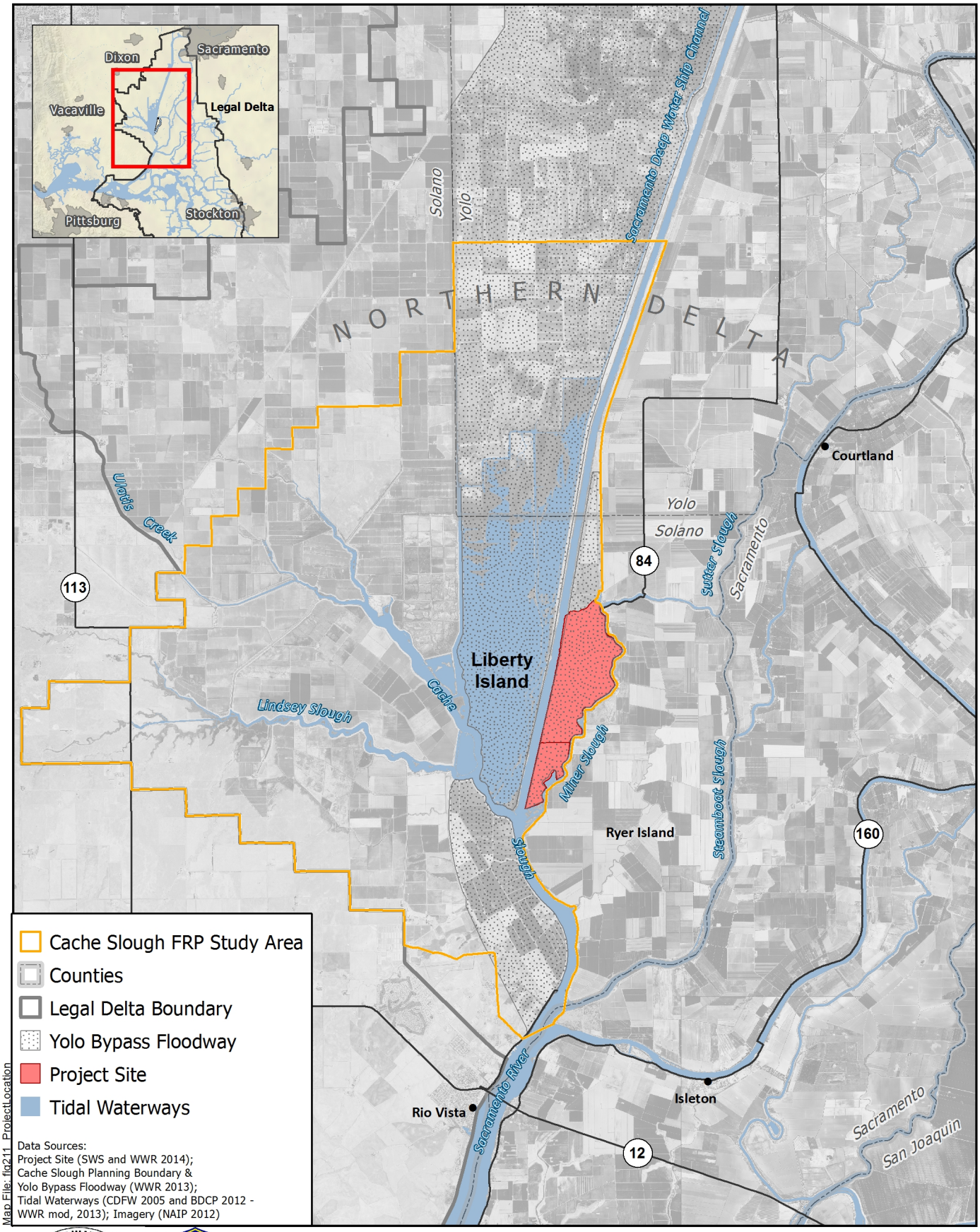

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Figure 2.1-1

Project Location

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

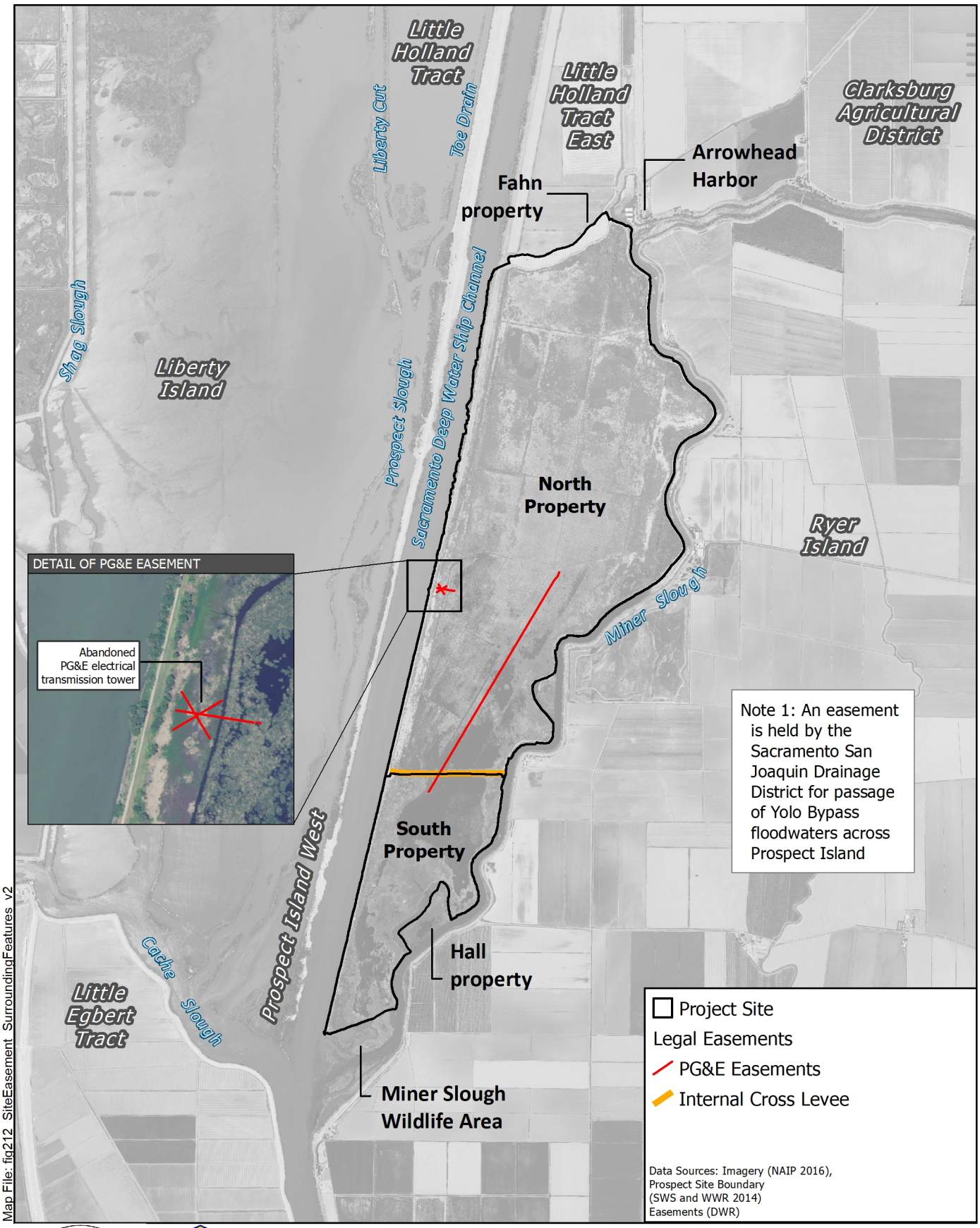


Figure 2.1-2
Prospect Island Site Easements and Surrounding Features

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

2.1.2 Site history

Levees around Prospect Island were first constructed during the late 19th century to create farmland. At that time, the tidal slough that formed the northern boundary of the island was diked as well, connecting Prospect Island to other reclaimed lands to the north. A cross-levee was later constructed and has been maintained to keep the southern portion of Prospect Island hydrologically separated from the lands to the north. The first ownership claims of the island date to 1860.

Prospect Island was made part of the SRFCP in the early twentieth century. Like other lands at the southern end of the Yolo Bypass (Little Holland Tract, Liberty Island, Little Egbert Tract), all of the Prospect Island levees were constructed and maintained as “restricted height levees”, designed to overtop during larger floods to provide additional flood storage capacity. By design, agricultural operations on the island were subject to interruption and damage during flood events. There were levee breaches and/or flooding on Prospect Island in 1919, 1938, 1940, 1962, 1963, 1980, 1981, 1983 (twice), and 1986. Following these events, the levees were repaired, and the island was pumped dry to return the land to agricultural use.

The Port of Sacramento purchased the island in the early 1950s for construction of the DWSC. All levees surrounding Prospect Island were kept at the restricted height elevations, including the western levee, which forms the eastern side of the DWSC and, with construction of the DWSC, became designated as a federal navigation levee. Placement and removal of dredge materials generated from the DWSC dredging operations occurred on the land- (internal) sides of the north, west, and internal cross-levees of Prospect Island, ranging in width from 200 ft along the cross-levee and western levee area, to a variable width along the northern levee segment.

The south property was also used as a receiving site for dredge material during construction. The south property has not been used for dredged material placement since construction of the DWSC, and may have been farmed between 1963 and 1986, although crop records are not available. The south property has been leased out for duck hunting for a number of years. California Department of Water Resources (DWR) obtained ownership of the south property in June 2015.

After the DWSC was constructed in 1963, the north property was sold by the Port to the Sakata Brothers, and Reclamation District (RD) 1667 was activated to maintain the north property as farmland. Wheat, corn, and safflower were grown

on the site until 1994 (USACE and DWR 2001). The Sakata Brothers maintained ownership until the U.S. Bureau of Reclamation (USBR) acquired the site in 1995 as part of a multi-agency effort to restore wetland and riparian habitats in the Delta (DWR 2012a). Prospect Island, along with two other parcels purchased using public funds (Liberty Island and Little Holland Tract), were to be part of a proposed North Delta National Wildlife Refuge and were to be managed by the USFWS. However, the refuge was never established.

Prospect Island has a significant history of flooding, with 13 reported flood events since 1919 (Hopf 2011). Shortly after the USBR acquired the property, in March 1995, flooding caused two levee breaches at the site, one in the Miner Slough levee on the south property and a second at the internal cross-levee separating the south property from the north property. The levee breaches were repaired, and the north property was pumped dry, in July 1996; however, the site was flooded again in 1997 before farming could resume. Levee repairs were completed in 1999; farming activities were not resumed following these repairs (USACE and DWR 2001). The levees breached again in 2006, including a failure of the internal cross-levee. These repeated levee failures were eventually repaired (at great expense), but lands remained flooded for extended periods following each breaching event before the island was again pumped dry.

Following the early 2008 repair of the 2006 levee breach, flood water was pumped off the north property. Sometime after the site was dewatered, the flap gate on the small drainage culvert on Miner Slough was damaged and pumping was discontinued, allowing inundation and very limited, but regular, water exchange between Prospect Island and Miner Slough.

DWR acquired the northern portion of Prospect Island from USBR in April 2010 and reactivated RD 1667 in January 2014 to facilitate pre-Project land management activities, as a responsible landowner.

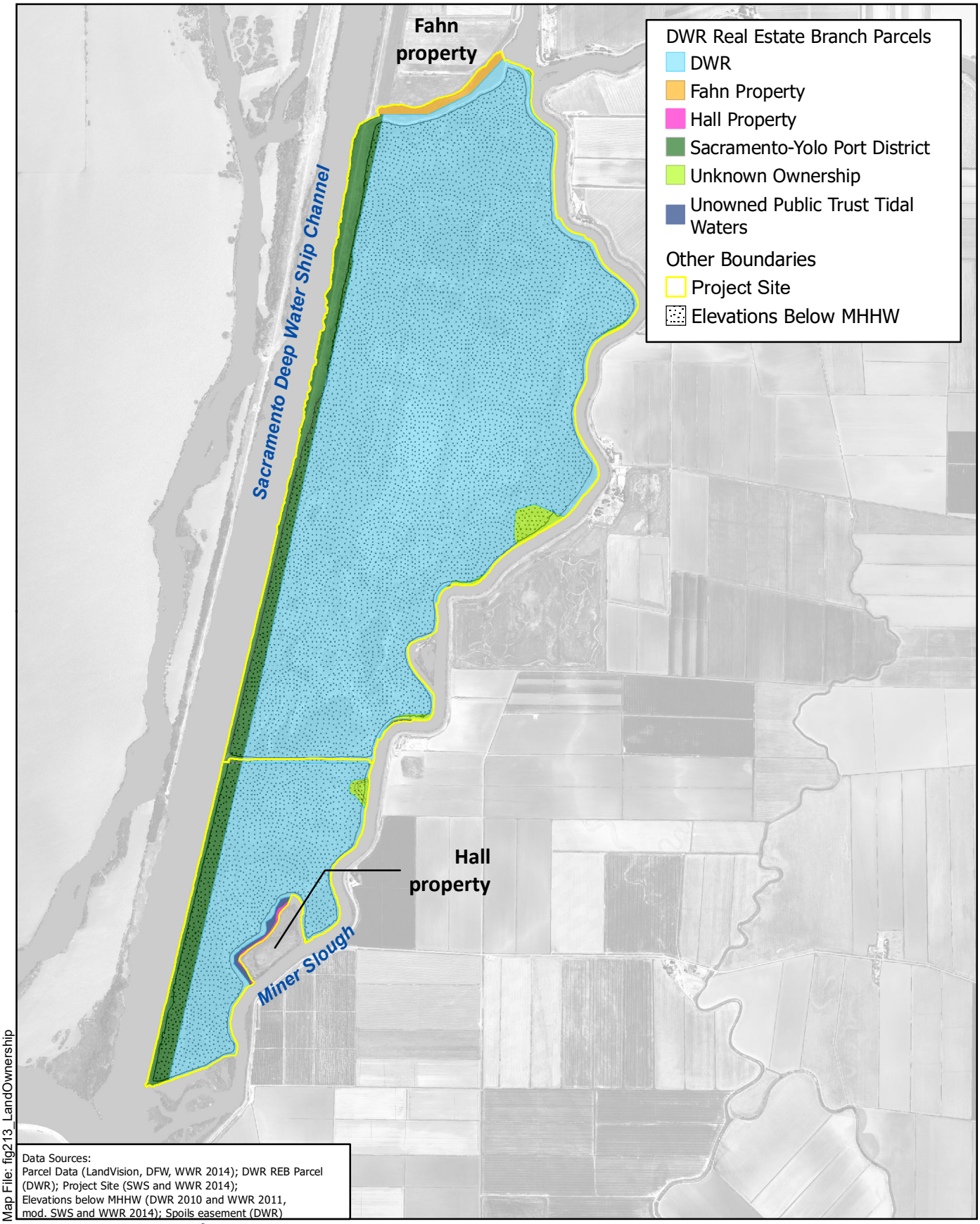
2.1.3 Current land use and ownership

The Proposed Project site (including both the north property and south property) is currently flooded, uncultivated land. The interior of the south property is largely shallow aquatic habitat with portions invaded by aquatic weeds and fringed by emergent marsh and riparian vegetation. The south property is currently leased out for year-round waterfowl hunting.

Ownership is shown in Figure 2.1-3. DWR owns most of the lands comprising the northern portion of Prospect Island, north of the internal cross-levee. There are

small pieces of land adjacent to Miner Slough with no assigned County Assessor's parcel number. This land appears to be old meander bends from the time before Miner Slough was straightened and is therefore unknown ownership, although it is presumed to be under the ownership of the California State Lands Commission (CSLC). DWR also owns most of the lands south of the internal cross-levee.

The DWSC adjacent to the site allows cargo vessels to access the Port of West Sacramento. Recreational vessels use the DWSC and Miner Slough, including the two side-channels, for fishing and recreational boating.



Map File: fig213_LandOwnership

Data Sources:
Parcel Data (LandVision, DFW, WWR 2014); DWR REB Parcel (DWR); Project Site (SWS and WWR 2014); Elevations below MHHW (DWR 2010 and WWR 2011, mod. SWS and WWR 2014); Spoils easement (DWR)

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0 0.25 0.5 Mi

0 0.5 1 Km

Figure 2.1-3
Land Ownership at Prospect Island

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

2.1.4 Surrounding properties

Prospect Island is flanked by the DWSC to the west and Miner Slough to the east (Figure 2.1-2). On the western side of the DWSC lies the flooded Liberty Island, and to the east, across Miner Slough, is Ryer Island. The Fahn property and Arrowhead Harbor Marina are located just north of Prospect Island.

There are two small additional properties adjacent or connected to Prospect Island. These include the Miner Slough Wildlife Area to the south and Hall Island along the Miner Slough side of the south property (Figure 2.1-2). Since circulation of the 2016 DEIR, DWR acquired a formerly privately-owned parcel adjacent to Miner Slough in the central part of the north property (property previously identified as the Stringer Property).

Miner Slough Wildlife Area

Located adjacent to the south end of Prospect Island is the Miner Slough Wildlife Area. Managed by CDFW, the Miner Slough Wildlife Area is a 37 ac tidal and riparian reserve. With only 10 ac above the high tide water elevation, the Miner Slough Wildlife Area is comprised of one small island and a narrow peninsula extending from Prospect Island. The Miner Slough Wildlife Area provides boat-accessible recreation opportunities, and supports a variety of fish and wildlife species, including beaver, Black-crowned Night Heron, and other waterfowl.

Ryer Island

To the east across Miner Slough is Ryer Island. With the exceptions of the Snug Harbor Resort residential area on the southeastern portion of the island, a marina on the southern tip, and a 'Wetland Reserve Program' managed wetland near Miner Slough; the vast majority of Ryer Island is actively farmed.

Hall Island

Hall Island is a privately-owned island bordered by Prospect Island and Miner Slough. The 21-ac property was once connected by a road to Prospect Island and supported multiple residences. The property flooded sometime between 1993 and 2002 and has remained inundated since. Currently, the only infrastructure remaining is a small, decrepit boat dock and associated development on the southern tip. There is currently no land access between Hall Island and the Prospect Island levees (Figure 2.1-2).

Fahn property

The Fahn property is actively farmed agricultural land just north of Prospect Island. The 457-ac property is a remnant of Little Holland Tract, which was bisected by construction of the DWSC.

Arrowhead Harbor Marina

Arrowhead Harbor Marina is located just north of Prospect Island across Miner Slough, at the southwestern tip of the Clarksburg Agricultural District. This small 5 ac marina is the closest marina to the Proposed Project site, and the only one currently operational on Miner Slough.

2.1.5 Proposed Project context within Delta regional restoration efforts

Prospect Island is located at a unique landscape position in the northern Delta. The Proposed Project site sits between the Cache Slough Complex (CSC) to the west at the downstream end of the Yolo Bypass, and the Sacramento River to the east via its distributary channel – Miner Slough (Figure 2.1-4). The CSC is a 53,000-ac region in the northern Delta comprised of extensive diked lands mostly in agricultural use; two large and four small flooded islands that now contain tidal marsh and shallow tidal open-waters; tidal sloughs, many of which support tidal marsh and riparian margins and in-channel islands; and the southern end of the Yolo Bypass.

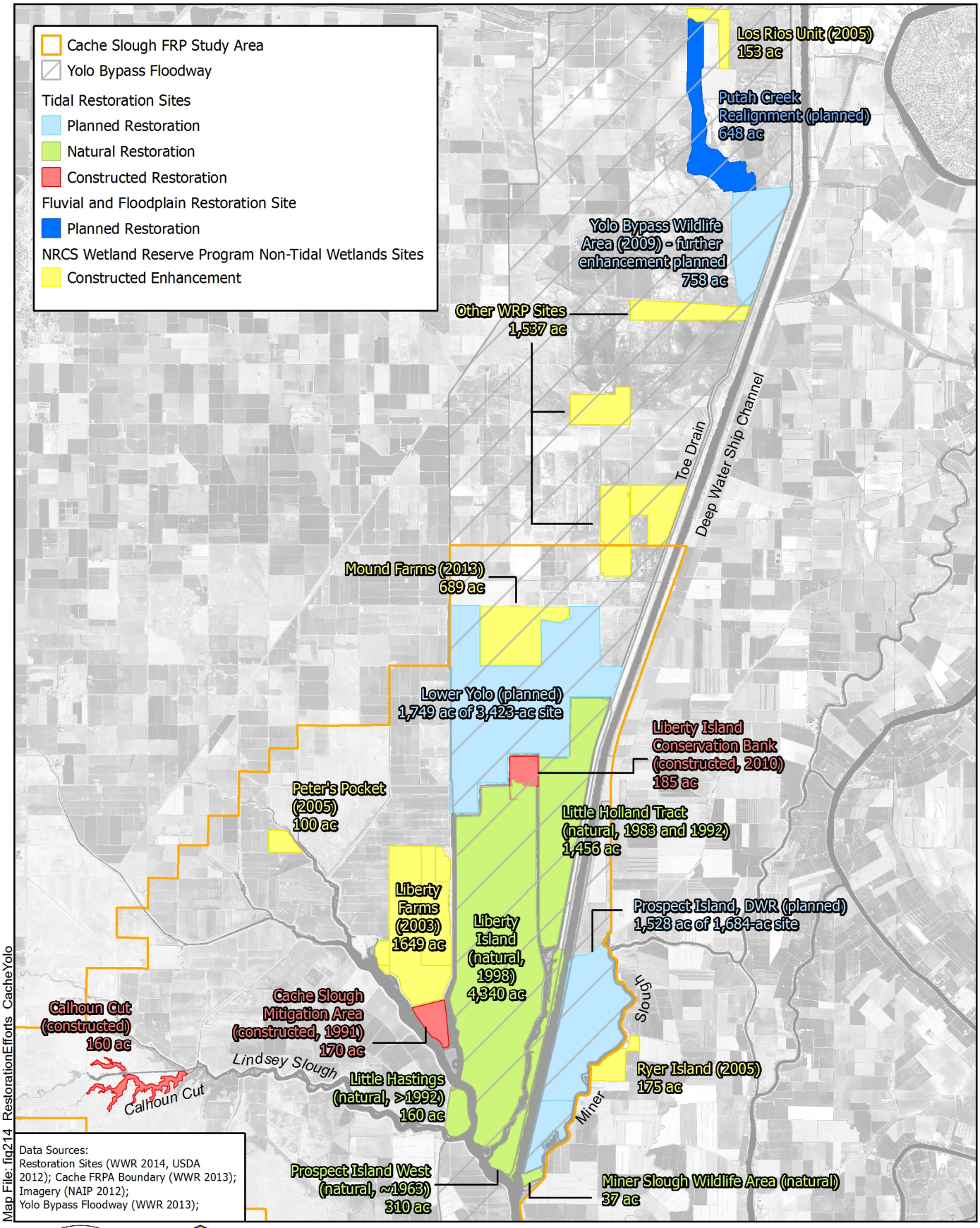


Figure 2.1-4
Restoration Efforts in the Cache - Yolo Region

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Turbidity levels in portions of the CSC are often the highest observed in the Delta, providing important habitat benefits to native fishes (Morgan-King and Schoellhamer 2013). The CSC has been identified as important spawning and rearing grounds for migratory Delta Smelt, in addition to supporting a year-round non-migratory population of Delta Smelt (Sommer and Mejia 2013). This is thought to be due to a combination of factors, including locally high turbidity, abundance of productive tidal marsh and shallow tidal aquatic habitats, connectivity to the Yolo Bypass, and the hydrodynamic influence of the large, shallow flooded islands creating a wide range of hydraulic residence times (the duration of time that a particle of water in the water column stays in one area) in various parts of the CSC.

Miner Slough connects the Sacramento River to the habitats in the CSC, and is a migration corridor for Sacramento River adult and juvenile Chinook salmon populations (Perry and Skalski 2009; Perry et al. 2013). Tidal restoration along this corridor would offer directly accessible habitats for migratory salmonids. The net downstream flow in Miner Slough creates a local setting where tidal influence diminishes rapidly over a short distance, reflecting the transition from the tidal Delta to the riverine Sacramento River. This hydrodynamic setting affords opportunities for variable aquatic residence times and tidal mixing with reconnection of Prospect Island.

The landscape position and identified ecological functions of the CSC, in combination with its sparse urban development and infrastructure, relatively intact hydrologic connections to tidal influence, and little land subsidence as compared with the central Delta, have made the region a focus for ecosystem restoration since the early development of the CALFED Bay-Delta Program (CALFED) Ecosystem Restoration Program (ERP) in the 1990s. Regional and local restoration efforts are described in greater detail in Section 3.19 *Cumulative Impacts*.

2.2 Proposed Project Actions

2.2.1 Summary

The Proposed Project would consist of a suite of actions necessary for site preparation, restoration, minimizing or avoiding potential adverse impacts, post-restoration monitoring, and maintenance (see Section 1.1 *Overview of the Proposed Project and Alternatives* and Section 2.2.3 *Description of Proposed Project components and construction activities*). Most activities are incorporated in the Proposed Project description, while others may be incorporated into the

Proposed Project and/or alternatives analyses. Restoration activities and features for the Proposed Project are summarized in Table 2.2-1.

Table 2.2-1. Restoration Activities and Features of the Proposed Project

Restoration Activities and Proposed Project Features	Proposed Project Activities and Components
South property levee repairs	Install sheet pile repair or rock and soil fill at 2:1 slopes Rock armor placed above low permeability geotextile
Site dewatering	Install temporary dewatering pumps (locations to be determined)
Invasive plant species control	Upland and wetland/upland species: apply mechanical and/or herbicide methods Aquatic species: application of aquatic-approved herbicide and/or physical removal with clearing (above)
Pre-construction clearing	Within moderate subtidal areas, clear all vegetation, dead trees, and snags. Within intertidal areas, clear all vegetation, dead trees and snags within 100 ft buffer around excavated channel network, breaches, eastern toe berm, eastern intertidal bench, and access roads/ramps. Avoid removal of dead trees and snags from areas within the intertidal zone that do not impede construction. Roll down all intertidal vegetation in areas outside of the 100 ft buffer. To the extent practicable, retain large (living) trees in place at eastern toe berm and bench locations. Also, retain cleared snags for potential re-use as raptor perches and turtle basking sites where possible.
Access roads and ramps	Build ramps from levees down into site interior at grades suitable for construction equipment Re-use access road materials on-site (e.g., for re-surfacing levee roads) (locations to be determined)
Staging areas	Prepare temporary staging location on historically agricultural land (i.e., not currently used for agriculture), between the northern cross-levee and the adjacent Fahn property Prepare temporary staging location in subtidal area To the extent practicable, avoid areas supporting riparian trees > 4 in in diameter at breast height (dbh)
Old infrastructure removal	Fill or remove existing Miner Slough culvert Remove dilapidated pump house, remains of bunkhouse, and any other remains of outbuildings on the north property, and remove collapsed house on south property Remove or relocate existing pump stations on the north property (following site dewatering) Remove transmission tower, power lines and poles

Restoration Activities and Proposed Project Features	Proposed Project Activities and Components
Interior channel network excavation (dimensions are approximate)	Excavate tidal channels in areas above -1 ft NAVD 88 Channel invert elevation: -3 to -4 ft NAVD 88 Channel invert width: 45 to 90 ft Side slopes: 2.5:1
Block or fill remnant agricultural ditches	Use excavated soils to block or fill remnant agricultural ditches not incorporated into constructed channel network
Construct interior topographic features	Create small patches of higher intertidal habitat within the site with materials excavated from channel network Max elevation ~ MHW to MHHW (6-6.5 ft NAVD 88)
Construct eastern toe berm	Construct non-structural berm along portions of the interior toe of the Miner Slough levee Upland areas revegetated with native riparian species
Construct eastern intertidal bench	Construct non-structural bench to intertidal elevations along the central portion of the interior of the Miner Slough levee Construct from fill generated by channel network excavation If needed, plant with tules in areas subject to wind-wave erosion, but no more than 20’ in width Limited experimental planting
Excavate internal cross-levee (dimensions are approximate)	Invert elevation: -4 ft NAVD 88 Invert width: 395 ft Side slopes: 2.5:1 Use excavated soils to block/fill borrow ditch that runs along north side of the internal cross-levee
Construct breach velocity dissipation	Place fill excavated from construction of the channel network and from upland portions of levee breaches onto the interior sides of the levee at one of the two breach locations
Dredge Miner Slough spur channel	Dredge spur channel between Miner Slough and south property breach, to accommodate required volume of tidal exchange between Miner Slough and the restored Proposed Project site Dewater and beneficially re-use dredge material in the south property

Restoration Activities and Proposed Project Features	**Proposed Project Activities and Components**	
Breach Miner Slough levee (dimensions are approximate)	Northern Miner Slough Invert elevation: -4.6 ft NAVD 88 Breach invert width: 531 ft Side slopes: 2:1	Southern Miner Slough Invert elevation: -4.0 ft NAVD 88 Breach invert width: 394 ft Side slopes: 2:1

2.2.2 Anticipated future habitat conditions, Proposed Project

This section describes the future habitat conditions anticipated following completion of the above-described site preparation and construction activities for the Proposed Project. Changes in Natural Community habitat types from existing conditions are shown in Figure 2.2-1 and Table 2.2-2.

As-built conditions

Upon completion of construction and breaching of the Miner Slough levee, the interior of Prospect Island would be reconnected with tidal exchange from Miner Slough. The resulting habitats would be primarily tidal perennial aquatic (open-water) habitat with tidal mudflat habitat exposed at intertidal elevations (Figure 2.2-1 and Table 2.2-2). The retained natural communities would initially be limited to emergent wetland vegetation remaining within intertidal habitats as well as valley/foothill riparian habitats located along the DWSC levee, northern cross-levee, and the upper slopes of the Miner Slough levee.

Future conditions

Valley/foothill riparian and tidal freshwater emergent wetland habitats on the restored Prospect Island site are anticipated to colonize and expand from the as-built condition (Figure 2.2-1). As emergent marsh vegetation establishes over time, open-water habitat is expected to decrease from the as-built condition, with a corresponding increase in tidal freshwater emergent wetland habitat at intertidal and shallow subtidal elevations (Table 2.2-2). Although future estimates of developed lands (i.e., roads) are shown to be the same as existing conditions, roads and grassland habitat along the portions of the Miner Slough and internal cross-levee that are not maintained would revert to valley/foothill riparian habitat in the future.

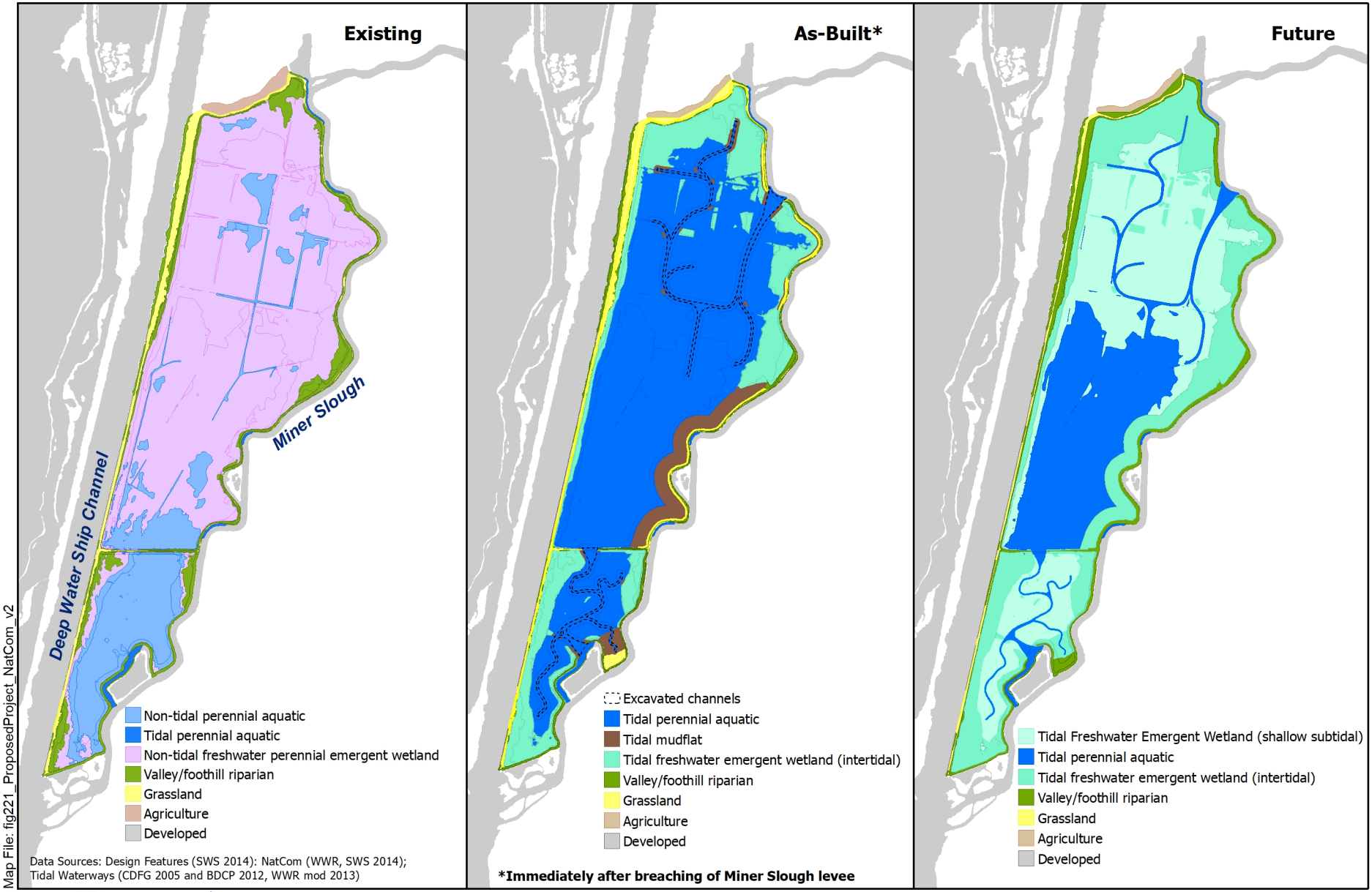


Figure 2.2-1

Prospect Island Natural Communities Existing, As-Built, and Future - Proposed Project

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

It is anticipated that emergent vegetation would colonize intertidal elevations within approximately the first three years post restoration and expand laterally into the shallow subtidal elevations within approximately 10–15 years following breaching. Figure 2.2-1 shows estimated maximum future tidal emergent marsh extent corresponding to establishment at intertidal (2.1–6.5 ft NAVD 88), as well as shallow subtidal, elevations (0.1–2.1 ft NAVD 88). Based upon observations in the Delta and known submergence tolerances of emergent marsh species, tidal freshwater emergent marsh habitat is expected to establish in the intertidal zone down to -2 ft Mean Lower Low Water (MLLW). Simenstad et al. (2000) surveyed six wetlands historically flooded islands and four reference wetlands and found the lower edge of emergent vegetation generally ranged between +0.7 ft to -2.0 ft MLLW, with a median of -1.0 ft. Furthermore, observations in natural tidal marshes, as well as recent observations at nearby Liberty Island (Simenstad et al. 2000, Orr et al. 2003, Hester et al. 2013), suggest that emergent marsh vegetation may slowly colonize shallow subtidal habitats (approx. 1–2 ft below MLLW) over the long-term via lateral growth (approx. 1–3 ft/year) from plants that establish in the adjacent low intertidal zone. However, there is currently uncertainty over the magnitude and rate at which such subtidal emergent vegetation can develop following restoration in the Delta (Hester et al. 2013), especially given the projected trajectory of mean sea level rise over the next several decades.

Table 2.2-2. Prospect Island Natural Communities: Existing, As-Built, and Future—Proposed Project

Acres by Natural Community Type[1]			Existing	As-Built[2]	Future	Change in Area
Aquatic	Non-tidal	Non-tidal perennial aquatic	339.8	0.0	0.0	-339.8
	Tidal	Tidal perennial aquatic[4]	10.3	1,088.7	472.4	462.0
Wetlands	Non-tidal	Non-tidal freshwater perennial emergent wetland	1,100.5	0.0	0.0	-1,100.5
	Tidal	Tidal mudflat (graded areas of eastern intertidal bench and toe berm)	0.0	87.7	0.0	0.0
		Tidal freshwater emergent wetland (intertidal)	0.0	347.7	437.3	437.3
		Tidal freshwater emergent wetland (shallow subtidal)	0.0	0.0	615.4	615.4
Uplands		Valley/foothill riparian	145.2	53.5	117.5	-27.7
		Grassland	66.4	91.5	26.5	-39.9
		Agriculture	17.7	10.9	10.9	-6.8
Other		Developed	4.5	4.5	4.5	0.0
Aquatic	Non-tidal		339.8	0.0	0.0	-339.8
	Tidal		10.3	1,088.7	472.4	462.0
					Subtotal aquatic	**+122.1**
Wetlands	Non-tidal		1,100.5	0.0	0.0	-1,100.5
	Tidal		0.0	435.4	1,052.7	1,052.7
					Subtotal wetlands	**-47.8**
Aquatic and Wetlands	Non-tidal		1,440.3	0.0	0.0	-1,440.3
	Tidal		10.3	1,524.1	1,525.1	1,514.8
					Subtotal perennial aquatic and wetlands	**+74.4**
Uplands			229.3	155.9	154.9	-74.4

[1] Acreages within Proposed Project site boundary are based on Natural Communities Data (ESA 1973, SWS 2014). Summations may vary due to rounding.

[2] As-built acres are immediately after breaching of Miner Slough levee.

[3] Change calculated as future minus existing area estimates of natural community types.

[4] Although portions of the south property interior were designated as tidal Waters of the U.S. in the Preliminary Wetland Delineation (DWR 2014a), there is no fish passage through the degraded breach repair and other habitat functions are similar to those in nontidal perennial aquatic habitats.

2.2.3 Description of Proposed Project components and construction activities

The Proposed Project consists of a suite of actions to prepare the site for restoration, construct restoration features, and restore tidal action to the site. This section summarizes the levee breach configurations and major restoration actions of the Proposed Project. It presents an overview of general restoration activities and features in greater detail, and it presents material quantities and dimensions for the Proposed Project.

The Proposed Project would start with pre-construction site preparation, to be followed by site modifications internal to the island, and would end with levee breaching to allow tidal inundation of the Proposed Project site. Figure 2.2-2 depicts a general design schematic for the Proposed Project, Figure 2.2-3 illustrates site preparation elements and Figure 2.2-4 illustrates clearing and grubbing areas. Table 2.2-3 provides estimated material quantities and dimensions for the restoration activities and features of the Proposed Project.

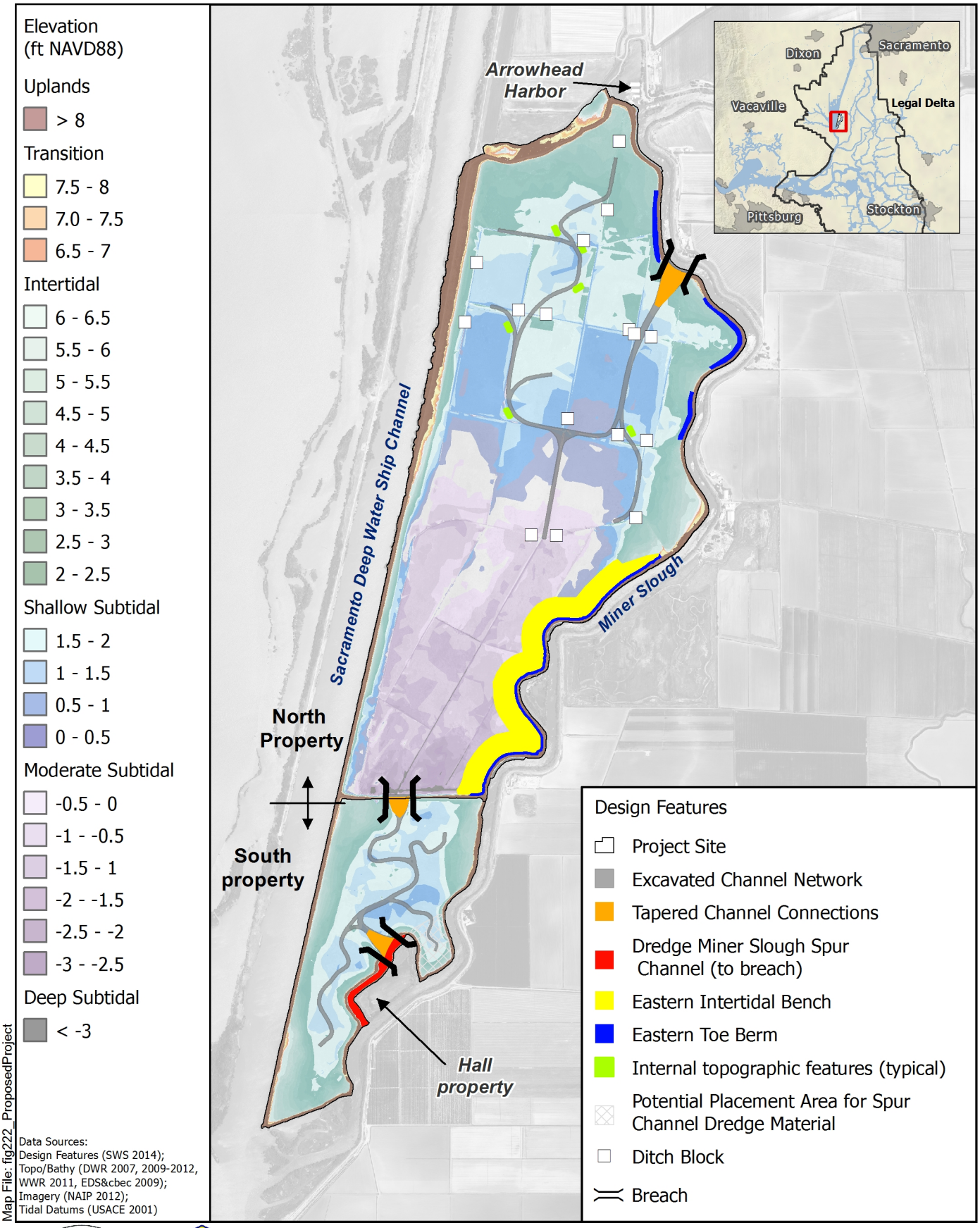
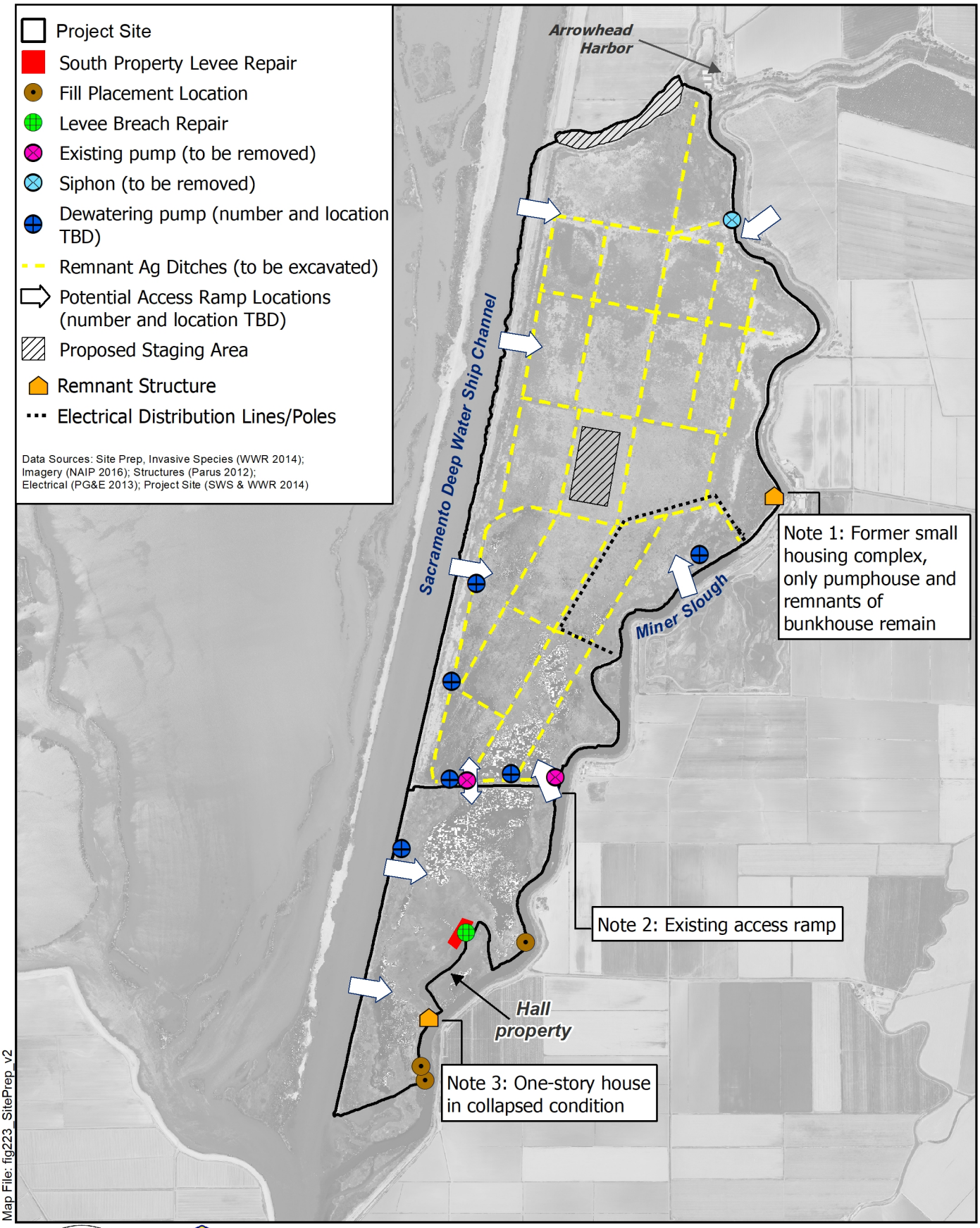


Figure 2.2-2
Proposed Project

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT



Map File: fig223_SitePrep_v2

1:31,680 (1 in = 0.5 miles at letter size)

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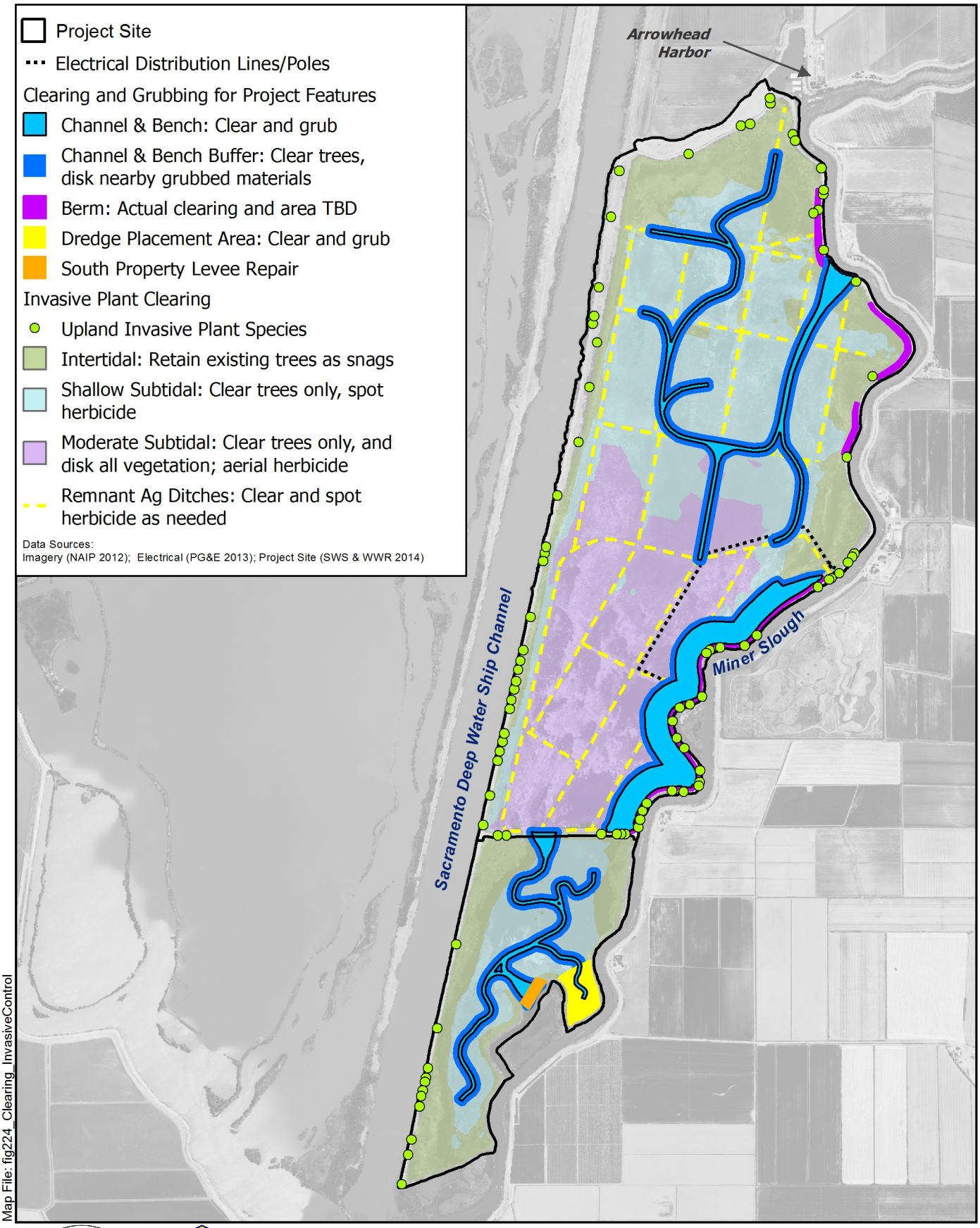
0 0.5 1 Km

Figure 2.2-3
Site Preparation

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT



Map File: fig224_Clearing_InvasiveControl

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Figure 2.2-4
Site Clearing and Invasive Species Control

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Table 2.2-3. Estimated Material Quantities and Dimensions

No.	Restoration Activities and Proposed Project Features	Units	Quantities
1	South property levee repair		
	Fill placement	cubic yard (cy)	3,000
	Sheet piles	ft	200
	Geotextile	square-feet (ft^2)	10,000
	Stone armoring	tons[1]	200
2	Pre-construction-site preparation		
2a	Dewatering and water management		
2a1	Clear existing agricultural ditches		
	Area	ac	62
	Debris to be chipped/disked on-site	cy	3,400
2a2	Plug existing culvert in Miner Slough levee	cy	22
2a3	Install temporary pump	# pumps	6
	Fill placement	cy	1,560
	Sheet piles	ft	660
	Excavate Sumps	cy	(500)
2b	Clearing		
2b1	Clearing and Grubbing (channel network, toe berm, intertidal bench, access roads/ramps, dredge placement area)		
	Area	ac	156
	Volume of debris to be disked on-site	cy	7,300
2b2	Clearing and disking within 100 ft buffer of construction footprint and all areas <0 ft NAVD 88 (moderate subtidal)		
	Area	ac	504
	Volume of debris to be disked in place	cy	18,500
2b3	Tree clearing within all areas from 0.0 to 2.1 ft NAVD 88 (shallow subtidal).		
	Area	ac	496
	Volume of debris to be disked on-site	cy	<10
2c	Roads and ramps		
	Ramps		
	Locations	each	12
	Length	ft	1,390
	Area	ac	1
	Volume of fill	cy	7,500
	Aggregate Base	cy	500

No.	Restoration Activities and Proposed Project Features	Units	Quantities
	Roads (contingency volume if site cannot be dewatered to fully support equipment)		
	Area	ac	16
	Volume of fill	cy	39,000
	Aggregate Base	cy	3,500
2d	Temporary staging area (adjacent to north levee)	ac	17.7
	Temporary staging area (interior)	ac	25
	Aggregate Base	cy	30,000
3	Pre-restoration invasive plant species control		
3a	Aquatic (aerial spraying of agricultural ditches and moderate subtidal habitats < 0 ft NAVD 88)		
	Area	ac	411
	Application rate	pounds (lbs)	2,900
3b	Upland (backpack spot treatment)		
	Area	ac	6.4
	Application rate	lbs	97
4	Debris and old infrastructure removal		
	Remove existing pumps	each	2
	Demolish/remove abandoned structures	each	2
	Total volume of debris (hauled to landfill)	cy	(100)
5	Excavate constructed channel network		
	Area	ac	59.4
5a	Excavation Volume (calculated)		
5a1	Tapered connections to channel network	cy	(61,000)
5a2	Channel network	cy	(335,200)
6	Block or fill remnant agricultural ditches		
	Length	ft	6,000
	Area	ac	2
	Volume of fill (estimated)	cy	17,000
7	Construct interior topographic features		
	Quantity	# mounds	6
	Area	ac	3
	Fill Volume	cy	27,000
8	Construct eastern toe berm		
	Area	ac	18.5
	Fill Volume	cy	139,000
9	Construct eastern intertidal bench		
	Area	ac	66.5
	Fill Volume	cy	340,000

No.	Restoration Activities and Proposed Project Features	Units	Quantities
10	Excavate internal cross-levee		
10a	Excavate breach		
	Invert Width	ft	400
	Area	ac	2
	Excavation Volume	cy	(20,000)
10b	Fill borrow ditch		
	Area	ac	3
	Fill Volume	cy	4,000
11	Construct breach velocity dissipation feature		
	Area	ac	1
	Fill Volume	cy	7,000
12	Dredge Miner Slough spur channel		
12a	Dredging		
	Area	ac	5
	Volume	cy	(47,000)
12b	Dredged Materials Placement Area		
	Containment Area	ac	12
	Fill Volume	cy	6,600
13	Planting and revegetation		
13a	Wetland planting		
	Eastern toe berm (maximum potential area shown, not all will be planted)	ac	14
	Eastern intertidal bench (experimental planting)	ac	5
13b	Riparian planting		
	Eastern toe berm (upper elevations) and other upland areas (staging area, DWSC levee interior)	ac	80
14	Remove Access Roads and Ramps		
	Area	ac	1
	Excavation Volume	cy	(34,000)
15	Breach Miner Slough levee		
	Total Top Width	ft	1,060
	Area	ac	3
	Rock slope protection	tons[1]	250
15a	Excavation volume (above MHHW)	cy	(47,300)
15b	Excavation volume (below MHHW)	cy	(3,500)

[1] Conversion to tons based on bulk density of 1.4 tons/cubic yard.

Construction activities for the Proposed Project

1. South property levee repairs

The purpose of repairing the south property Miner Slough levee would be to facilitate dewatering of the south property as needed during Proposed Project construction. This activity would restore proper function to the Miner Slough levee (Figure 2.2-3). This would involve placement of compacted fill to restore the Miner Slough levee to its original design elevation at four locations (with Shallow Sites 2 and 3 grouped together for descriptive purposes in point three below) on the south property:

1. At Levee Low Point Repair Site 1 (just south of the cross-levee, and shown as a 'Fill Placement Location' on Figure 2.2-3), a depression in the interior of the levee crown would be built-up. Access would likely occur from the levee road, with no vegetation clearing required below mean higher high water (MHHW). Waterside fill would be required for Section 2 of the repair.
2. The South Breach Temporary Levee Repair Site (known as the leaky breach, and shown as the 'Levee Breach Repair' on Figure 2.2-3) within the Miner Slough spur channel would be accomplished using soil and rock fill, or by installing a sheet pile cut-off wall at the end of the Miner Slough spur channel (to be removed during final breaching). A layer of low-permeability geotextile may be placed above the earth fill, and armored with stone at a 2:1 slope to protect against erosion from the new levee crest down to the base of the slope, below the water. This repair site would be accessed from the waterside, but vegetation removal would be minimal because the site is primarily loose rock. Armoring would be placed on the exposed levee ends.
3. At Levee Low Point Repair Site 2 (including both Shallow Area 2 and Shallow Area 3 shown together as 'Fill Placement Location's on Figure 2.2-3), fill would be placed in two small depressions in the levee crown south of the spur channel repair site and near the southern tip of the Miner Slough levee. Fill would occur above MHHW, with no armoring likely below MHHW. Access would occur from the waterside of the levee. Vegetation clearing is required because there is currently no access road to the southern tip of the Miner Slough levee. To allow access, vegetation clearing will occur on the berm between the waterside of the channel edge and levee crown. Post-construction, vegetation would be reestablished on the berm.

Construction materials and equipment would be transported by local barge and/or truck.

2. Pre-construction-site preparation

The purpose of pre-construction site preparation activities would be to ready the site for equipment operations and access during Proposed Project construction, including removal of snags and other debris, and to facilitate invasive plant species control activities. Figure 2.2-3 illustrates the general locations of these activities, to the extent they are currently defined.

Pre-construction-site preparation activities would include the following:

a. Dewatering and water management, for the purpose of creating suitable conditions for Proposed Project construction

Both the north and south properties are currently flooded. Dewatering of surface waters in the north property would rely on clearing of the existing agricultural drainage ditch network, with temporary pumps installed at low points within the Proposed Project site. All, or portions of, the existing remnant agricultural drainage network would be cleared of vegetation and rehabilitated for site drainage, as needed. As there are no remnant agricultural ditches on the south property, temporary drainage ditches may be excavated to allow drainage towards the north property, with soils beneficially re-used as part of the Miner Slough eastern toe berm. The existing culvert and flap gate structure connecting the north property to Miner Slough would be plugged using concrete.

Platforms and drainage sumps for temporary pumps would be constructed at up to five locations along the north side of the cross-levee, and up to two locations along the south side of the levee. Pump platforms would be constructed using a combination of excavation, sheet piles, and 108 cubic yards (cy) of temporary fill. Depending upon the number of pumps used, the areal extent of temporary fill is proposed to be approximately 0.17 ac. Dewatering will be conducted in two phases. During Phase 1, pumps along the north side of the cross-levee would be used to discharge into the south property where it will pass through the existing leaky breach repair at the end of the Miner Slough spur channel. Once the temporary breach repair is complete, Phase 2 drainage would route all pump discharges from the North and South properties to Miner Slough.

As no electrical service remains to Prospect Island, all pumps would be diesel powered, or electrically powered using a diesel generator. Diesel fuel would either be stored on-site, on the levee or at a staging area, or the pumps would be serviced regularly with a refueling vehicle. Once the

pumps are no longer needed, the pump platform fill material would be re-used on-site, sumps filled to grade, with all equipment and temporary sheet piles removed and transported off-site.

Similar to practices typical of Delta island drainage operations, drainage pumps would continue to be used to manage interior water levels during construction with appropriate Best Management Practices (BMPs) employed on exposed slopes (e.g., hydro-seeding, slope breaks, mulching of cleared vegetation) and within the drainage ditches (e.g., temporary ditch checks, wattles, hay bales) to limit suspended sediments from reaching the drainage sumps. Soil moisture conditions would determine use of amphibious excavators, low ground pressure excavators, or standard excavators.

b. Clearing

Clearing and grubbing would occur across 156 ac. An additional 504 ac would be cleared, generating a total of up to 29,000 cy of organic material that would be chipped and disked on-site (Table 2.2-3). This activity is necessary to allow for construction vehicle access, as well as uniform characteristics of soils reused on-site. Following initial site dewatering, existing vegetation would be cleared and grubbed within the construction footprint (i.e., excavated channel network, eastern toe berm and intertidal bench, site access roads/ramps, Miner Slough spur channel dredge placement area) (Table 2.2-3, Figure 2.2-4). In addition, all above ground vegetation would be cleared within moderate subtidal areas (<0 ft NAVD 88) as well as within a 100 ft buffer outside of the construction footprint. These cleared materials would be disked in place. To limit habitat suitability for ambush predators within shallow subtidal (0.0 to 2.1 ft NAVD 88) habitats, the limited number of existing trees at these elevations would be removed. Existing trees at intertidal elevations (2.1 to 6.5 ft NAVD 88) that are outside of the construction footprint and buffer areas described above would be left intact to serve as snags within future emergent wetland habitats.

This activity would require a variety of construction equipment and methods. Smaller trees, brush, and debris would be cleared using a combination of bulldozers, excavators, and wheel loaders. Any larger trees within areas designated for clearing may need to be cut down and bucked by hand crews using chain saws. Larger tree trunk/limbs and root wads (i.e., large woody debris) would, to the extent practicable, be re-used

on-site to enhance habitat structure along the upland edge of the intertidal zone. All plant debris, not including large woody debris, retained for future use would be chipped, transported, and disked within the moderate subtidal areas.

c. Creation of temporary ramps and roads, for the purpose of creating construction access into and out of the site interior

This activity would involve constructing temporary access ramps and roads within the Proposed Project site to facilitate construction. The site is currently surrounded by levees on all sides, with levee side slopes that are generally too steep to allow construction equipment to be safely driven down into the site interior. Additionally, depending on the types of equipment needed to complete construction, and on the conditions of site soils and ground surfaces, temporary access/haul roads may need to be established within the site to facilitate construction of many of the restoration features.

Where necessary, temporary access ramps and roads would be constructed by importing clean fill by local barge and/or trucks along designated access points and routes. Access ramps and roads may be aligned with the constructed channel network and breach locations. The number, location, and dimensions of ramps would be determined during final design. Geotextile fabric base may be used as determined by engineering analyses. Ramps and roads may be surfaced with aggregate road base. Road and ramp construction would be accomplished using a combination of excavators, bulldozers, and wheel loaders.

d. Creation of temporary staging areas, for the purpose of managing construction activities

This activity would involve designating temporary staging areas to facilitate construction. Up to 17.7 ac of land north of the northern cross-levee would potentially be used for temporary staging and parking. Additionally, portions of the cleared subtidal area within the Proposed Project site would be used for temporary staging (Figure 2.2-3). Staging areas would be cleared of vegetation and/or any debris. Depending on equipment types and soil and ground surface conditions, an aggregate base may be used for the subtidal staging area.

3. Invasive plant species control measures, for the purpose of reducing the potential for ecological or other invasive species impairments within the restoration-site and surrounding areas

The purpose of this restoration activity would be to remove existing non-native, invasive plants found at Prospect Island. Invasive plant control would help to promote restoration success and prevent the site from becoming a source of invasive plant species dispersal into the surrounding tidal waterways.

Under existing conditions, the Proposed Project site is host to several ecologically disruptive, invasive plant species. This restoration activity would involve removing existing invasive plants (to the greatest extent practicable) at the Proposed Project site prior to restoration, with a focus on controlling those species with the potential to: (1) interfere with Proposed Project ecological objectives and/or (2) to spread outside the site and degrade surrounding habitats. The most significant invasive plant species present at the site is water primrose, an aquatic weed which covers between 160–200 ac of the wetted areas of the site (Table 2.2-4). Other invasive plant species present include emergent, submerged aquatic, riparian, and upland species, including: Eurasian water-milfoil, curlyleaf pondweed, giant reed, yellow star thistle, poison hemlock, pampas grass, fennel, perennial pepperweed, wild radish, Himalayan blackberry, red sesbania, and tamarisk. Additionally, water hyacinth and Brazilian waterweed are documented in the waters adjacent to Prospect Island.

a. Aquatic invasive plant species control

For aquatic species, the first control measure would be to dewater the site (see above). This would allow physical access and maximize effectiveness of subsequent herbicide application. Following initial site dewatering, invasive aquatic plant species would be targeted in moderate subtidal habitats (< 0 ft NAVD 88) (Figure 2.2-4) using an aerial application of State Water Resources Control Board-approved aquatic herbicides (i.e., imazapyr, glyphosate, or other similar products; possibly aminopyralid, if it is approved before Proposed Project implementation) (Table 2.2-4). These materials would be cleared and disked in place (see Sub-section 2b *Clearing* above).

b. Terrestrial invasive plant species control

Invasive terrestrial plant species would be targeted in upland habitats (Figure 2.2-4) and would be removed by mechanical methods (e.g., excavation, mowing) as well as spot application of herbicides (Table

2.2-4). These activities would be timed to coincide with specific bloom periods (Table 2.2-5). Cleared terrestrial vegetation debris would be disked on-site (Figure 2.2-4).

Table 2.2-4. Removal Techniques for Aquatic and Terrestrial Non-native Invasive Plant Species[1]

Scientific name (common name)	Approximate Extent on Prospect	Technique	Herbicide	Herbicide Timing	Mechanical Timing
AQUATIC PLANT SPECIES					
Ludwigia spp. (*peploides*-ss *montevendensis*) (water primrose)	160–200 ac	dewater, herbicide, and physical removal	tank-mix of imazapyr (est. 6 pints (pts)/ac of Habitat or Polaris), glyphosate (est. 7.5 pts/ac of Roundup Custom or AquaMaster), or other approved products	post-dewatering	post-herbicide
Myriophyllum spicatum (Eurasian water-milfoil)	50–60 ac				
Potamogeton crispus (curlyleaf pondweed)	5–7 ac				
TERRESTRIAL PLANT SPECIES					
Arundo donax (giant reed)	<0.1 ac	physical rhizome removal and cut/herbicide	spot application of glyphosate (est. 3.3 qts/ac of Roundup ProMax)	Sep–Oct	3 weeks–3 months prior to herbicide
Foeniculum vulgare (fennel)	2 ac	herbicide	spot application of triclopyr (est. 8 qts/ac of Garlon 4 Ultra)	Mar–Apr	N/A
Centaurea solstitialis (yellow star-thistle)	0.2 ac	mowing and herbicide	spot application of glyphosate (est. 3.3 qts/ac of Roundup ProMax)	Apr–May	prior to herbicide, April–May
Sesbania punicea (red sesbania)	<0.01 ac	physical and herbicide	spot application of triclopyr (est. 8 qts/ac of Garlon 4 Ultra)	Apr–May	year-round, immediately prior to herbicide
Rubus armeniacus (Himalayan blackberry)	2–5 ac (estimated)	mowing and herbicide	spot application of triclopyr (est. 8 qts/ac of Garlon 4 Ultra)	Mar–Apr	Mar, immediately prior to herbicide

Scientific name (common name)	Approximate Extent on Prospect	Technique	Herbicide	Herbicide Timing	Mechanical Timing
Cortaderia selloana (pampas grass)	<0.01 ac	mowing and herbicide	spot application of glyphosate (est. 3.3 qts/ac of Roundup ProMax)	Sept–Nov	Sep–Nov, immediately prior to herbicide
Lepidium latifolium (perennial pepperweed)	unknown	herbicide	spot application of chlorsulfuron (est. 2.5 oz/ac of Telar)	Apr–May	N/A

[1] Removal techniques may be modified by recommendations from a Pest Contol Advisor, as part of the Weed Management Plan to be developed by the construction contractor; only state and locally approved pesticides shall be used.

Table 2.2-5. Timeline of Invasive Terrestrial Plant Species Removal Techniques

Scientific name (common name)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arundo donax (giant reed)							Mechanical removal		Herbicide			
Foeniculum vulgare (fennel)			Herbicide									
Centaurea solstitialis (yellow star-thistle)				Mechanical removal followed immediately by herbicide								
Sesbania punicea (red sesbania)												
Rubus armeniacus (Himalayan blackberry)			Mechanical removal followed immediately by herbicide									
Cortaderia selloana (pampas grass)									Mechanical removal followed immediately by herbicide			
Lepidium latifolium (perennial pepperweed)				Herbicide								

Source: (WWR and SWS 2013).

4. Debris and old infrastructure removal

Old infrastructure has the potential to interfere with Proposed Project construction and/or with achieving Proposed Project ecological goals. This restoration activity would involve removing old infrastructure from the Proposed Project site.

Following initial dewatering, the existing pump stations and the siphon on the north property would be removed and transported off-site for disposal or re-use. Additionally, the site contains remnants of dilapidated, long-abandoned structures from a complex of buildings on the north property and a collapsed residence on the south property. Other miscellaneous debris remain from agriculture uses (discarded and/or broken irrigation piping, scrap metal), recreational use (e.g., abandoned rowboat, illegal duck blinds), and debris brought into the site during times when levees failed and the site was flooded.

Removal of these materials from the Proposed Project site would require a combination of bulldozers, excavators, and wheel loaders. These efforts would require access to the site interior, which would occur following dewatering. All excess and/or unusable debris would be loaded into dump trucks for removal and proper disposal off-site, or ground and chipped for incorporation into fill areas on-site, as appropriate.

Following site dewatering and prior to Proposed Project construction, the transmission tower on the north property (Figure 2.1-2) and the wooden poles and downed power lines (Figure 2.2-3) would be removed.

5. Excavate constructed channel network

The purpose of this restoration activity would be to provide a network of tidal channels within the restored site. Excavated tidal channels would serve three functions. First, within the emergent marsh areas they would provide open-water-edge habitats. Second, they would provide hydraulic connectivity and transport pathways within the restored site. Third, as the restoration-site rebuilds its elevation through the natural processes of sedimentation and plant matter accumulation (aggradation), these channels would become more geomorphologically distinct and serve as the “template” for the continued evolution of a tidal channel network on the site.

Based on preliminary design calculations, the channels would be excavated in the site interior to have approximate invert elevations ranging from -3 to -4 ft NAVD 88, invert widths of 45 to 90 ft, and side slopes of 2.5:1 (Figure 2.2-5).

Channel segments connecting to breaches would have gradual longitudinal slopes. Invert widths of these connecting channel segments would narrow from the widths of the breach inverts to the widths of the constructed channel inverts at a uniform angle, over the length of the connecting segment.

For the Proposed Project, the total excavation volume for the constructed channel network is shown in Table 2.2-3. Suitable material excavated from the site would be re-used on-site. Construction of the channel network would be accomplished using a combination of excavators, bulldozers, and wheel loaders.

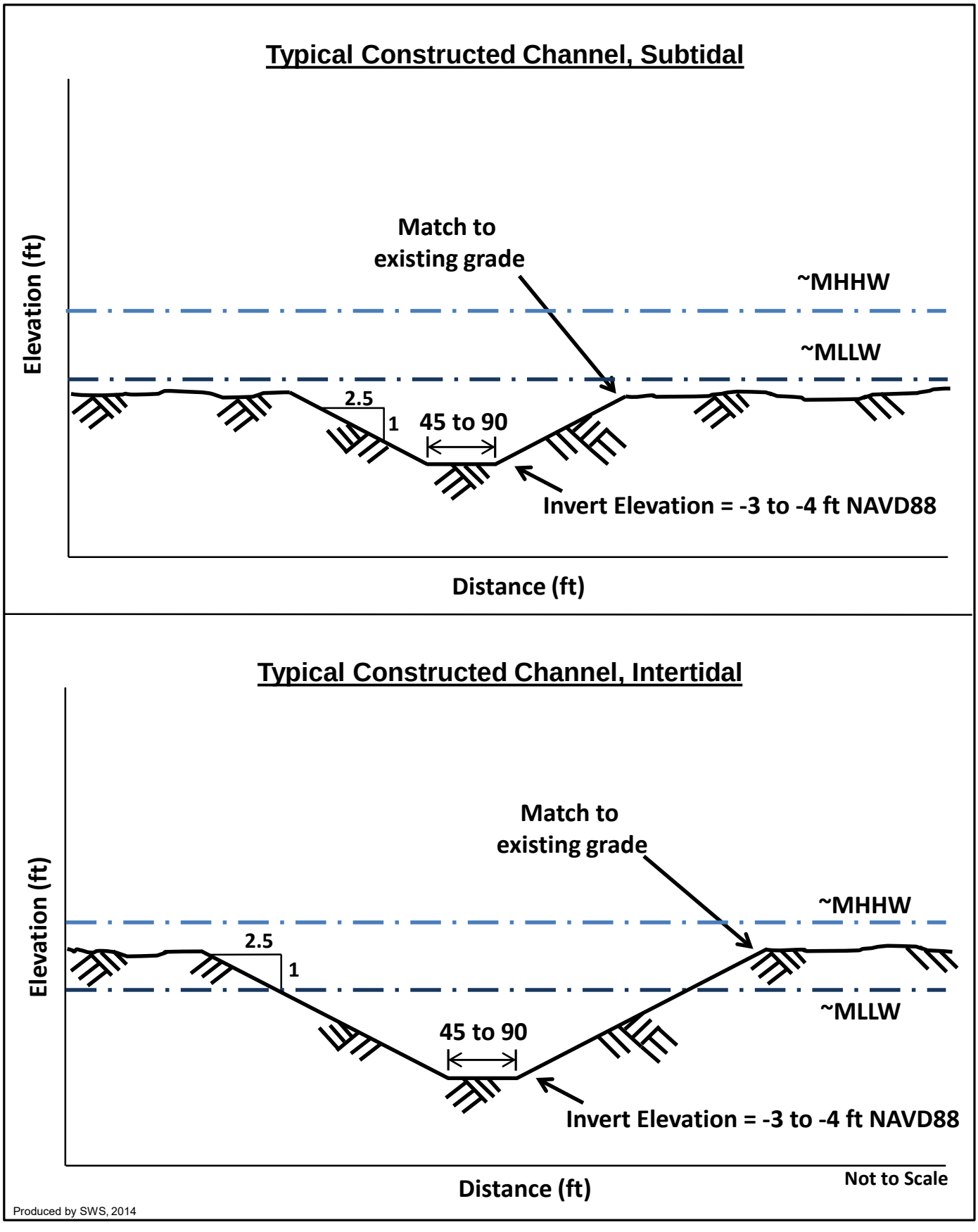


Figure 2.2-5

Typical Constructed Channel Cross Sections

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

6. Block or fill remnant agricultural ditches

The purpose of this restoration activity would be to close-off sections of remnant agricultural ditches that would not be incorporated into the constructed channel network, so as to prevent flow capture and consequent hydraulic short circuiting.

The constructed channel network would cross several remnant agricultural ditches. This restoration activity would involve re-using soils excavated on-site to block or completely fill certain remnant agricultural ditches. At the intersection of constructed channels in some of the larger of these ditches, fill soils would be placed, up to the elevation of the surrounding subsided land surface. The lengths of these 'ditch blocks' would vary, based on the sizes and positions (intersecting angles) of the individual remnant agricultural ditches at such intersecting locations, relative to the flow velocities that can create scour.

Ditch blocks would be constructed by placing fill generated by excavation of the constructed channel network into portions of the remnant agricultural ditches and compacting the fill to levels sufficient to minimize scour potential. Construction of these features would be accomplished using a combination of excavators, bulldozers, compactors, and wheel loaders. The estimated total fill volume that would be placed in creating these site features is shown in Table 2.2-3.

7. Construct interior topographic features

The purpose of this non-structural restoration feature would be to create small patches of higher elevation intertidal habitat within the Prospect Island interior, in order to benefit marsh development and support a greater diversity of wildlife species that may use the restored site.

Interior topographic features would be created using previously excavated materials. The mounds would be built up to approximately MHW to MHHW elevation (6–6.5 ft NAVD 88), with side slopes of approximately 5:1 to 10:1, and would be compacted only to the extent that would occur as a result of the use of construction equipment in placing and grading soils (i.e., levels of compaction would be incidental rather than engineered). The estimated total volume placed for creation of these features is shown in Table 2.2-3.

8. Construct eastern toe berm

The Prospect Island Miner Slough levee runs for approximately 27,600 ft (5.2 mi) along Miner Slough. The Prospect Island levees are not part of the SRFCP and do not meet Federal Emergency Management Agency (FEMA) Hazard Mitigation

Plan guidance, nor are they in compliance with the USACE PL84-99 standard (DWR 2012b). Under the Proposed Project, large portions of the Proposed Project site interior would become permanent, open-water areas, with depths of up to 9 ft at high tides, and greater during winter high flow events. Therefore, levee slopes not containing rooted woody vegetation could be subject to wind-wave action leading to potential erosion of the levee slopes. The purpose of this non-structural berm along portions of the interior of the Miner Slough levee would be to protect these areas from potential wind-wave erosion by supporting colonization of emergent vegetation and valley/foothill riparian habitat at appropriate intertidal elevations.

As part of the Proposed Project and prior to any substantial work, potential soils re-use locations along the eastern toe berm would be tested for geotechnical properties. The eastern toe berm would be constructed at an approximate 20:1 slope from elevation 9 ft NAVD 88 down to the approximate MHHW elevation (6.5 ft NAVD 88), and at an approximate 10:1 slope from MHHW down to existing grade (see Figure 2.2-6). Exact dimensions would be determined based on quantities of materials available to construct this feature. The estimated total volume placed for creation of this feature is shown in Table 2.2-3. Construction would consist of the following actions prior to levee breaching:

a. Clearing of areas within the footprint of the toe berm.
b. Placing geotextile fabric to help maintain slope stability, as determined in final design engineering analyses.
c. Transporting soils excavated during channel construction to placement locations within the toe berm footprint.
d. Grading of excavated soils to form the eastern toe berm. Compaction requirements for geotechnical stability and finish grades would be determined during final design.
e. Erosion control by hydro-seeding of native grass species, as well as limited planting of native riparian vegetation, at elevations along the eastern toe berm that would be above high tide following tidal restoration (see 13 below).
f. Pre-breach maintenance and water management as needed to promote Proposed Project objectives.

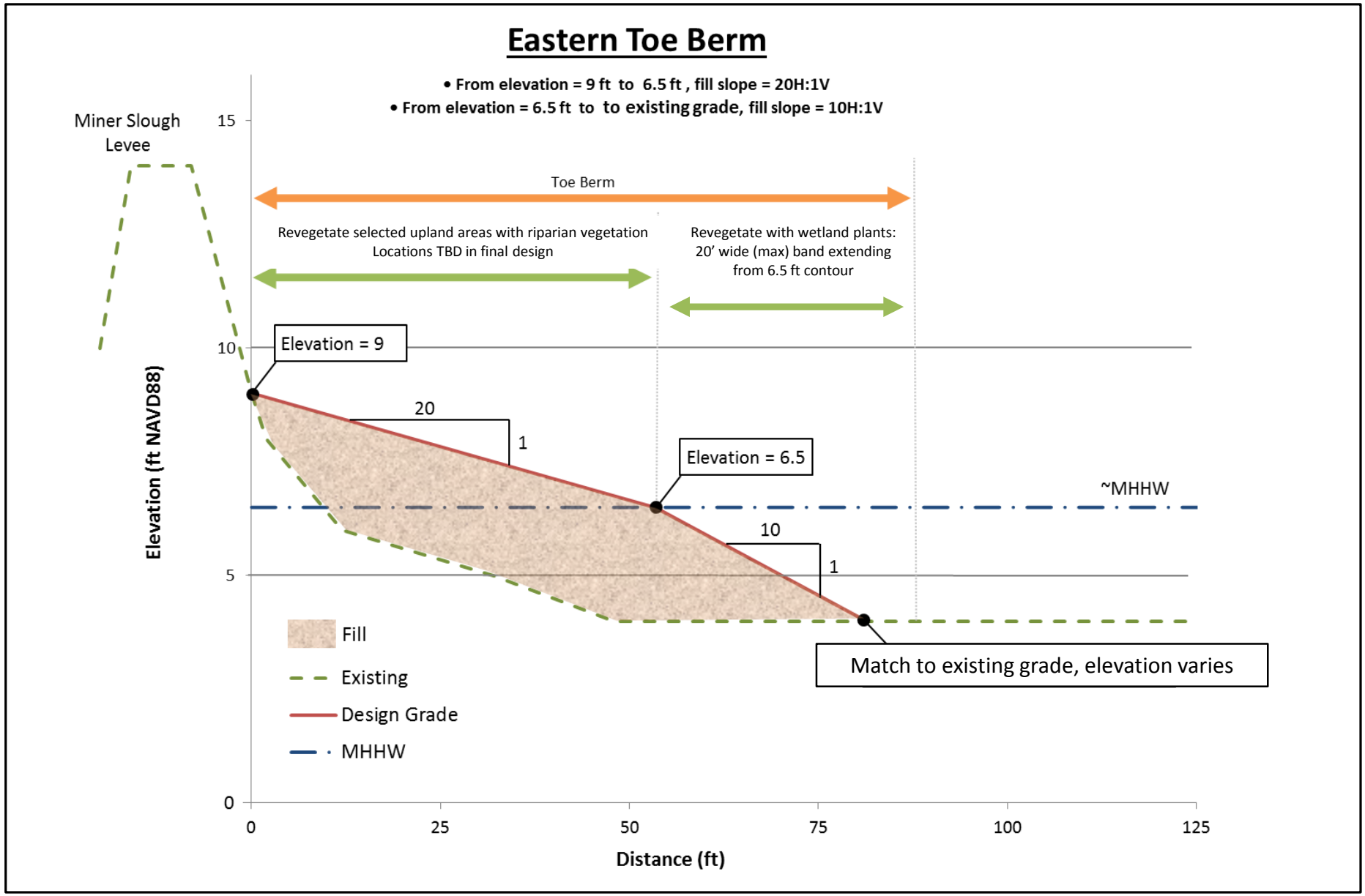


Figure 2.2-6

Eastern Toe Berm Typical Cross Section

9. Construct eastern intertidal bench

The central portion of the Proposed Project site is comprised of open-water areas at subtidal elevations. The purpose of this non-structural intertidal bench would be to provide appropriate elevations for colonization of emergent vegetation and thereby protect the Prospect Island – Miner Slough levee from potential wind-wave erosion. Creation of this feature would involve re-use of excavated soils to construct a wide, earthen bench along the interior side of the eastern levee, to intertidal elevations, in areas where existing interior elevations adjacent to the levee are subtidal. These conditions are found from the internal cross-levee northward approximately 1 mi (Figure 2.2-2).

The bench would have a slope of approximately 10:1 from elevation 6.5 ft NAVD 88 (MHHW) to 3.5 ft NAVD 88. The slope would then decrease to 280:1 from elevation 3.5 ft NAVD 88 to 2.1 ft NAVD 88 (roughly MLLW), and at 5:1 from 2.1 ft NAVD 88 until the bench edge elevation reaches existing grade (Figure 2.2-7). The estimated total volume placed for creation of this feature is shown in Table 2.2-3. Exact dimensions would be determined based on quantities of materials available to construct this feature. Construction would consist of the following activities, which would be implemented prior to restoring tidal action:

a. Clearing of areas within the footprint of the intertidal bench.
b. Placing geotextile fabric near the bench toe transition to existing grade, to help maintain slope stability, as determined in final design engineering analyses.
c. Transporting soils excavated during channel network construction to placement locations within the intertidal bench footprint.
d. Grading of soils. Compaction requirements for geotechnical stability and finish grades would be determined during final design.
e. Native wetland vegetation may be planted in areas that would form open-water edge habitat following breaching (see point 13 *Planting and revegetation* below).
f. Maintenance and water management as needed to promote Proposed Project objectives.

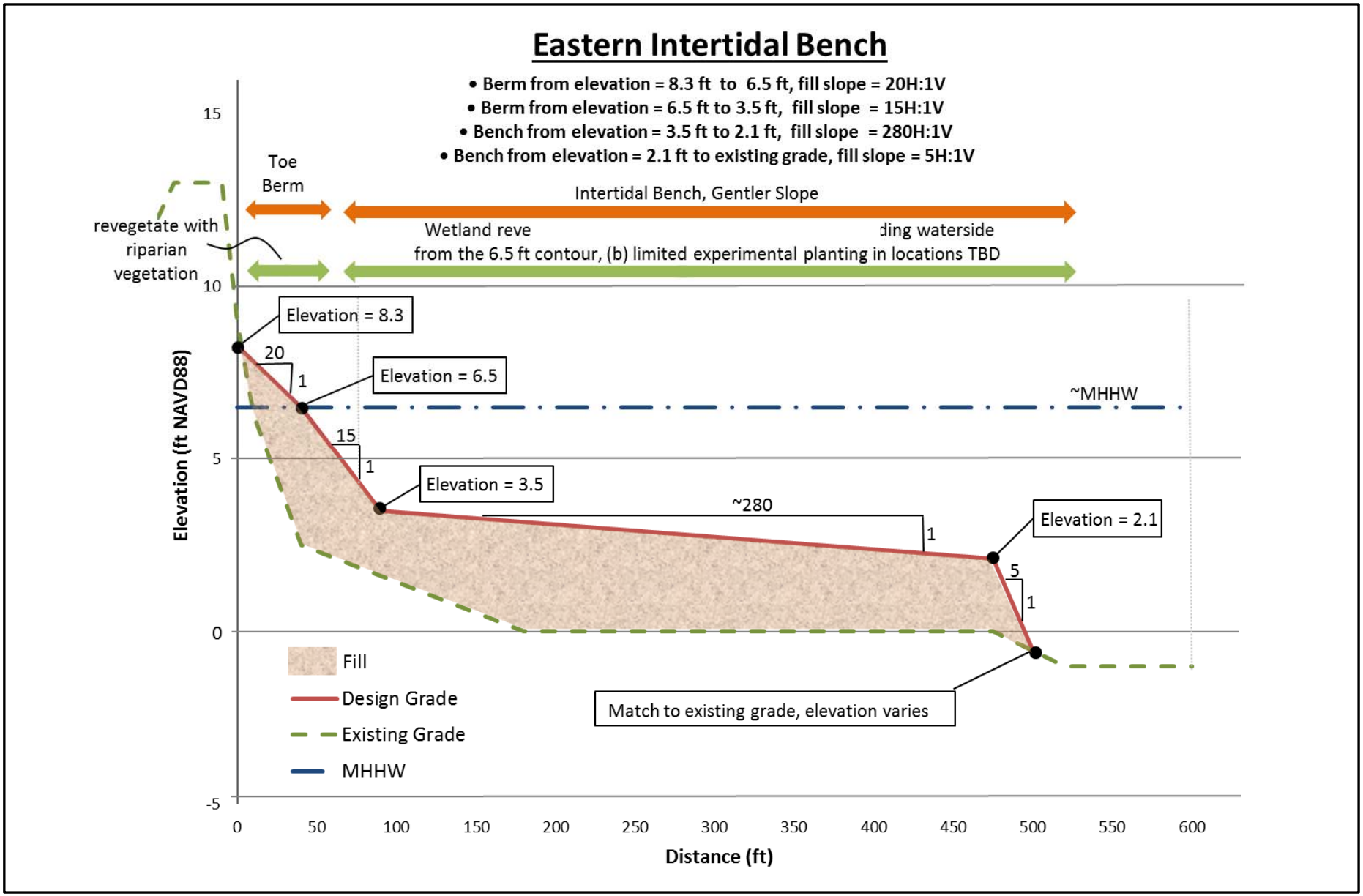


Figure 2.2-7

Eastern Intertidal Bench Typical Cross Section

10. Excavate internal cross-levee

The purpose of this restoration activity would be to provide hydraulic connection between the north and south properties following breaching of the Miner Slough levee.

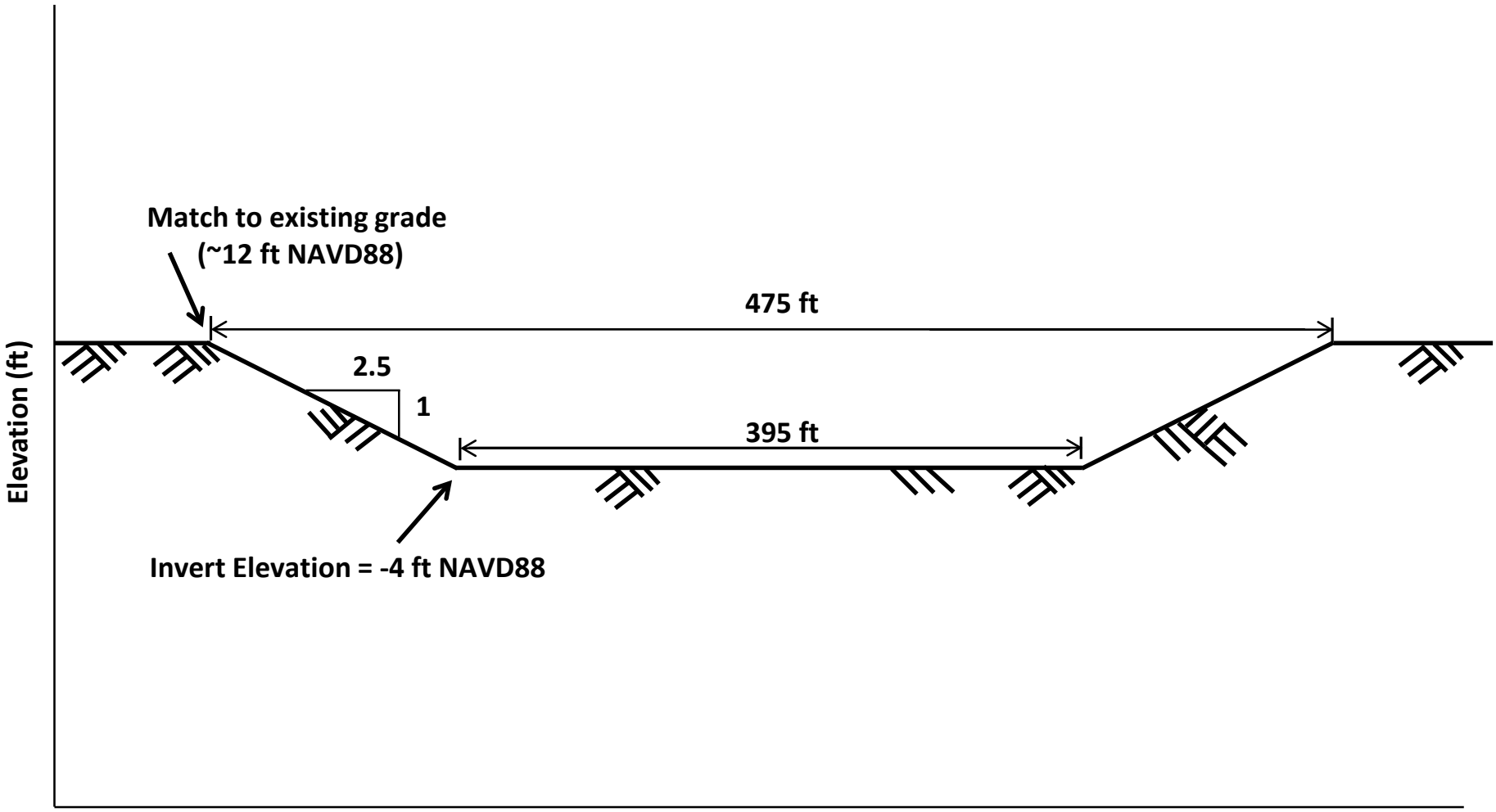
As part of the Proposed Project and prior to any substantial work, planned locations for soil excavation were sampled and tested for chemical and geotechnical properties to determine whether excavated soils would be suitable for beneficial reuse in aquatic and upland areas. Chemical testing of these soils included CAM 17 metals, percent solids, total recoverable petroleum hydrocarbons (TRPH), as well as organochlorine and organophosphate pesticides (Kinnetic Laboratories 2016a,b).

The internal cross-levee would be excavated to provide an opening with cross sectional area matching that of the south breach. The invert elevation would be at -4 ft NAVD 88, to match that of the constructed channel network in the south property and the existing grade in the north property adjacent to the cross-levee. Invert width would be approximately 395 ft, with side slopes of approximately 2.5:1 (Figure 2.2-8).

Excavated soils would be used to fill the existing borrow ditch that runs along the north side of the internal cross-levee to elevation -3 ft NAVD 88 at the notch location. Fill in the borrow ditch would extend at least 100 ft to either side of the cross-levee to create ditch blocks.

This activity would be accomplished using excavators. Excavators and/or bulldozers would place and grade a portion of the excavated soils into the borrow ditch. Excavation volumes are shown in Table 2.2-3.

Internal Cross Levee Excavation



Produced by SWS 2014

Figure 2.2-8
Internal Cross Levee Excavation Cross Section

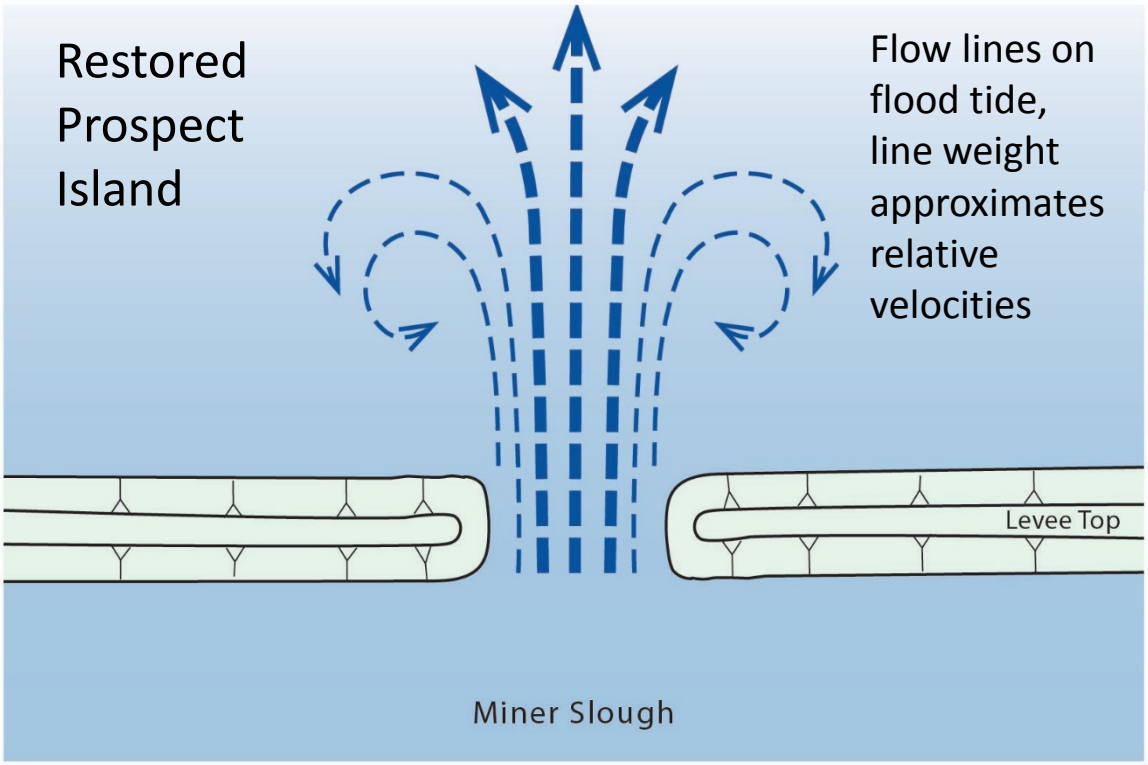
11. Construct breach velocity dissipation features

The purpose of constructing breach velocity dissipation features on the interior ends of the levee breaches is to test an experimental design intended to minimize strong velocity gradients where predatory fishes are known to congregate and prey successfully on smaller fishes.

Hydrodynamic modeling conducted for the Proposed Project indicates that the proposed levee breaches would create velocity gradients and associated eddies on the internal sides of these breaches. Although no direct studies of higher predation rates effects within low velocity eddies adjacent to levee breaches have been identified, anecdotal observation of fish congregations within these areas suggests that predatory fish species preferentially seek out these habitats for foraging. USFWS and USBR monitoring of fish habitat use during gate operations in the 1990s at the Red Bluff Diversion Dam on the Sacramento River showed increased presence of Sacramento Pikeminnow in turbulent areas, with Striped Bass habitat use concentrated along the turbulent eddy line adjacent to the gate structure (Tucker et al. 2003). In studies of Smallmouth Bass, velocity refugia afforded by structures was hypothesized to allow fish to forage in high velocity areas that would otherwise be energetically unfavorable (Rankin 1986). In addition, anglers often congregate at levee breaches and other locations that offer these strong velocity gradients, as well-known locations for successful fishing.

Prior to breaching the levee, gradually sloping grade transitions would be constructed at the northernmost breach location. This would be accomplished by placing fill excavated in construction of the channel network onto the interior side of the levee, and grading to the appropriate design dimensions (Figure 2.2-9). The breach interior would slope downward longitudinally along the banks of the constructed channel inside the breach and laterally along the interior toe of the levee. Construction of these features would utilize a combination of excavators and bulldozers. Compaction requirements would be determined during final design. Revegetation measures (if any) would be determined during final design and, if employed, would be similar to those described above for the eastern toe berm.

Levee Breach without Breach Transition



Levee Breach with Breach Transition

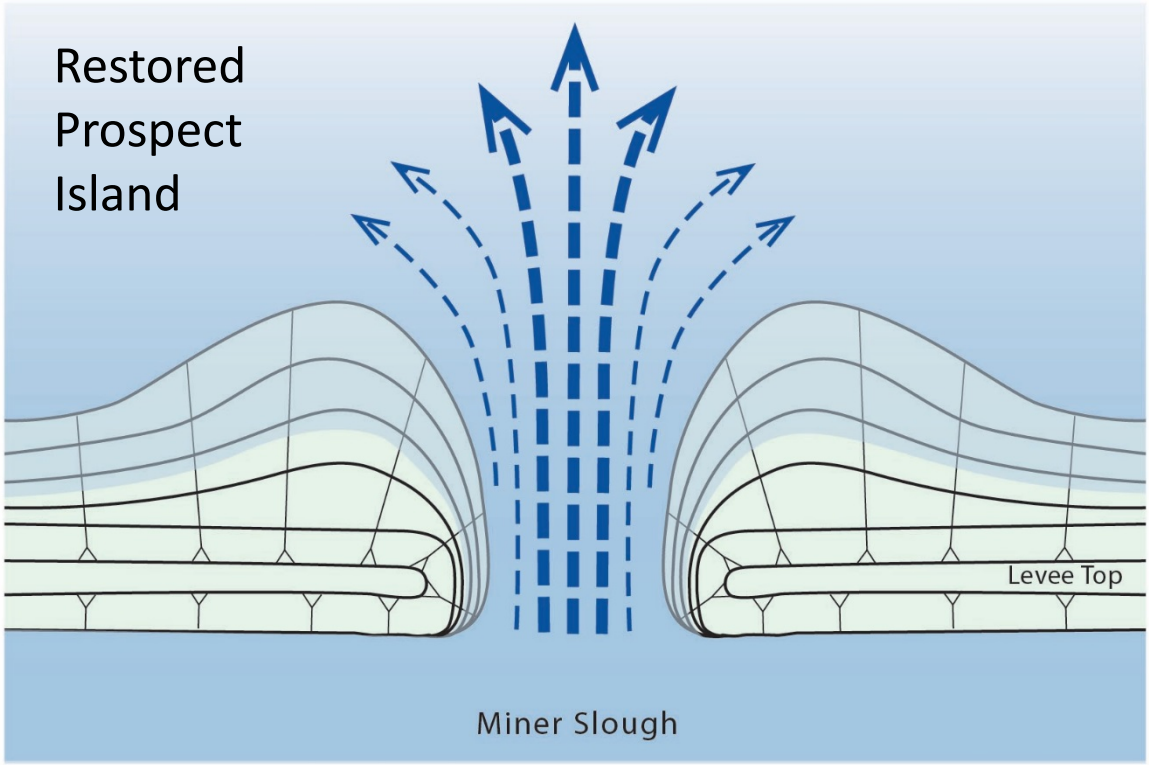


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Figure 2.2-9

Breach Velocity Dissipation Feature

12. Dredge Miner Slough spur channel

The purpose of this restoration activity is to ensure that unimpeded tidal exchange occurs through the southern breach to Miner Slough.

This restoration feature would involve dredging of the spur channel between Miner Slough and the south breach location. Hydraulic modeling results show that the current geometry of the Miner Sough spur channel is undersized for the anticipated volume of tidal exchange between Miner Slough and the restored Proposed Project site, and would, therefore, result in tidal dampening within the Proposed Project site.

Dredging would occur after the south property levee is repaired and prior to breaching the Proposed Project site. Current depths in the spur channel range from -5 to -8 ft NAVD 88. Preliminary design would lower the channel invert elevation to -16 ft NAVD 88. The channel width would remain unchanged. Channel side slopes would vary between 2:1 and 1.5:1. The estimated volume of material to be dredged from the spur channel is shown in Table 2.2-3.

Mechanical dredging of the Miner Slough spur channel would be accomplished by clamshell bucket with appropriate turbidity control measures (e.g., silt curtains) employed during dredge operations at the entrance to the spur channel. All excavated materials would be transported by local barge to the designated placement area within the south property (Figure 2.2-2) or may be beneficially re-used at one or more locations within the Proposed Project site. Because mechanically dredged sediments typically have a solids content comparable to that of *in situ* sediments, it is expected that evaporative drying during handling and after placement would be sufficient for dewatering with no decant or drainage water discharge to the exterior waterways surrounding the Proposed Project site.

As noted in Section 4 *Alternatives*, the design configurations for Alternatives 2 and 3 would not require dredging of the Miner Slough spur channel.

13. Planting and revegetation

Native wetland vegetation may be planted in areas that would form open-water edge habitat following breaching of the Miner Slough levee (i.e., highly energetic areas subject to undampened wind-wave energy). This includes areas up to a maximum width of 20 ft along exposed portions of the eastern toe berm (Figure 2.2-6) as well as the eastern intertidal bench (Figure 2.2-7). In addition, a larger experimental plot of wetland vegetation would be planted along the intertidal

bench to provide information on the relative success of planting methods and to compare vegetation establishment between planted and unplanted areas. The remainder of the intertidal bench would be left unplanted to allow for natural colonization. Plot locations, dimensions, and planting methods would be determined during final design.

Following construction, hydro-seeding of native grass species will be used for erosion control of bare soil along interior levee slopes. In addition, planting of native riparian vegetation, containing both canopy and understory trees and shrubs, would occur along upper slopes of the eastern toe berm, within the upland staging area to the north of the Proposed Project site, as well as along the interior of the DWSC levee. Specific locations and extents of riparian revegetation zones, plant species composition, planting methods, and initial irrigation requirements would be determined during final design.

14. Remove access roads and ramps

Following construction of the Proposed project, materials used for the construction of temporary access road and ramps would be beneficially reused to the extent practicable (e.g., for re-surfacing levee roads, interior topographic features, intertidal bench, etc.). One to three access roads would be kept in place for future monitoring access.

15. Breach Miner Slough levee

The purpose of this restoration activity is to reconnect the Proposed Project site to tidal action and is the final step in the restoration construction process. This restoration activity would involve excavating two levee breaches to Miner Slough. One breach would be located in the north portion of Prospect Island, approximately 0.5 mi south of Arrowhead Harbor Marina. The second breach would be located in the south property, at the location of the formerly repaired breach connecting to the Miner Slough spur channel (Figure 2.2-2).

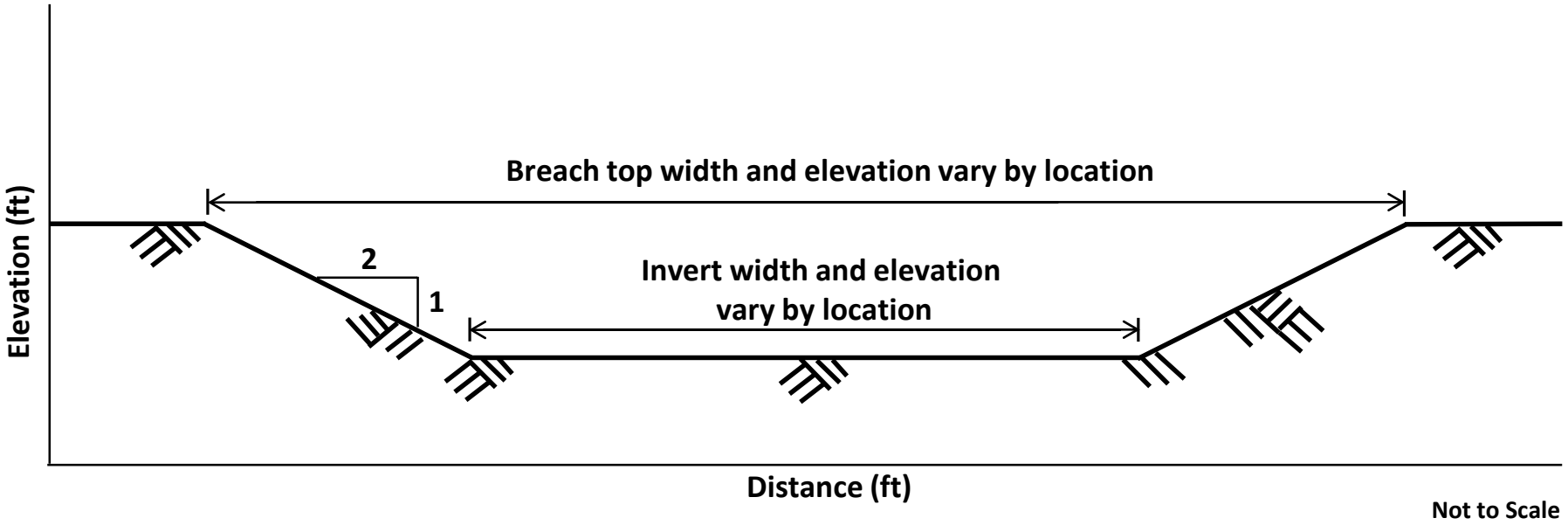
Levee breaching would be accomplished using excavators. The material excavated from the levee would be handled in one or more of the following ways: (1) directly placed within the site interior near the levee breach, (2) spread on the top or interior side slopes of the levee as reinforcement, (3) loaded into dump trucks and hauled to other areas of the Proposed Project site for re-use, (4) or loaded into dump trucks and hauled off-site. Materials excavated from portions of the levee that are above the high tide line would be readily moved and re-used within the site. Once excavation levels drop below the elevation of high tide and tidal waters may enter the site, placement of excavated soils would, for the most

part, be limited to areas in the immediate proximity of the breach or on the levee, or the soils would be removed from the site. Total excavation volumes for the breaches above and below MHHW are shown in Table 2.2-3.

Rock slope protection would be placed on the exposed levee ends of the north breach to provide protection from erosion (Figure 2.2-10). The rock slope protection would be imported using local barge and/or trucks, and would be placed from the levee crest down to the base of the slope in the water.

Together, excavation of the channel network, dredging of Miner Slough spur channel, construction of the levee toe berm and the intertidal bench, interior topographic features, and levee breaches, would generate approximately 8,400 cy of compacted fill material, 12,400 cy of aggregate base, 17,300 cy of rip-rap / rock (temporary pump platforms, stone armoring, and rock slope protection). Additionally, deliveries of sheetpile, geotextile fabric, and nursery planting materials would be imported from off-site locations for the construction of access roads, ramps, and interior staging area. Over 500,000 cy of soil would be excavated and re-used on-site.

Miner Slough Levee Breach(es)



Location	Top Width (ft)	Top Elevation (ft NAVD 88)	Invert Width (ft)	Invert Elevation (ft NAVD 88)
North property	610	16	510	-4
South property	477	9 to 16	394	-4

Figure 2.2-10
Miner Slough Levee Breach(es) Cross Section

Construction schedule for the Proposed Project

The purposes of providing an implementation schedule for the Proposed Project are to determine the time frames during which construction and post-construction activities would take place, for CEQA evaluation, and to optimize sequencing and seasonality of construction activities to allow for the shortest viable construction duration. Table 2.2-6 provides the estimated construction implementation schedule. It is anticipated that Year 1 will occur in 2020, and Year 3 will occur in 2022.

Table 2.2-6. Estimated Construction Implementation Timing

Restoration Activities	Start Date	End Date
Construction [1-7]	April 16 (Year 1)	October 31 (Year 3)
Terrestrial invasive spp. control[7]	April 16 (Year 1)	October 31 (Year 1)
Dredge Miner Slough spur channel[6]	July 1 (Year 1)	October 31 (Year 2)
South property levee repair[6]	July (Year 1)	September (Year 1)
Planting and revegetation [3]	October (Year 2)	October (Year 3)
Miner Slough levee breaches[6]	September (Year 3)	October (Year 3)

[1] Includes mobilization, site preparation, dewatering, aquatic invasive plant species control, clearing, excavation, fill, construction of the eastern toe berm, intertidal bench, and breach velocity dissipation features, and demobilization.

[2] Work will occur within the Central Valley Flood Protection Board (CVFPB) work window (April 16 – October 31), unless work outside of this period (November 1 – April 15) is subject to approval of time variance requests.

[3] Ground disturbing activities in terrestrial habitats are limited to the period May 1 to October 1 for the protection of Giant Garter snakes.

[4] If Western Red Bats are present during pre-constructions surveys, removal of mature trees, snags, and remnant structures will be limited to September to April to avoid their maternity season.

[5] Nesting bird surveys are required 14 days prior to construction, with non-disturbance buffers or monitoring of active nests established for birds found. Trimming and removal of trees is allowed from August 15 to February 15.

[6] Dredging, underwater excavation, and other in-water work in tidal waters is limited to July 1 to October 31 for the protection of aquatic species.

[7] Timing of control technique varies by species (Table 2.2-5).

Post construction-site maintenance, monitoring, and adaptive management activities

Following construction of the Proposed Project, the DWSC levee would continue to be maintained as a Navigation Project Levee, and the Port would continue to be responsible for all necessary inspection and maintenance activities.

Monitoring following construction would focus on three general areas: (1) evaluating how the site is meeting the overall Proposed Project objectives, (2) evaluating the need for any corrective measures to address potential problems, and (3) gathering scientific information for testing tidal restoration hypotheses to contribute to regional adaptive management science. Monitoring and management plans will include a Mitigation, Monitoring, and Reporting Program (MMRP); Adaptive Management and Monitoring Plan (AMMP); and a Revegetation Strategy. There is also an existing Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary (IEP TWM PWT 2017). While there will be overlap and linkages between the monitoring and management plans, each of these plans has a different purpose, as described in General Response H of **Appendix D**.

3 ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION MEASURES

ENVIRONMENTAL BASLINE AND SIGNIFICANCE DETERMINATIONS

As explained in Section 1 *[Introduction] Public Involvement and Environmental Issues Raised*, the NOP was issued on May 17, 2013. Per the CEQA Guidelines (Section 15125(a)), the physical conditions at the time the NOP was published are described in the *environmental setting* sections below for each resource area. This constitutes the baseline physical conditions from which DWR determines whether there are one or more significant impacts for each resource area.

CEQA Guidelines Section 15126 requires a discussion of the: significant environmental effects of the Proposed Project, significant environmental effects which cannot be avoided if the Proposed Project is implemented, and significant irreversible environmental changes which would be involved if the Proposed Project is implemented. CEQA Guidelines Section 15382 defines a significant effect as a "substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project…" Towards achieving these requirements and determining significant impacts, DWR uses the following classifications for significance determinations:

- *Beneficial* – effect on the resource is positive.
- *No impact* – there is no alteration to the resource.
- *Less than significant* – potential effect either would not cause any adverse alterations to existing conditions, or would cause alterations which would not result in a significant adverse effect.
- *Less than significant with mitigation* – significant or potentially significant adverse effect would be eliminated or reduced to an effect that is not significant with implementation of an identified mitigation measure(s).
- *Significant and unavoidable* – effect would be adverse and substantial, or potentially substantial, and cannot be mitigated to less than significant.

In setting criteria for evaluating significance, this EIR relies on scientific and factual data, consideration of relevant local, regional and state standards, and the questions presented in Appendix G *Environmental Checklist* of the CEQA Guidelines.

BIOPHYSICAL RESOURCES

3.1 Hydrology (Surface and Groundwater)

3.1.1 Setting

This section describes the existing hydrologic conditions on Prospect Island and in the general vicinity, and assesses potential Proposed Project-related impacts and associated mitigation measures.

Prospect Island is located in the northern Sacramento-San Joaquin River Delta (Delta) at the south-eastern edge of the Cache Slough Complex (CSC) (Figure 2.1-1). It is part of the Sacramento River Flood Control Project (SRFCP) and is within the boundaries of the Yolo Bypass Floodway (Yolo Bypass). The location of Prospect Island at the hydrological intersection of the CSC and the Sacramento River system results in a complex hydrological setting that exhibits distinct conditions, processes, and areas of effect depending on the time of year.

Environmental setting

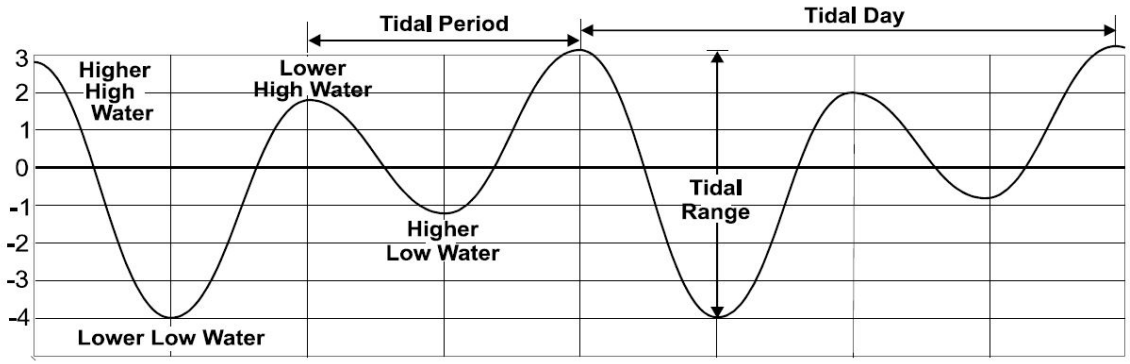
Prospect Island's hydrologic setting is presented in relation to geographic scale, including a general description of Delta hydrology to provide regional context, a more detailed description of conditions within the northern Delta and the CSC, and a summary of local hydrologic conditions in the vicinity of and within Prospect Island.

Sacramento-San Joaquin River Delta

The Sacramento-San Joaquin River Delta (Delta) is an expansive inland river delta and estuary that formed at the western edge of the Central Valley by the confluence of the Sacramento and San Joaquin rivers. The Delta receives run-off from approximately 40% of the land area of California, and approximately 50% of California's total stream flow (Strange 2008). Surface water flows in the Delta are extremely complex and are defined by river inflows, tides, flood conveyance, and water supply operations.

Dams in the Sacramento and San Joaquin river watersheds upstream of the Delta capture water and reduce downstream river flows during approximately November through April. During May through October, water is released for agricultural and municipal water supply. This managed hydrologic regime directly contrasts that of the historical unimpaired regime in the Delta, which exhibited high winter and spring flows (from rainfall and snow melt) and low summer and fall flows (during the dry season).

Tides, or the rise and fall of sea levels due to gravitational forces exerted by the moon, sun, and the rotation of the Earth, influence the Delta. The Delta experiences a mixed, semi-diurnal tidal cycle, which corresponds to two unequal tides each day including higher-high, high, low, and lower-low water levels (Figure 3.1-1). The latter are standard terms called *tidal datums*, which are used to describe the elevations of tides relative to a geodetic (earth surface) reference and are updated approximately every 25 years to adjust for long-term changes in mean sea level.



Source: NOAA 2003.

Figure 3.1-1. Diagram of Mixed, Semi-Diurnal Tides of the San Francisco Estuary

Regional tides diminish in amplitude and rise in mean level from the Golden Gate Bridge into the Delta (DWR 2004). This pattern reflects absorption of tidal energy as the tide wave moves inland and meets incoming river flows.

Numerous water supply withdrawals occur from the Delta, including exports for the State Water Project (SWP) and Central Valley Project (CVP), diversions to the Contra Costa Water District (CCWD), and local agricultural diversions. Flows in the Delta also are managed via upstream reservoir releases and in-channel control structures to meet water quality objectives to support municipal, industrial, agricultural, and fish and wildlife needs. One of these structures, the Delta Cross Channel (DCC), is located on the Sacramento River approximately 30 mi downstream of Sacramento, in Walnut Grove (USBR 2013). The DCC diverts water from the Sacramento River into a branch of the Mokelumne River to manage salinity intrusion into the Delta, dilute local water pollution, and improve the quality of irrigation water supplies in the Central Valley (USBR 2013). The South Delta Temporary Barriers Project is another set of in-channel structures operated by the California Department of Water Resources (DWR) in four locations in the South Delta: Head of Old River, Old River at Tracy, Middle River, and Grant Line Canal (DWR 2015). Temporary rock-fill barriers are seasonally

placed in channels to protect migratory fish and provide adequate agricultural water supply.

Projected mean sea level rise

The California Climate Change Center's *Third Assessment on Climate Change* explores a regionally focused range of potential mean sea level rise scenarios and associated impacts in the San Francisco Bay area based on a set of climate scenarios prepared for the California Energy Commission's Public Interest Energy Research Program (Ekstrom and Moser 2012). Over the past century, mean sea level at the San Francisco Tide Station (CA Station ID: 9414290) has risen approximately 8 inches (in) (0.7 ft), which is consistent with global mean sea level rise (Hanak et al. 2011). Under the medium to medium-high emissions scenarios, mean sea level is projected to increase by 3.3 to 4.6 ft by the year 2100 (Ekstrom and Moser 2012). Similar sea level rise projections (1.38 to 5.48 ft) are reported by the Coastal and Ocean Working Group of the California Climate Action Team (2013) for the coastline south of Cape Mendocino, which are in turn based on findings in the National Research Council (2012) report on *Sea Level Rise for the Coasts of California, Oregon, and Washington*. In a recent review of sea level rise projections, Griggs et al. (2017) estimates that there is a 67% chance that mean sea level will increase by 1 ft to 3.4 ft (0.3 to 1 m).at the Golden Gate Bridge by 2100. Using a probabilistic approach, the *State of California Sea-Level Rise Guidance 2018 Update* recommends planning for 1.1 ft of sea level rise by 2050 as the upper end of the "Likely Range" for management projects that pose low risk or low consequences of flooding (CNRA and OPC 2018).

Cache Slough Complex

The CSC is a 53,000 ac region of low-lying land in the northwest portion of the Delta (Figure 2.1-1; Figure 3.1-2). A network of tidal sloughs surrounds the diked, subsided lands of the CSC, converging into the main stem of lower Cache Slough upstream of its confluence with the Sacramento River. Along the eastern edge of the CSC runs a segment of the Sacramento Deep Water Ship Channel (DWSC), a 30 ft deep navigation channel that extends from the confluence of the Sacramento and San Joaquin rivers to the Port of West Sacramento. Surface water flows in the sloughs surrounding the CSC and in the DWSC are primarily defined by tides, flood conveyance, and water supply operations.

Sacramento River Flood Control Project and the Yolo Bypass

The SRFCP addresses Sacramento Valley's basin-wide flooding and drainage problems and was completed by local, state, and federal agencies in 1948. As

part of the SRFCP, levees were constructed and strengthened along the Sacramento River and the Yolo Basin, creating the Yolo Bypass. Levees were also constructed or strengthened along many of the tidal waterways in the CSC and the sloughs and channels east of Prospect Island, including along the eastern bank of Miner Slough adjacent to Prospect Island. Miner Slough conveys flows from the Sacramento River, via Sutter Slough, to Cache Slough (Figure 2.1-1). The design flow of Miner Slough, as part of the SRFCP, is 10,000 cubic feet per second (cfs) (USACE 2006), which falls between a 1.5- and 2-year recurrence-interval flow. Water surface elevation relating to this flow varies by tidal conditions (cbec and WWR 2012).

The Yolo Bypass provides flood protection to the City of Sacramento and other nearby cities and farmland by capturing and diverting up to 455,000 cfs of floodwaters from the Sacramento River, through the Fremont and Sacramento weirs (CDFG and Yolo Basin Foundation 2008). The Yolo Bypass was constructed in 1924 and has undergone one major modification since that time—the completion of the DWSC in 1963 (CDFG and Yolo Basin Foundation 2008), which separated Prospect Island and Little Holland East from the main body of the Bypass. Prospect Island was included in the SRFCP with “restricted height” levee requirements in order to allow it to function as a high-stage overflow basin. A restricted height levee is a levee whose maximum elevation is limited so that water may overtop the levee during storm events, converting the land usually protected by the levee into a flood storage basin. This function remains today.

Agricultural and municipal diversions and drains

A large number of agricultural diversions and drains are located throughout the CSC. During summer, irrigation return flows and groundwater seepage from the surrounding sloughs and channels collects in the drains in subsided agricultural islands; it is then pumped back to the surrounding sloughs and channels. In the winter, the agricultural drains collect and pump primarily stormwater run-off from the islands to the surrounding sloughs and channels.

The North Bay Aqueduct (NBA) is part of the SWP. It draws water from the Barker Slough Pumping Plant, at the western edge of the CSC. Barker Slough is a dead-end tidal slough except during winter rain events, when water that is normally impounded in Campbell Lake, which captures a small portion of the total annual runoff from Barker Creek watershed, is released to Barker Creek and discharges to Barker Slough at the Barker Slough Pumping Plant Forebay. Both the Barker Slough Pumping Plant and the NBA are owned and operated by the DWR, and the Solano County Water Agency holds a contract for water deliveries. Diversions from the Barker Slough Pumping Plant provide drinking water to the

cities of American Canyon, Benicia, Calistoga, Fairfield, Napa, Vacaville, Vallejo, and Yountville, as well as to Travis Air Force Base. The design capacity of the aqueduct is 175 cfs; however, the maximum diversion capacity is currently 140 cfs. Typical mean monthly diversion rates from Barker Slough Pumping Plant range from a low of 10 cfs in the winter to a high of 120 cfs in the summer.

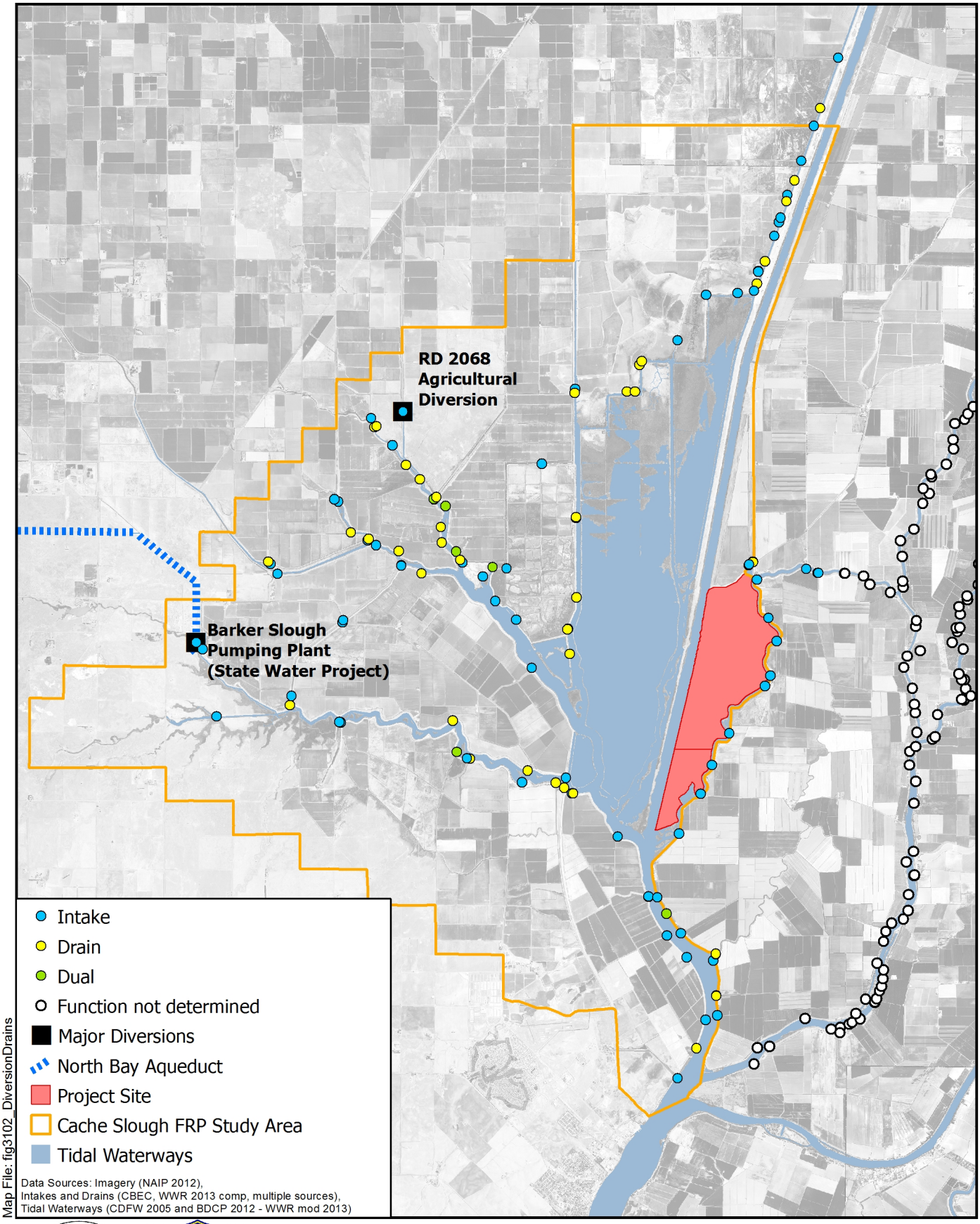


Figure 3.1-2
Diversions and Drains in the Project Vicinity

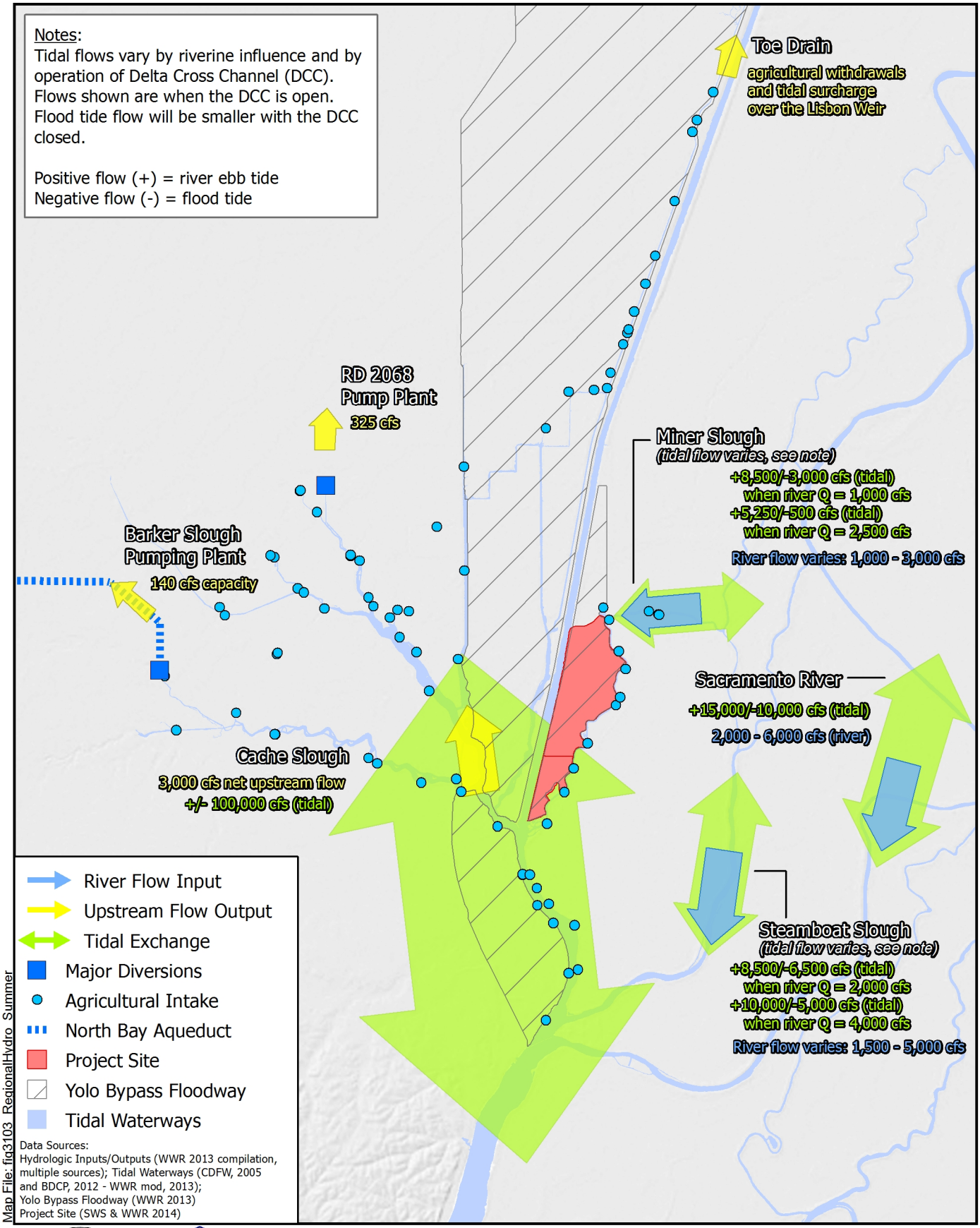
Seasonal patterns in surface water hydrology

Distinctly different hydrologic conditions and processes have been observed in the CSC during the summer (agricultural irrigation during the dry season) and winter (no irrigation, combined with the region's conveyance of storm and flood flows). These seasonal changes and conditions are discussed below to provide context for the assessment of potential impacts associated with flow and velocity changes under the Proposed Project. Flows expressed as positive values represent the "downstream" direction that equate to ebb tides, and negative values represent the "upstream" direction that equate to flood tides.

In the summer, CSC hydrology is influenced primarily by the tidal regime and agricultural and water supply diversions (Figure 3.1-3). The tidal exchange of the CSC (as measured at the U.S. Geological Survey [USGS] Cache Slough at Ryer Island station) is approximately ±100,000 cfs. Due to the numerous agricultural diversions within the CSC, the water supply diversion at the Barker Slough Pumping Plant, and Yolo Bypass diversions via the Lisbon Weir in the Toe Drain, the system can experience a net upstream flow of up to 3,000 cfs. Miner Slough, Steamboat Slough, and the Sacramento River all have a net downstream flow into the CSC in addition to their respective tidal exchanges. The Sacramento River has tidal exchange of +15,000/-10,000 cfs, with summer month river flows varying between 2,000 and 6,000 cfs. Miner Slough and Steamboat Slough have river flows varying between 1,000 and 3,000 cfs and 1,500 and 5,000 cfs, respectively. The tidal exchange varies with both river flow and DCC operation. In general, when river flow in Miner and Steamboat sloughs is higher (when the DCC is closed), the sloughs are river-dominated and the flood tide flow is lower. When the DCC is open and flows are being diverted from the sloughs to the Mokelumne River, the system is still river-dominated. For example, when the DCC is open and Miner Slough river flow is at 1,000 cfs, tidal exchange is +5,000/-3,000 cfs. When river flow increases to 2,500 cfs, tidal exchange becomes even more ebb (river) flow-dominated with +5,250/-500 cfs. In addition, during summer months, cross-sectional average velocity in Miner Slough peaks around 1.75 feet per second (fps).

In the winter, CSC hydrology is dominated by storm flows and large-scale flood control operations (Yolo Bypass, SRFCP) and pumped drainage from the diked agricultural lands (Figure 3.1-4). During non-storm events, winter flow in the CSC includes tidal exchanges of ±100,000 cfs in Cache Slough and flows in Miner Slough, Steamboat Slough, and the Sacramento River are similar to, but slightly larger than, summer flows. Cross-sectional average velocity in Miner Slough peaks around 4 fps during this time. During storm events, river flows dominate

Miner Slough, Steamboat Slough, and the Sacramento River, overwhelming the tidal exchange. These flows, combined with flow draining from the Yolo Bypass, can cause Cache Slough to become river-dominated. An example of the storm flow dominance can be seen in Figure 3.1-5. A mid-March 2011 storm event resulted in river flows in the Sacramento River, Steamboat Slough, and Miner Slough high enough to overwhelm the tidal exchange in these waterbodies. This storm also inundated the Yolo Bypass. The combination of these flows overwhelmed the normal ±100,000 cfs tidal exchange in Cache Slough, causing the system to be river-dominated with ebb flows ranging from 50,000 to 150,000 cfs and no flood tides observed.



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0 1 2 Mi

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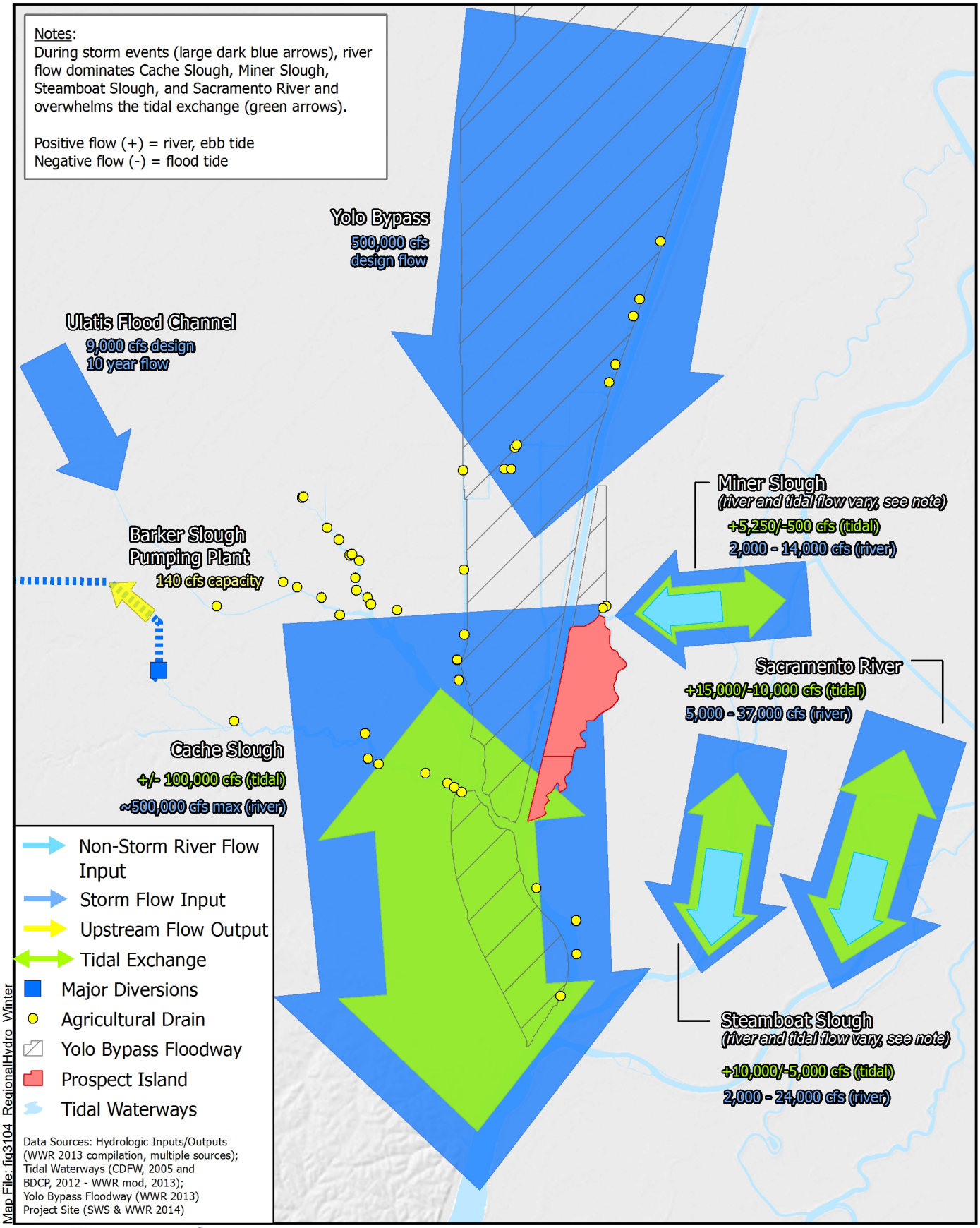
Figure 3.1-3
Regional Hydrology - Summer



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0 2.5 5 Km

Figure 3.1-4
Regional Hydrology - Winter

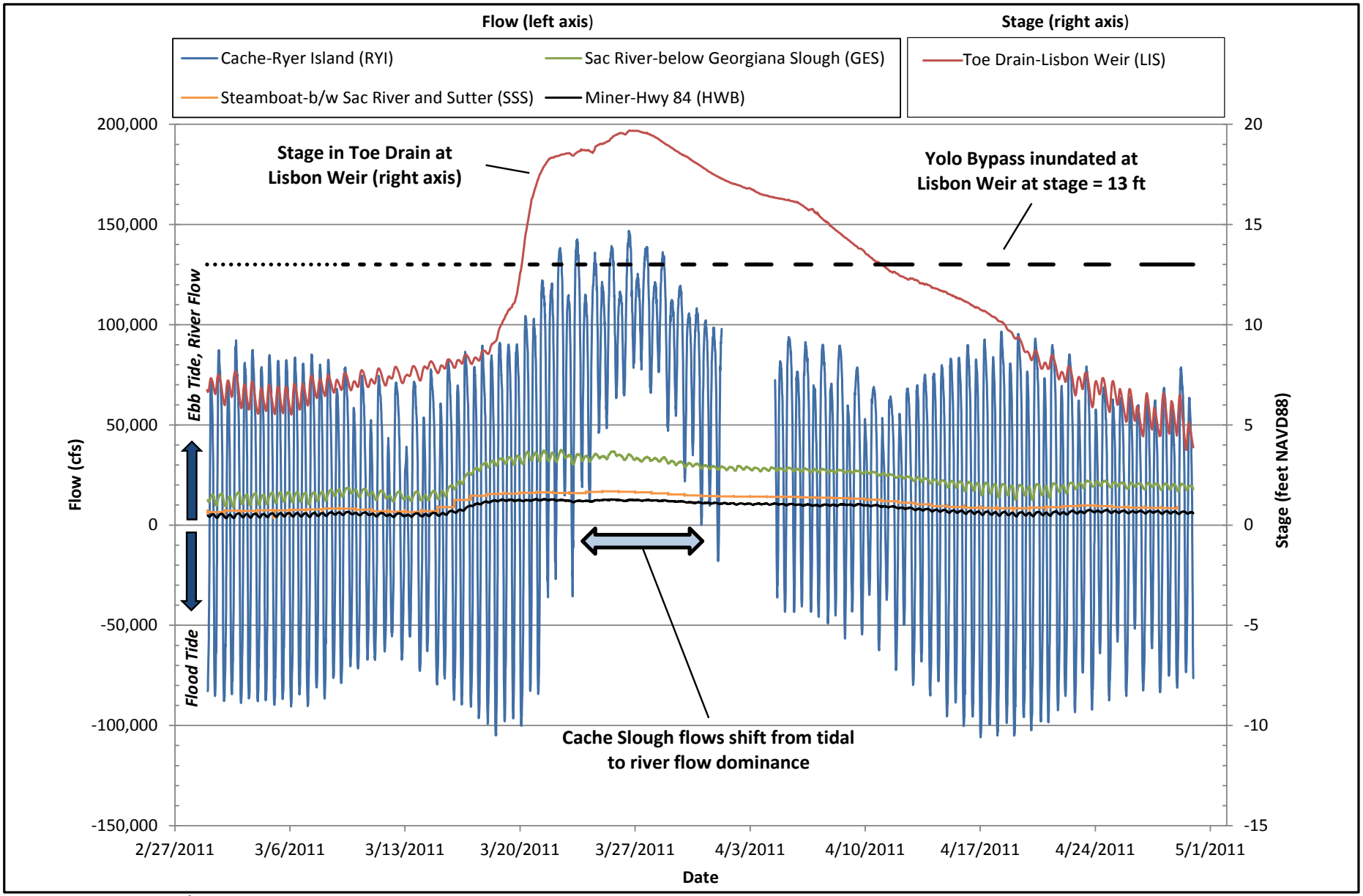


Figure 3.1-5
Comparison of Regional Flow Changes during March 2011 Storm Event

Regional groundwater

Prospect Island is situated within the southeastern portion of the Solano Subbasin of the Sacramento Valley Groundwater Basin (Basin Number 5-21.66) (DWR 2003; Figure 3.1-6). Primary waterways in and bordering the sub-basin include the Sacramento, Mokelumne and San Joaquin Rivers, the DWSC, and Putah Creek. In 1912, groundwater levels were measured by the USGS at what are now considered to be natural, predevelopment levels (Bryan 1923). At that time, the general direction of groundwater flow in the sub-basin was from northwest to southeast. Currently, the regional groundwater flow gradient is from west to east toward the lower elevations of the central Delta; however, local drainage system operations on adjacent islands modify this gradient and increase the gradient from the surrounding sloughs to the island interiors (DWR 2003). During the spring of 2012, regional groundwater elevations in the vicinity of the Proposed Project site were between +5 and -5 ft mean sea level (MSL) (NAVD 88) and groundwater flow was generally from the northwest to the southeast similar to pre-development conditions.

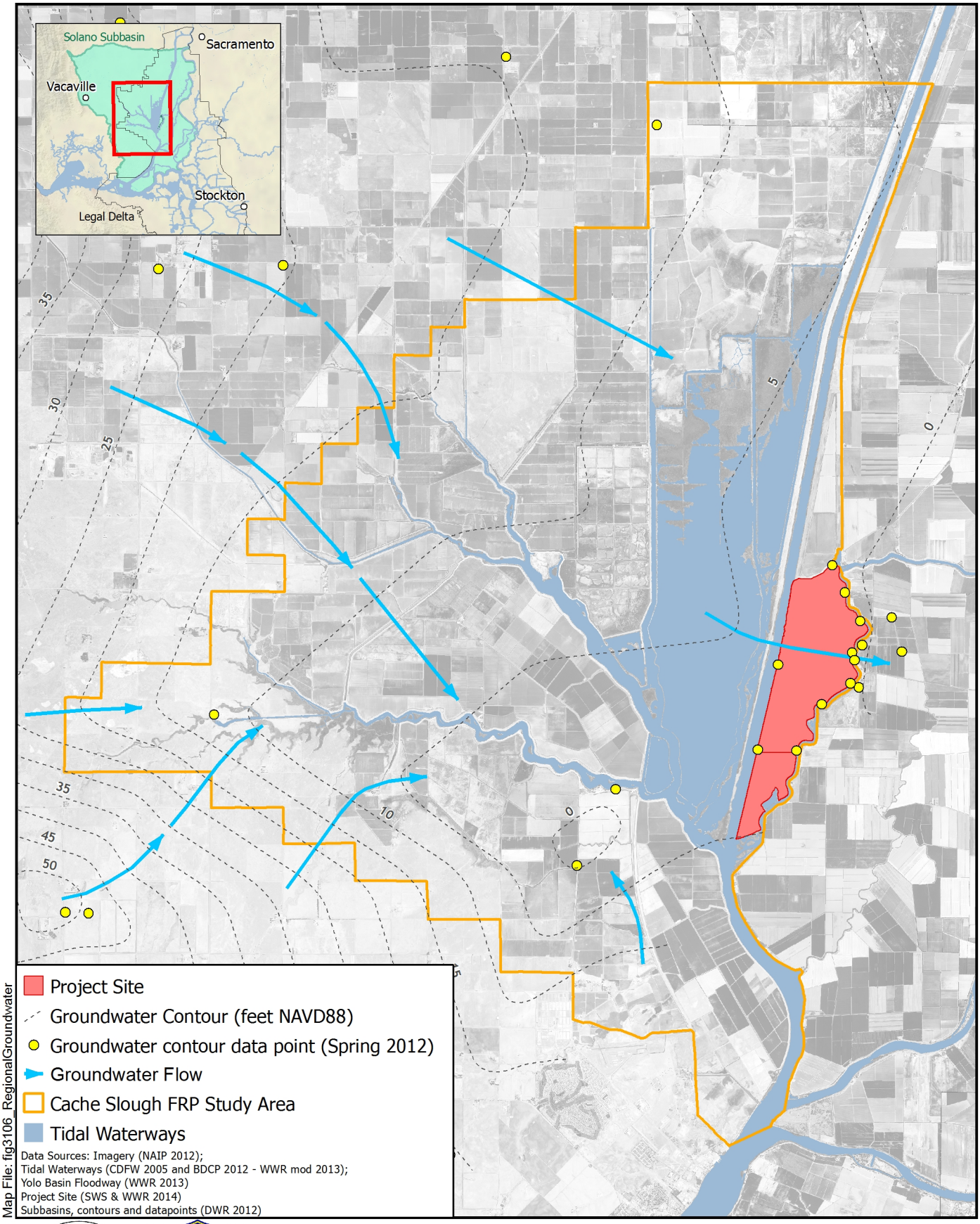


Figure 3.1-6
Groundwater Elevation Contour Map for a Portion of the Solano Subbasin, Spring 2012

Prospect Island area hydrology

As with regional conditions, local hydrologic conditions in the vicinity of Prospect Island are influenced by tides, flood conveyance, and water supply operations. Surface water/groundwater interactions also are important at the local scale, as described below.

Tidal datums

Tidal datums in the vicinity of Prospect Island are presented in Table 3.1-1. The datums were estimated considering 19 years of record at the Sacramento River at Rio Vista Bridge tide gage in the Delta and using those values, adjusted for the Prospect Island site (USACE and DWR 2001).

Table 3.1-1. Tidal Datums in the Vicinity of Prospect Island

Tidal Datum	Elevation (feet NAVD 88)
Mean Higher High Water (MHHW)	6.5
Mean High Water (MHW)	5.9
Mean Tide Level (MTL)	4.4
Mean Low Water (MLW)	2.6
Mean Lower Low Water (MLLW)	2.1

Source: USACE and DWR (2001).

Agricultural and municipal diversions and drains

There are numerous agricultural diversions along Miner and Cache sloughs in the vicinity of Prospect Island (Figure 3.1-2). These diversions are a mix of gravity siphons and pumps, varying in size from less than 15 in to greater than 30 in in diameter (A. Rabidoux, pers. comm., June 2013). There are also several agricultural drains along Miner and Cache sloughs proximal to the Project site.

Surface water

Surface water on Prospect Island originates from four sources: rainfall, Miner Slough, DWSC, and groundwater seepage. Average annual rainfall in the CSC is approximately 20 in, with most precipitation occurring during the rainy season, primarily between November and March. Some additional surface water originates from ground fog, known regionally as tule fog, during late fall and winter after the first significant rainfall, when atmospheric inversions generate fog.

Since the cessation of agricultural uses on Prospect Island, the two main properties on the island have had somewhat different hydrologic conditions. On the north property, water has entered from Miner Slough via a 4 ft diameter

culvert, 50–75 ft in length, located in the southeast corner of the property. This culvert had a flap gate to prevent inflowing tidal waters, but unknown parties removed it not long after the 2008 levee breach repair, resulting in the property being inundated. DWR repaired and reinstalled the flap gate in December 2013.

The south property receives water from Miner Slough via seepage through the large rocks of the levee breach repair on the side channel to Miner Slough. Much of the south property is submerged. The south property experiences limited tidal exchange, but no water-level measurements have occurred to date to establish the magnitude of this tidal exchange.

Groundwater

Prospect Island

DWR completed a comprehensive, multi-year hydrogeologic study in the vicinity of Prospect Island (DWR 2014b). The study found that groundwater levels on Prospect Island vary daily and seasonally and from December 2011 to October 2013, groundwater elevations on Prospect Island ranged from +8.2 ft to -1.4 ft MSL NAVD 88 (DWR 2014b).

The DWR 2014b study also indicates that two primary hydrogeologic units (HU) are present in the vicinity of the Proposed Project area, including the Upper Clay HU and the Main Sand HU (DWR 2014b). Based on lithology, bathymetry, bed sediment samples, and water level monitoring data, it appears that the channel bottoms of Miner Slough and DWSC are physically and hydraulically connected to the Main Sand HU. Due to the permeable nature of sandy soils, the intersections of the Miner Slough channel bottom and the Main Sand HU provide significant pathways for surface water to flow into the groundwater system. In contrast, lithology, geology and geomorphic maps, and trench logs indicate that surface water on Prospect Island is not connected to the Main Sand HU due to a low-permeability clay layer (Upper Clay HU) underlying Prospect Island that is 25 ft thick on average and separates surface water from groundwater flows (DWR 2014b). Overall, groundwater contour maps for the summer and winter 2012 periods indicate that Miner Slough is the dominant hydrologic feature controlling surface water and groundwater flow within the Proposed Project area (DWR 2014b).

The south property was not included as part of the original groundwater study area, so groundwater conditions on this portion of Prospect Island can only be inferred from those in the general vicinity.

Ryer Island

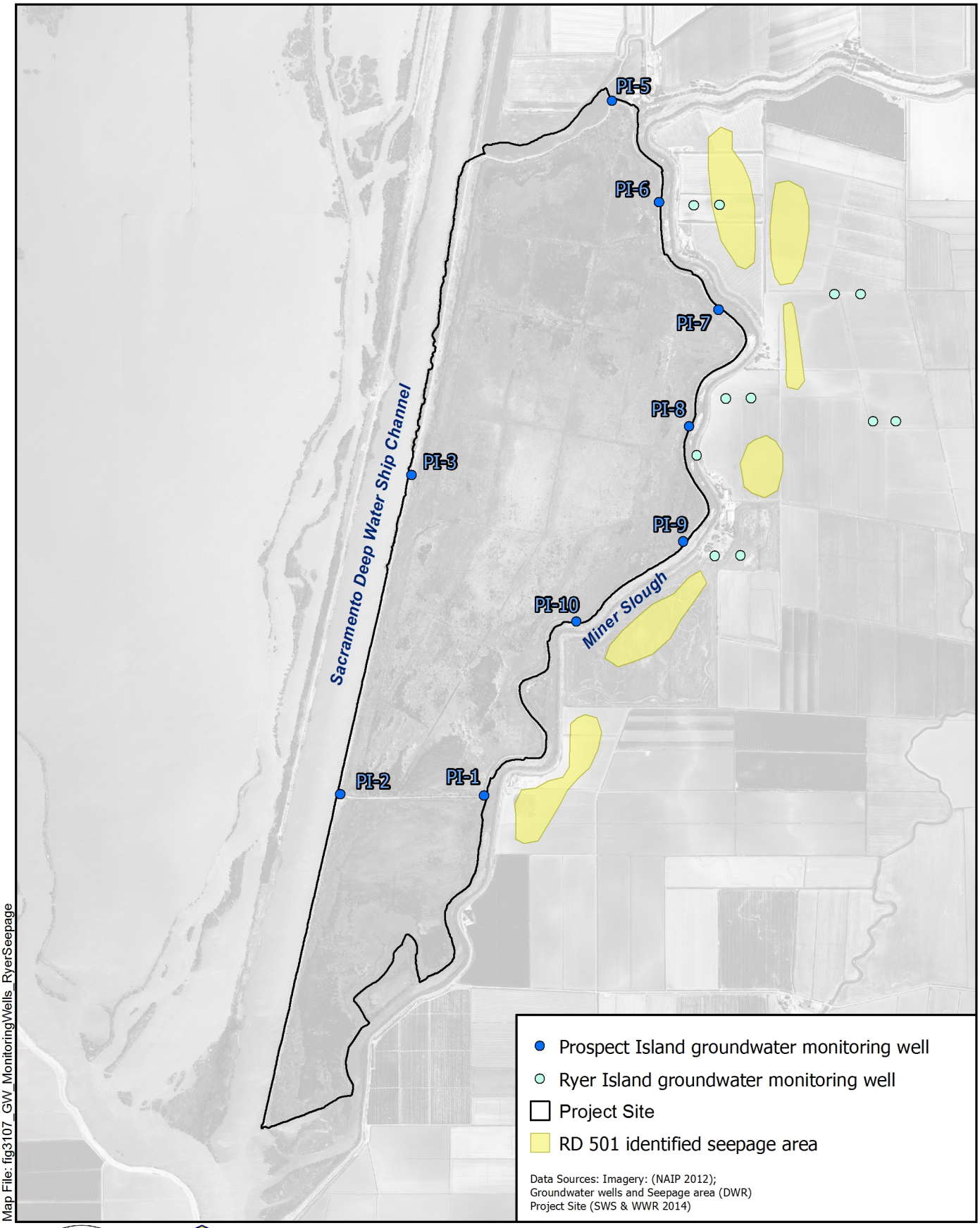
Groundwater levels on the adjacent Ryer Island are significantly influenced by local precipitation and stage in Miner Slough (DWR 2014b). From December 2011 to October 2013, groundwater elevations on Ryer Island ranged from +0.67 ft to -6.71 ft MSL NAVD 88. Multiple seepage areas on Ryer Island potentially under the influence of surface water on Prospect Island have been reported by RD 501 and landowners (Figure 3.1-7).

The 2014 DWR study indicates that surface water from Miner Slough enters the Main Sand HU and flows east beneath and to the surface of Ryer Island. During the winter and early spring, groundwater levels on Ryer Island are close to, or above, the ground surface. These conditions coincide with precipitation events, stage increases in Miner Slough, and potentially the seasonal change in drainage system operation. This is significant because when groundwater levels in the shallow aquifer system rise to within a foot or less from the ground surface on Ryer Island, agricultural activities may be affected due to the saturation of shallow-depth, clay-rich soils. Also, when groundwater levels in the shallow aquifer system rise above the ground surface, groundwater seepage occurs. Furthermore, when the shallow groundwater levels are close to or above the ground surface, any precipitation that occurs can result in ponding.

During the spring and summer, the groundwater levels on Ryer Island decrease up to several feet; this is likely due to the operation of the Ryer Island drainage ditch system, which lowers shallow groundwater levels in order to create a seasonal unsaturated zone to grow crops. Additionally, groundwater levels in many Ryer Island monitoring wells show small increases during the spring and summer, which are likely caused by irrigation activities.

Overall, groundwater levels, and to a limited extent drainage ditch stage, on Ryer Island appear to correspond to Miner Slough stage and precipitation. There are also fluctuations in drainage ditch stage that do not correspond to groundwater level changes, and these are likely caused by irrigation activities on Ryer Island.

Groundwater elevation contours mapped as part of the 2014 DWR study indicate that Miner Slough is the dominant hydrologic feature in the Proposed Project area. In addition, Ryer Island groundwater levels follow a tidal pattern similar to Miner Slough and respond to precipitation events and drainage and irrigation cycles. Therefore, there does not appear to be a significant relationship between the stage on Prospect Island and the groundwater levels on Ryer Island.



Map File: fig3107_GW_MonitoringWells_RyerSeepage

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0 0.25 0.5 Mi

0 0.5 1 Km

Figure 3.1-7
Prospect Island Groundwater Monitoring Wells and Ryer Island Seepage Areas
PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Legal and regulatory setting

Federal laws

Unless otherwise noted, the Proposed Project would comply with the following federal laws.

Rivers and Harbors Act of 1899

The Rivers and Harbors Act of 1899 regulates the quality and hydrology of navigable waters and their tributaries through permitting administered by the USACE. Pursuant to this Act, any discharge of refuse matter into navigable waters and/or their tributaries without a permit is prohibited. Additionally, the Rivers and Harbors Act requires a permit to excavate, fill, or alter the condition, or capacity of any navigable water or federal levee. The Proposed Project would involve work within navigable waters of the U.S.; thus, the Proposed Project would be subject to applicable regulations as set forth by the Rivers and Harbors Act.

Clean Water Act

Alterations that may impact the hydrology or affect the surface and groundwater quality on the Proposed Project site or in receiving waters are subject to regulation by the Federal Clean Water Act of 1972 (CWA), and to requirements established by the USEPA and the USACE. The CWA is described in detail in Section 3.2 *Water Quality*.

State regulations

Unless otherwise noted, the Proposed Project would comply with the following state regulations.

Reclamation Districts

The Proposed Project site is located on Reclamation District (RD) 1667 and borders RDs 501 and 999. Notification of these neighboring RDs is required as part of the CVFPB permit process, as described below.

Central Valley Flood Protection Board

Pursuant to CCR Title 23 *Waters*, the Central Valley Flood Protection Board (CVFPB) is responsible for enforcing standards for construction, maintenance, and protection of adopted flood control plans within the Central Valley of California, including the Yolo Bypass. Proposed restoration and levee work within the Proposed Project area would require an encroachment permit from the CVFPB.

An encroachment permit from the CVFPB is required for any project or plan of work that: (1) is within federal flood control project levees and within a CVFPB easement; (2) may have an effect on the flood control functions of project levees; (3) is within a CVFPB designated floodway; or (4) is within the regulated Central Valley streams listed in Table 8.1 of CCR Title 23.

CCR Title 23, Section 107 provides for uses that may be permitted in a designated floodway, provided they would not unduly impede the free flow of water in the floodway or jeopardize public safety. Some of these uses that may apply to Proposed Project activities include: (a) open space uses not requiring a closed building, such as agricultural croplands, orchards, livestock feeding and grazing, or public and private recreation areas; (b) fences, fills, walls, or other appurtenances which do not create an obstruction or debris-catching obstacle to the passage of floodwaters; (f) improvements in stream channel alignment, cross-section, and capacity; and (i) other uses which are not appreciably damaged by floodwaters.

The standards that govern the design and construction of encroachments within CVFPB jurisdiction are provided in CCR Title 23, Article 8. The following sections provide standards that may apply to the activities associated with the Proposed Project.

- CCR Title 23, Section 112 *Streams Regulated and Nonpermissible Work Periods*, prohibits banks, levees, and channels of floodways from being be excavated, cut, filled, obstructed, or left to remain excavated during the flood season for a given area. The flood season for the Yolo Bypass is November 1 through April 15. CVFPB may allow work to be done during the flood season provided forecasts for weather and river conditions are favorable.
- CCR, Title 23, Section 115 *Dredged, Spoil, and Waste Material*, prohibits dredged, spoil, or waste materials from being deposited on the levee crown, levee slope, or within the limits of a project floodway without specific prior approval from CVFPB. Approval is conditioned on the effect of the deposition on the flood-carrying capacity of the stream channel, floodway, or bypass; recreational and environmental factors; and fish and wildlife.
- CCR Title 23, Section 116 *Borrow and Excavation Activities-Land and Channel*, authorizes the CVFPB to limit borrow and excavation activities within a floodway based on an area's hydraulics, hydrology, sediment transport, and history of the borrow sites. Borrow activities may be allowed if an activity would not cause an unplanned change of the stream's location;

the sediment transport downstream would not change in a manner that produces or tends to produce increased flood or erosion problems in the area; and the activity is consistent with the overall flood control objectives for the area.

- CCR Title 23, Section 120 *Levees*, mandates that levees constructed, reconstructed, raised, enlarged, or modified within a floodway must be designed and constructed in accordance with the USACE Manual, Design and Construction of Levees (USACE 2000).
- CCR Title 23, Section 131 *Vegetation*, permits suitable vegetation, if properly maintained, within an adopted plan of flood control, provided it does not interfere with the maintenance, inspection, flood fight procedures or the overall integrity of that plan.
- CCR Title 23, Section 136 *Supplemental Standards for Yolo Bypass and Sutter Bypass* provides supplemental standards. This section specifically notes that it is CVFPB policy to permit development of suitable wetlands within the Yolo Bypass. Other specifically relevant provisions of this section indicate planting of vegetation or the impoundment of water shall not be permitted in any area where there could be an adverse hydraulic impact; planting of vegetation is generally permitted for the development of native marsh, riparian vegetation, and wetlands; and no permanent berms or dikes are permitted above natural ground elevation without a detailed hydraulic analysis.

State Water Resources Control Board

Water Rights Decision 1641 (D-1641) (SWRCB 2000) is part of the State Water Resources Control Board's (SWRCB) implementation of the 1996 Bay-Delta Plan. The decision amends water rights by assigning responsibilities to persons or entities holding said rights, thereby affecting permits and licenses.

Sacramento River flow at Rio Vista is identified as a water quality objective applicable to fish and wildlife beneficial uses (SWRCB 2006), with threshold levels for flow associated with these beneficial uses defined in D-1641. Table 3.1-2 below summarizes the minimum monthly flow requirements at Rio Vista. In addition, D-1641 requires that the 7-day running average not be less than 1,000 cfs below the monthly objective.

Table 3.1-2. Rio Vista Minimum Monthly Flow Requirements

Month	Flow (cfs) by Water Year Type[1]					
	All	Wet	Above Normal	Below Normal	Dry	Critically Dry
September	3,000					
October		4,000	4,000	4,000	4,000	3,000
November–December		4,500	4,500	4,500	4,500	3,500

Source: (SWRCB 2006).

[1] Sacramento Valley Water Year Hydrologic Classification (http://cdec.water.ca.gov/cgi-progs/iodir_ss/wsihist).

Local ordinances and policies

The Solano County General Plan (Solano County Board of Supervisors 2008) contains ordinances and policies that pertain to hydrology. These ordinances and policies, listed below, deal with public health and safety as related to flood protection and management.

- HS.P-2: Restore and maintain the natural functions of riparian corridors and water channels throughout the county to reduce flooding, convey stormwater flows, and improve water quality.
- HS.P-8: Work with responsible parties to ensure dams, levees, and canals throughout the county are properly maintained and/or improved.
- HS.P-9: Preserve open space and agricultural areas that are subject to natural flooding and are not designated for future urban growth; prohibit permanent structures in a designated floodway where such structures could increase risks to human life or restrict the carrying capacity of the floodway.
- HS.P-10: Ensure that flood management policies that minimize loss of life and property also balance with environmental health considerations of the floodplain and therefore do not cause further erosion, sedimentation, or water quality problems in the floodplain area.

3.1.2 Significance criteria

Criteria for determining significant impacts are based upon Appendix G *Environmental Checklist* of the CEQA Guidelines. In the evaluation that follows, a potential impact to hydrology was considered significant if the implementation of the Proposed Project would cause any of the following:

4. Substantial depletion of groundwater supplies or substantial interference with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the

production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted).

5. Substantial alteration of the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, to the extent that the rate or amount of surface runoff is altered in a manner that would result in flooding, erosion, or siltation on- or off-site.
6. Substantial alteration of agricultural water supply and drainage in the vicinity of the Proposed Project.
7. Creation or contribution to runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.
8. Placement of structures within a 100-year flood hazard resulting in impedance or redirection of flood flows.
9. Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam.
10. Substantial groundwater seepage changes to adjacent properties.

Because groundwater would not be used under the Proposed Project, there would be no substantial depletion of groundwater supplies or interference with groundwater recharge; therefore, this potential impact is not considered further.

3.1.3 Impacts and mitigation

Impact 3.1-1: Potential changes in agricultural water supply and drainage due to changes in tidal range

The Proposed Project would increase the tidal prism of the CSC, and, in turn, reduce tidal range (MHHW-MLLW). The reductions to the heights of high tides and increases to the heights of low tides have the potential to both negatively and positively affect agricultural water management of both irrigation intakes and drains in the vicinity of Prospect Island. Depending on the location and the elevation of the associated farm field, intakes and drains operate by either gravity or powered pumps. Considering pumped intakes, an increase in MLLW would decrease the head that a pump would have to overcome to lift water onto the site during low tide, which would result in lower energy consumption and decreased costs (i.e., benefit). A decrease in MHHW would increase the head the pump would have to overcome to lift water onto the site during high tides, which would result in higher energy consumption and increased costs (i.e., negative impact).

For intake siphons (not pumped), an increase in MLLW would increase the duration and flow of water into the site (i.e., benefit) and a decrease in MHHW would decrease the duration and flow of water into the site (i.e., negative impact).

Considering site drainage, underwater discharges are generally uncommon for agricultural drainage pumps. For this reason, potential changes in tidal ranges would not be expected to affect drainage pump operating conditions under the Proposed Project.

During the conceptual planning phase of the Proposed Project, a hydrodynamic model was used to calculate water level at 15 representative locations throughout the Delta for a variety of project configurations with varying numbers and locations of breaches and weirs along Miner Slough (Figure 3.1-8) (Appendix I in SWS and WWR 2012). These Phase 1 model results were similar between conceptual alternatives, regardless of number or location of breaches. The chosen analysis period (June 19–July 18, 2010) encompassed a strong neap-spring tide cycle; the type expected to be most affected by the Proposed Project. The model configuration most similar to the Proposed Project, Phase 1 Alternative 23, exhibited slight increases in MLLW elevations mirrored by nearly equal decreases in MHHW elevations. Generally, tide range reductions varied from 0.02 ft (less than 1 in) to 0.23 ft (approximately 3 in). The only station that exhibited a greater change in tide range (6 in) was Miner Slough at Highway 84 (HWB), located a short distance upstream of the northeast corner of Prospect Island (Figure 3.1-8). The effects on tidal range at HWB were not propagated farther upstream, indicating a localized effect of the Proposed Project on tide range.

Quantification of the potential effects of the Proposed Project on pipeline hydraulics of agricultural water operations would require pipe sizes, intake and outlet elevations, and design specifications at each potentially affected location. These data are not readily available for the numerous intakes in the Proposed Project vicinity. A maximum change in tide range of up to 0.5 ft was modeled immediately upstream of the Proposed Project, and this change would result in small but offsetting benefits, and negative impacts for local agricultural water supply over the course of a complete tidal cycle.

Overall, the effects would be *less than significant*.

Impact significance

Less than significant

Table 3.1-3. Change in Summer, Strong Neap-Spring Tidal Range (MHHW–MLLW) from Base Conditions

Station Location	Station ID	Base Tide Range (ft)	Change in Tide Range Proposed Project (ft) (Phase 1 Alt 23)
Miner Slough at Highway 84 Bridge	HWB	3.25	-0.50
Steamboat Slough	SSS	2.83	-0.23
Sutter Slough at Courtland	SUT	2.52	-0.21
Sacramento River at Snodgrass Slough	B91750	2.39	-0.19
Yolo Bypass at Liberty Island	LIY	4.51	-0.18
Lindsey Slough at Hastings Bridge	LSHB	4.37	-0.17
Sacramento Deep Water Shipping Channel	DWS	4.33	-0.17
Sacramento River above Delta Cross Channel	SDC	2.96	-0.16
Cache Slough at Ryer Island	RYI	4.15	-0.16
Sacramento River at Freeport	FPT	1.86	-0.15
Sacramento River at Rio Vista	SRV	4.06	-0.11
South Fork Mokelumne River at New Hope Bridge	B94150	3.22	-0.09
Threemile Slough	TSL	3.71	-0.04
San Joaquin at San Andres Landing	B95100	3.53	-0.02
San Joaquin at Antioch	ANH	4.20	-0.02

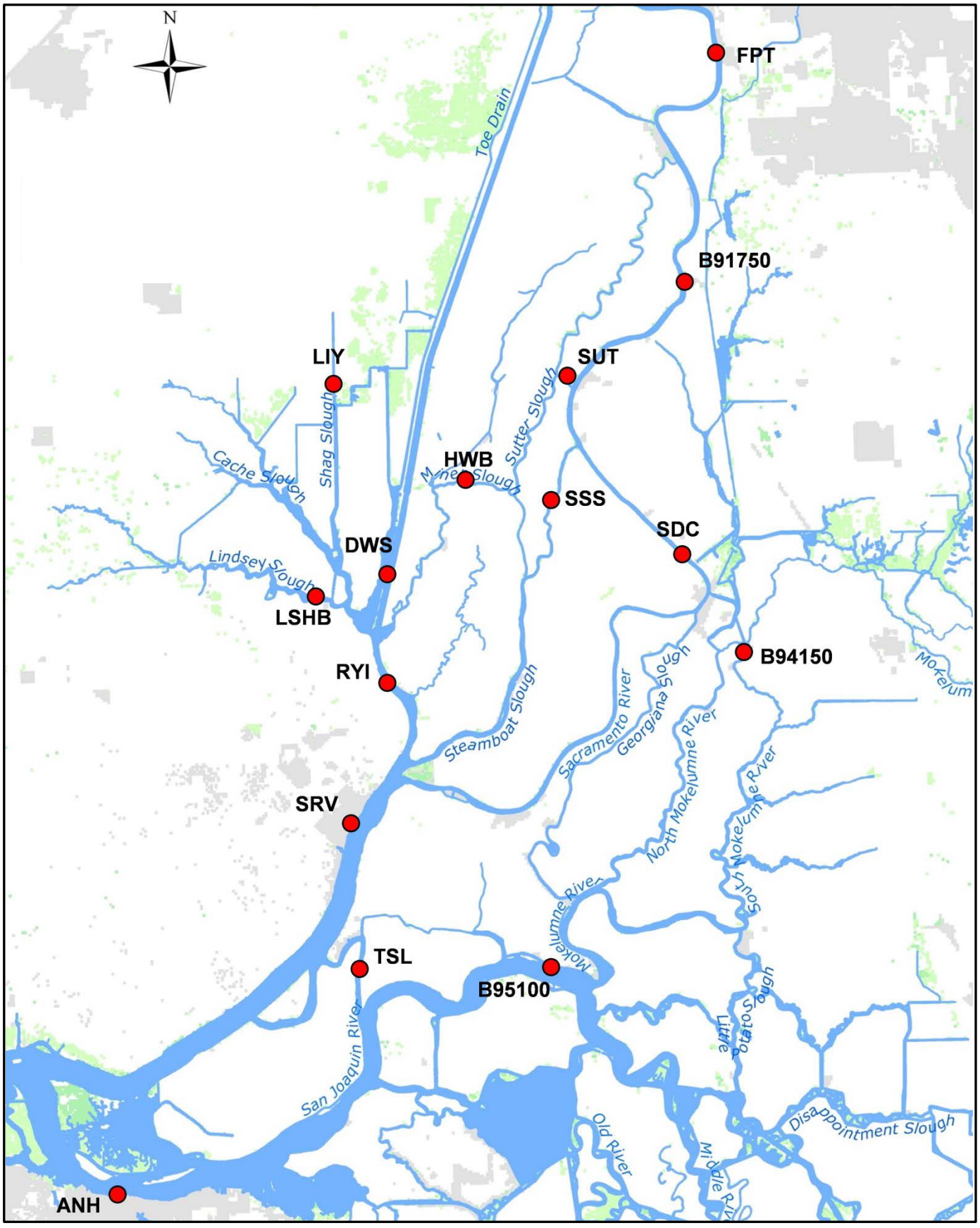

Figure 3.1-8
Hydrodynamic Model Tide Station Locations

Impact 3.1-2: Potential impacts to Sacramento River Flood Control Project and Yolo Bypass Floodway flood conveyance

Prospect Island is located within the Yolo Bypass and adjacent to lands protected by levees that are part of the SRFCP. Restoration of Prospect Island would result in new conveyance paths for flood flow via breaches along the Prospect Island Miner Slough restricted height levee. Changes in these paths could result in changes in flow splits in various locations in the lower portions of the SRFCP, which in turn could increase water levels within the Yolo Bypass Floodway and along channels and sloughs protected by SRFCP levees relative to existing conditions. Formal numerical guidance on allowable increases in flood elevation is not available from the CVFPB and by default project proponents generally rely upon a zero rise or flood neutral standard. However, due to inherent modeling uncertainties, projected increases in stage of up to 0.1 ft along SRFCP levees have been acceptable in other studies (Appendix H in SWS and WWR 2012).

Potential impacts to flood conveyance within the Yolo Bypass and along Miner Slough, Sutter Slough, Steamboat Slough, and the Sacramento River from Rio Vista to Freeport were evaluated using a hydraulic model developed by the USACE based on the RMA2 platform (USACE 2007). Fifteen conceptual alternatives, one of which was similar to the Proposed Project (Alternative 23), were modeled and compared to the baseline flow and water surface elevation conditions under 1957 SRFCP design flow conditions (Appendix H in SWS and WWR 2012). The modeled conceptual alternatives included a variety of configurations with varying numbers and locations of breaches along both Miner Slough and the DWSC. None of the conceptual planning alternatives correspond exactly with the Proposed Project with respect to location of breaches along Miner Slough; configuration, location or size of internal channels; size of the internal cross-levee breach; placement of fill to create the intertidal bench; nor placement of fill to create the toe berm.

Collectively, alterations to the topography and vegetation interior to Prospect Island and breaches to the levees around Prospect Island, as defined under the various conceptual alternatives, would not have flood conveyance impacts to the Yolo Bypass or to the rivers and sloughs protected by the SRFCP. Miner Slough, Sutter Slough, and Steamboat Slough exhibited small increases (less than 1%) and the Sacramento River exhibited small decreases (less than 1%) in flow across all alternatives. These modeled flow changes resulted in very small localized changes in water surface elevations (less than 0.05 ft) near the DWSC and internal to Prospect Island, none of which were adjacent to SRFCP levees. Modeled changes in flow and water surface elevation were within the range of

model uncertainty and therefore considered insignificant (Appendix H in SWS and WWR 2012). The fact that the modeling results were similar across alternatives with a variety of configurations implies that similar results would occur for the Proposed Project.

Impact significance

No impact

Impact 3.1-3: Groundwater seepage impacts from Prospect Island to adjacent areas

The Proposed Project has the potential to cause an increase in groundwater seepage on Ryer Island which may affect agricultural land uses. Multiple seepage areas on Ryer Island, potentially under the influence of surface water on Prospect Island, have been identified by RD 501 (Figure 3.1-7). To evaluate this possible impact, DWR completed a multi-year Site Characterization and Groundwater Monitoring Study (DWR 2014b). As part of the study, two-dimensional, finite element models along three Prospect Island - Ryer Island transects were used to analyze seepage conditions. This modeling approach was chosen as it considered the major elements of the subsurface hydrogeology along each transect. The models were created to analyze seepage conditions along three different transects that cross the levees and sloughs in the Proposed Project area and were developed to model average and high Miner Slough stage, and variable subsurface conditions. Two seepage-model scenarios were evaluated under two different stage conditions to determine if there may be any impacts to adjacent areas due to the Proposed Project:

- Existing Conditions Scenario (flooded Prospect Island—no levee breach)
    - Average and high Miner Slough stage during the period of record
- Restored Conditions Scenario (flooded Prospect Island—levee breached and connected to Miner Slough)
    - Average and high Miner Slough stage during the period of record

Surface water stage and groundwater levels vary significantly daily (due to tides) and on a seasonal basis within the Proposed Project area. In order to evaluate potential impacts caused by the Proposed Project, both average and high-stage conditions were used. The high-stage conditions (those that would result in maximum head and flow) were determined based on the highest stage of Miner Slough during the period of record in the DWR (2014b) study. The remaining model inputs were chosen at this same time interval or were approximated based on the best available data. The models developed for the seepage analysis were

used to estimate hydraulic parameters that were considered critical for the evaluation of potential Proposed Project effects. Specific parameters include:

- The total head (in feet) in the Main Sand hydrogeologic unit (HU) underlying the Ryer Island levee.
- The total groundwater flow through a vertical section, termed the seepage flux through the middle of the Ryer Island levee.

Total head and groundwater flow were considered to be important indicators of potential impacts detrimental to adjacent islands, as a significant rise in total head and/or groundwater flow may impact agricultural operations.

The seepage modeling results (DWR 2014b) indicate that~~,~~: (1) the groundwater flow under the Ryer Island levee is directly related to the stage in Miner Slough, (2) the source of seepage on Ryer Island is from Miner Slough and seepage flow increases with higher Miner Slough stage, and (3) regardless of the model scenario (existing flooded or restored flooded) on Prospect Island or Miner Slough conditions (average or high stage), the total head and groundwater flow under the Ryer Island levee show little to no change. Therefore, while there does not appear to be a significant relationship between the stage on Prospect Island and groundwater levels on Ryer Island, there does appear to be a significant relationship between stage in Miner Slough and stage and groundwater levels on Ryer Island, as well as between local precipitation and groundwater levels on Ryer Island.

After publication of the 2016 DEIR, an updated hydrologic data analysis for the period spanning October 2013 through April 2017 was completed by DWR in the Proposed Project area that spanned extended periods of both higher and lower water levels on Prospect Island (DWR 2018). The analysis evaluated relationships between groundwater and surface water levels, as well as precipitation during periods that included both higher and lower stage on Prospect Island. As with DWR (2014b), DWR (2018) concluded that there is no significant relationship between Ryer Island groundwater levels and Prospect Island stage that is not explained by Miner Slough stage and local precipitation. Numerous examples were identified in the new period of record in which Ryer Island groundwater levels moved in the opposite direction to surface water levels on Prospect Island (DWR 2018). Therefore, the Proposed Project is not expected to have any seepage effects on Ryer Island.

Impact significance

Less than significant

Impact 3.1-4: Potential wind-wave erosion of the interior side of Prospect Island levees

The Proposed Project would expose the interior side of the Prospect Island–Miner Slough levee on Prospect Island to wind-generated waves. This could lead to erosion and affect the integrity of this levee over time, and if substantial degradation of the Prospect Island–Miner Slough levee occurs this may potentially lead to subsequent erosion impacts on the SRFCP Miner Slough–Ryer Island levee. While wind-wave erosion depends on several factors (e.g., levee bank conditions, levee geometry), the dissipation of wave energy over time is considered a primary contributor (URS et al. 2006). Wind-wave energy often varies seasonally with wind speed and direction. In the Proposed Project vicinity, average wind speeds during the spring and summer months are generally greater and more constant, directed strongly from the west-southwest (BAAQMD 2014). In fall and winter, wind direction is more variable and average wind speeds are significantly lower. As the length of open-water across which wind can blow uninterrupted (i.e., fetch) increases, so does wind-wave energy. As measured in the predominant west-southwest wind direction, maximum fetch for the Proposed Project would be approximately 1–1.5 mi/hour (hr).

During the conceptual planning phase of the Proposed Project, the Simulating WAves Nearshore (SWAN) model was used to model wind-wave properties within Prospect Island for the months of October–December, capturing low and high Sacramento River flow conditions, to analyze potential erosion and transport of bottom sediments for seven restoration alternatives (Appendix C in WWR and SWS 2014). The modeled conceptual alternatives included a variety of configurations with varying numbers and locations of breaches and weirs along Miner Slough along with internal design features (e.g., channel network, vegetation extent, eastern berm and intertidal bench). Alternative 26 of Appendix C in WWR and SWS (2014) corresponds to the Proposed Project design configuration, while Alternatives 4 and 31 correspond to Alternatives 2 and 3 of this EIR, respectively. Modeling showed strong wave damping in vegetated areas, decreasing wave height, period, and orbital velocity compared to open-water areas. Several wave-damping design features have been included in the Proposed Project that would reduce the potential for wind-wave erosion, including a planted soil toe berm along the exposed portions of the levee interior, as well as a planted intertidal bench along the eastern edge of areas expected to remain open-water habitat in the future. Even in open-water (unvegetated) areas, modeling predicted relatively low significant wave heights (< 0.8 ft) and wave periods (< 2 seconds [sec]) for wind speeds ranging from approximately 0 to 25

mi per hour (mph) (Figure 5.4-2 in Appendix C in WWR and SWS 2014). In vegetated (< 0.3 ft) and shallow (< 0.2 ft) areas modeled wave heights were significantly lower, especially during periods of stronger winds. Prospect Island would not undergo significant wave-driven sediment resuspension under low or high flows in Sacramento River for any of the modeled alternatives because of the limited wind fetch and vegetation damping effects. Wave height and bottom orbital velocity would be considerably less than that which occurs from nearby Liberty Island (Figure 5.4-3 of Appendix C in WWR and SWS 2014).

While Appendix C in WWR and SWS (2014) modeled wind-wave heights during a range of seasonal wind and flow conditions, other hydrodynamic models for the Proposed Project specifically included assessment of potential changes in water surface elevation and velocities along Miner Slough under flood flows that would overtop the Prospect Island levees (Appendices H and K in SWS and WWR 2012 and WWR and SWS 2013). Additionally, an updated model report has been prepared in support of CVFPB permitting that includes assessment of flood stages and velocities corresponding to 100- and 200-year recurrence interval storm flows for Alternative 2 (RMA, 2016). Maximum stage modeled in RMA (2016) was 20.4 ft (NAVD 88) in Miner Slough at the Hwy 84 Bridge and 18.6 ft in the Sacramento River at Walnut Grove. These conditions surpass the federal definitions of floods flows used for levee operation and maintenance purposes, which include stage of 10.0 in the Sacramento River upstream of Georgiana Slough (USACE, 2016a), and a stage of 19-22 in Yolo Bypass (USACE, 2016b); therefore, are indicative of hydrodynamics during floods.

The conclusions of SWS and WWR (2012), WWR and SWS (2013), WWR and SWS (2014), and RMA (2016) are consistently that construction of the Proposed Project or Alternatives would not be expected to significantly change flood frequency, flood stage, or discharge within the Yolo bypass floodway, or channels surrounding Prospect Island, in the future. Therefore, maximum water levels in Miner Slough and overtopping of the approximately 13 ft tall restricted height levees surrounding Prospect Island would be expected to occur at the same frequency as under existing conditions; therefore, the relative frequency and intensity of wind-wave erosion events on the Ryer Island levees, which are approximately 19.7-19.8 ft tall, would be the same. For this reason, the potential for increased wind fetch to cause erosion, as well as soil instability due to increased water levels during storm flow conditions, would be similar under the Proposed Project as occurs currently.

Proposed Project elements, including the intertidal bench and toe berm on the interior side of the Prospect Island – Miner Slough levee (Figure 2.2-2), as well as siting the northernmost breach at a right angle to the predominant wind direction (Figure 2.2-10) and armoring the edges of this breach location, would serve to dissipate wave energy and prevent wind-wave erosion of the Prospect Island–Miner Slough levee. Thus wind-wave action on the interior of Prospect Island resulting from the Proposed Project would not erode the Miner Slough-Ryer Island levee. In addition, in areas of Prospect Island exposed to potential wind-wave erosion impacts, as part of the Proposed Project, DWR will plant and water the planned eastern toe berm, as well as allow one year from the time of planting prior to levee breaching, which will serve to further reduce any potential erosion of the levee.

Overall, this would be a *less than significant* impact.

Impact significance
Less than significant

Impact 3.1-5: Potential toe-scour and erosion of Miner Slough levees affecting Ryer Island levee stability

As discussed under the environmental setting section and under Impact 3.1-2 above, Prospect Island is located within the Yolo Bypass and adjacent to lands protected by levees that are part of the SRFCP. The adjacent Ryer Island Miner Slough levee maintained by RD 501 provides flood protection to Ryer Island as part of the SRFCP.

Breaching the levees on the Miner Slough side of Prospect Island would potentially lead to increased velocities in Miner Slough by increasing the tidal prism, and could also create localized cross-currents at the breach locations towards Ryer Island. Both of these changes have the potential to erode the Miner Slough levee and thereby threaten the long-term stability of the flood protection provided. To determine the potential for scour, Phase 1 hydrodynamic modeling was conducted for a variety of conceptual alternatives (Appendix K in SWS and WWR 2012). Modeling results were used to calculate in-channel and breach exit velocities and directions for two flow conditions: (1) a strong neap-spring tide cycle during summer, which was expected to generate maximum velocities during periods not influenced by storm flows in Miner Slough; and (2) high North Delta inflow conditions occurring during winter which represent periods when Miner Slough carries storm flows. The modeling was completed during the Prospect Island habitat restoration conceptual planning phase, and as such the

configurations of the modeled alternatives with respect to the number and location of breaches do not correspond exactly to the Proposed Project. However, since modeling results were similar between conceptual alternatives, regardless of number or location of breaches, it is anticipated that refinement of the designs for the Proposed Project (Section 1.1 *Overview of the Project*) would not alter the modeled outcomes. The Phase 1 model configuration most similar to the Proposed Project is Alternative 23.

Potential for cross-currents to impact the Ryer Island levee

Model results indicate flow leaving Prospect Island through the levee breaches would converge rapidly with the primary Miner Slough flow path. Cross-current flows would not reach or impact the Ryer Island side of the Miner Slough levee, and therefore would not have the potential to scour the levee (Appendix K in SWS and WWR 2012).

Potential for bed scour to impact the Ryer Island levee

Under existing conditions, the banks of Miner Slough are heavily vegetated and have some rock rip-rap slope protection. Surficial sediment sampling data collected in 2013 from Miner Slough (cited as Data Collection Summary during 2013 [Appendix J in DWR 2013b] within DWR 2014b) show the channel-bed of Miner Slough is mostly composed of fine-grained materials. Per Fischenich (2001), stability thresholds for fine bed materials are assumed to range from 2–4 fps. These thresholds increase to a range of 4–6 fps when native vegetation is present and 5–18 fps when rip-rap is used (depending on rock diameter size). Modeled results (Appendix K in SWS and WWR 2012) indicate the Proposed Project may increase channel velocities downstream of breach locations and decrease channel velocities upstream of breach locations, relative to baseline conditions (Figure 3.1-9, Figure 3.1-10, Figure 3.1-11). During summer low flow and winter high flow baseline conditions, cross-sectionally averaged longitudinal velocities in Miner Slough ranged from 1.6 to 3.9 fps, which are within the identified stability thresholds. However, during high flow winter conditions, modeled results indicate that cross-sectionally averaged velocities under the Proposed Project would range 1.5 to 5.2 fps, slightly in excess of the identified stability thresholds for locations where no rip-rap is used (Table 3.1-4).

Modeled spot velocities under both the low and high flow scenarios (Appendix K in SWS and WWR 2012) rose above the fine-grained scour threshold (4 ft/s) in some locations, with the highest velocities occurring near the center of the channel cross-section (Figure 3.1-9, Figure 3.1-10 and Figure 3.1-11). Water velocities are lower along the channel bed and channel margins. This indicates

the potential for scour along the center of the channel bottom during winter conditions under both baseline and future conditions under the Proposed Project. However, modeled velocities near the banks of the Miner Slough levees, which are most relevant to toe scour, remain below stability thresholds for fine-grained materials, and well below those for vegetated and rip-rap protected areas under both low and high flow scenarios (Figure 3.1-9, Figure 3.1-10 and Figure 3.1-11).

Since modeling results were similar between conceptual alternatives, the conclusion that the velocities would be largely below stability thresholds is confirmed by more recent detailed modeling of 100- and 200-year flood events that was undertaken for Alternative 2 of this EIR (RMA 2016a), and is summarized in *Alternatives* Section 4.5.2 *Environmental impacts [Hydrology]* below.

Overall, this impact is *less than significant*.

Impact significance
Less than significant

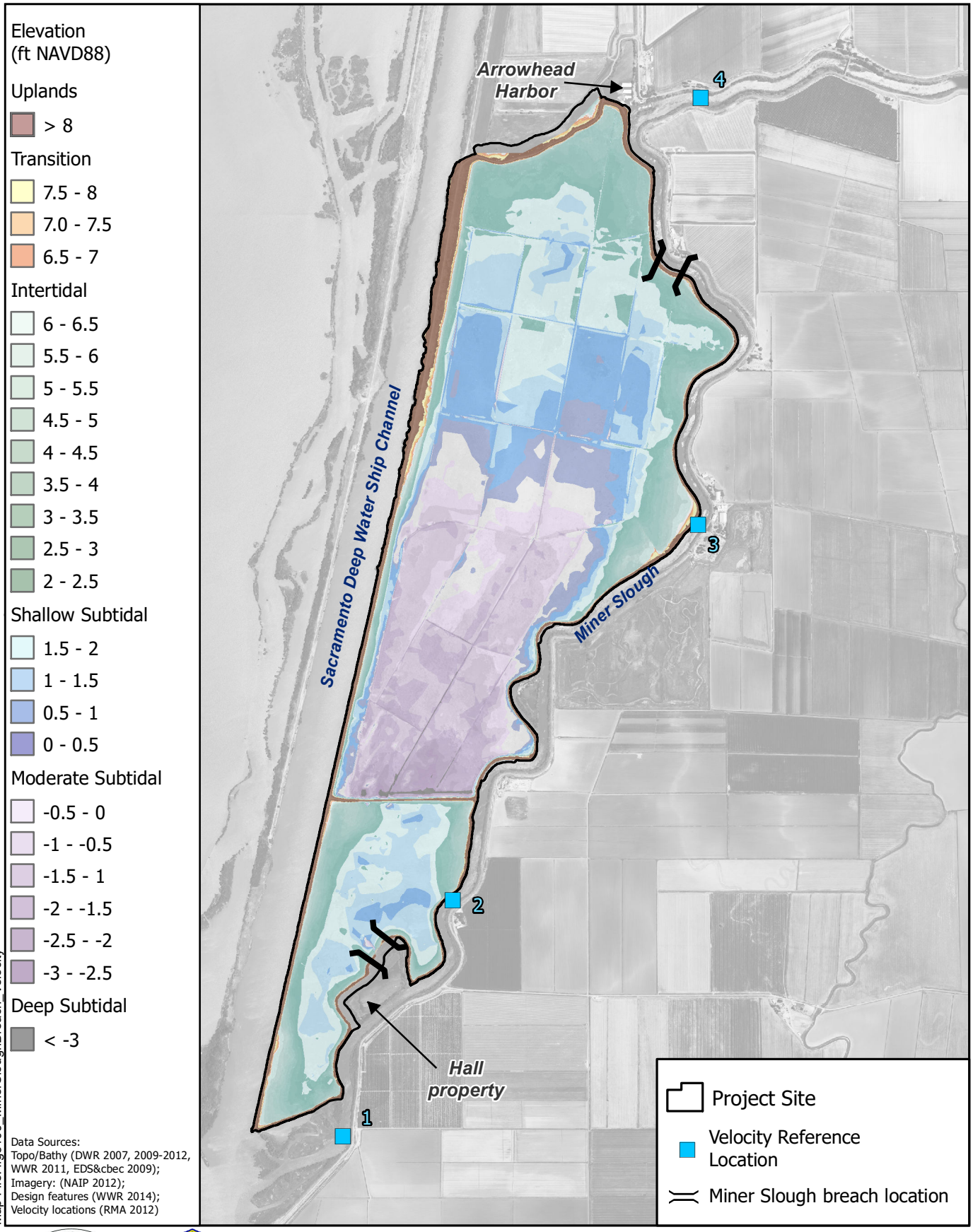

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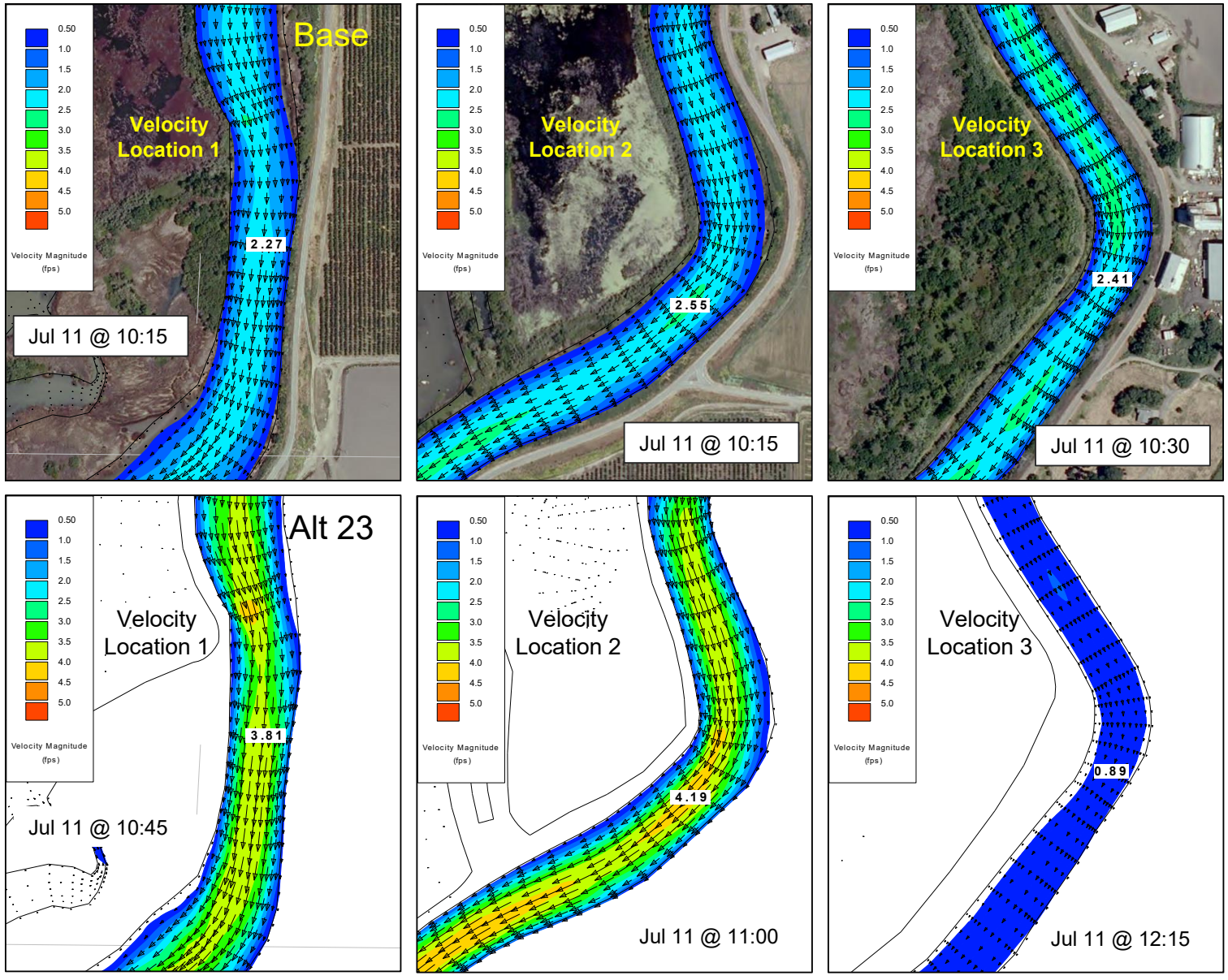
Figure 3.1-9

Miner Slough Breach and Velocity Reference Locations

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT



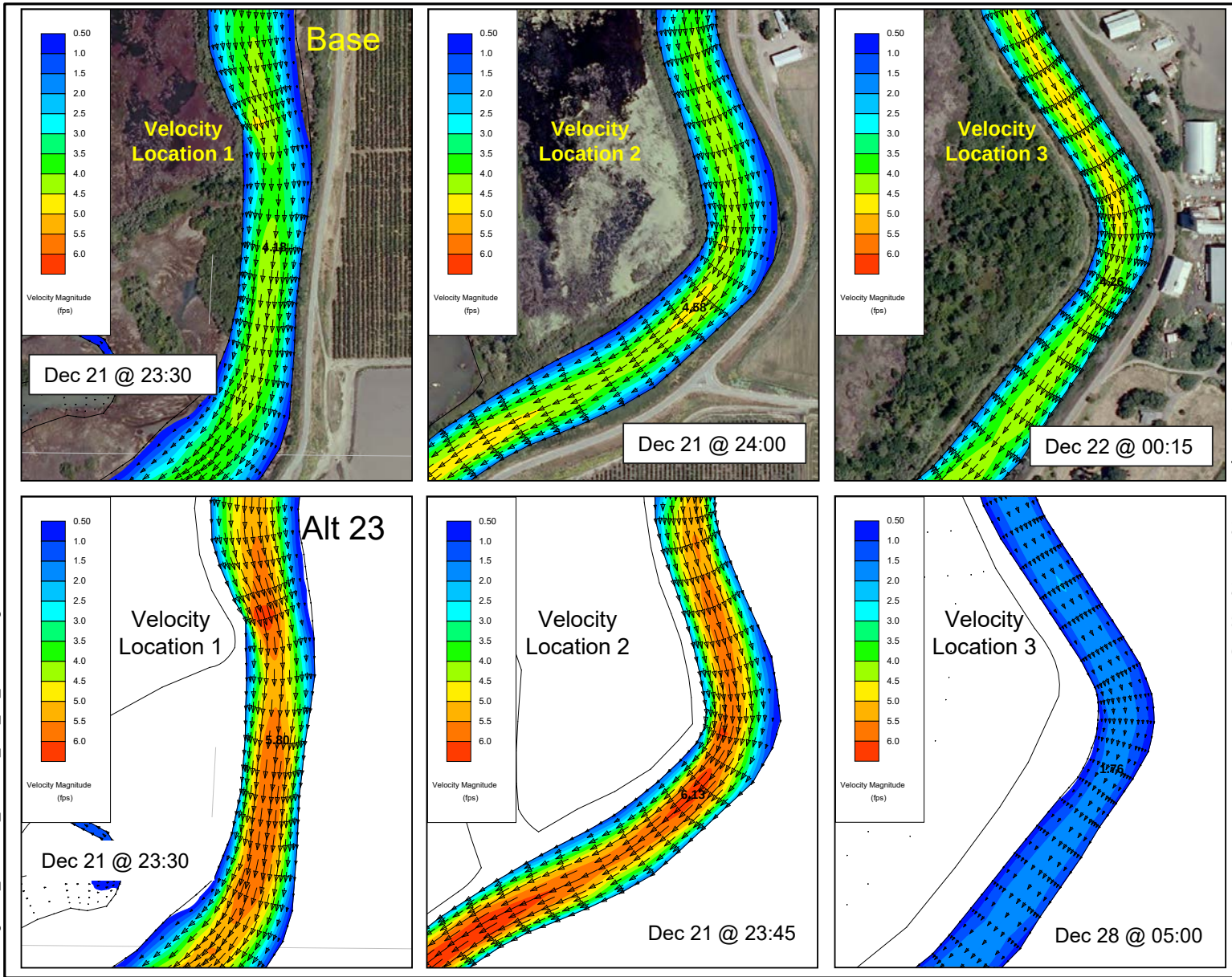
Model peak ebb current velocities for Base (No Project) & Alt 23 condition, July 11, 2010 at the three velocity reference locations along Miner Slough.

Spot velocity values are shown near the channel center.

Source: RMA 2012

Figure 3.1-10

Peak Ebb Current Velocities for Baseline and Alternative Similar to Proposed Project - Summer (Strong Neap-spring Conditions)



Model peak ebb current velocities for Base (No Project) & Alt 23 condition, December 2010 at the three velocity reference locations along Miner Slough.

Spot velocity values are shown near the channel center.

Source: RMA 2012

File: Fig 3-20_Peak-Vel_Summer_EIR_AL_2014-0811gal

Figure 3.1-11

Peak Ebb Current Velocities for Baseline and Alternative Similar to Proposed Project - Winter (Storm Conditions)

Table 3.1-4. Modeled Velocities in Miner Slough by Flow Period for Baseline Conditions and Under the Proposed Project

Flow Period	Modeled Velocity Location	Peak Longitudinal Cross-section Averaged Velocity (fps)	
		Baseline	Proposed Project (Phase 1 Alt 23)
Summer, strong neap-spring conditions	1	1.58	3.24
	2	1.76	3.58
	3	1.69	0.78
	4	1.64	1.33
Winter storm conditions	1	3.56	4.93
	2	3.9	5.21
	3	3.69	1.52
	4	3.29	3.97

Source: Appendix K in SWS and WWR (2012).

Impact 3.1-6: Potential increase in seepage on adjacent lands due to Miner Slough bed scour

Given that hydraulic modeling suggests that flow velocities could slightly exceed scour thresholds downstream of the southern levee breach under both existing conditions as well as future conditions under the Proposed Project (Impact 3.1-5; Appendix K in SWS and WWR 2012), the potential for increased seepage on Ryer Island is assessed (Figure 3.1-7). The DWR hydrogeologic study (DWR 2014b) concluded that there is a significant hydraulic connection between the DWSC, Miner Slough, and the Main Sand HU underlying the Proposed Project area. Although Miner Slough intersects the higher permeability Main Sand HU throughout the Proposed Project area, its channel bottom lies primarily within the lower-permeability Upper Clay HU. Because potential bed scour would primarily expose additional fine-grained (i.e., clay and silt) materials within the Upper Clay HU, it is unlikely this scour would significantly increase the area of hydrologic connection between Miner Slough and the Main Sand HU. Furthermore, DWR (2014b) shows the areas reported by RD 501 as being seepage-prone lie generally upstream of planned breach locations, where lower velocity conditions (based on modeling) are expected following Proposed Project implementation compared to existing conditions. Therefore, it is unlikely that potential bed scour along the thalweg of Miner Slough following Proposed Project implementation will significantly increase the existing surface water-groundwater connection. Seepage impacts on adjacent areas due to increased Miner Slough bed scour are expected to be *less than significant*.

Impact significance
Less than significant

Impact 3.1-7: Potential impacts to regional flow resulting in non-compliance with D-1641 flow requirements on the Sacramento River at Rio Vista

Under existing conditions, flows are managed in the Delta to meet D-1641 (SWRCB 2000) minimum monthly average and 7 day running average flow requirements in the Sacramento River at Rio Vista. The Proposed Project would increase the tidal prism of the CSC, thereby increasing flows into and out of the region during flood and ebb tides.

Hydrodynamic modeling of regional flow patterns was conducted for 12 selected conceptual restoration alternatives during Phase 2 modeling (Appendix D in WWR and SWS 2014). The modeled conceptual alternatives included a variety of configurations with varying numbers and locations of weirs and breaches along both Miner Slough and the DWSC. The alternatives considered in Phase 2 modeling correspond to alternatives in this 2019 FEIR as follows:

- Proposed Project (two breaches) = Alternative 26 of the Phase 2 modeling;
- Alternative 2 (two breaches and weir) = Alternative 4 of the Phase 2 modeling; and
- Alternative 3 (three breaches) = Alternative 31 of the Phase 2 modeling.

Using existing Delta operational scenarios, model results predicted small increases in Sacramento River net outflow at Rio Vista for all modeled alternatives. The fact that the modeling results were the same across alternatives with a variety of configurations implies that similar results would occur for the Proposed Project. As the existing flows are already in compliance and the modeling predicted increases over the existing flows, it is not expected the Proposed Project would result in non-compliance with the monthly average D-1641 flow requirement. In addition, the modeling also predicted increases in the seven-day running average, above the existing condition, indicating no potential for non-compliance relative to the existing condition. Based on these modeling results, the Proposed Project would not impact D-1641 compliance.

Impact significance
No impact

Impact 3.1-8: Potential scour impacting stability of nearby bridges, trestles, culverts or other structures

The major river-crossing structures in the vicinity of Prospect Island are the Highway 84 Bridge over Miner Slough (approximately 0.8 river miles [RMs] upstream from the north end of Prospect Island), the Hastings Island bridge over Lindsey Slough (approximately 2 RMs upstream of the confluence of Cache Slough, the DWSC, and Miner Slough), and the Ryer Island Ferry on Highway 84 crossing between Rio Vista and Ryer Island (approximately 3 RMs downstream of the confluence of Cache Slough, the DWSC, and Miner Slough). Breaching the levees on the Miner Slough side of Prospect Island would increase flows in Miner Slough by increasing the tidal prism. As discussed under Impact 3.1-6, Phase 1 modeling completed during Prospect Island conceptual planning predicted the Proposed Project would increase channel velocity downstream of breach locations and decrease channel velocity upstream of breach locations (Appendix K in SWS and WWR 2012). No flow changes were predicted within Lindsey Slough. Thus, the Proposed Project would not increase scour at the Highway 84 Bridge or the Hastings Island bridge.

Modeled Cache Slough flows downstream of Prospect Island are expected to slightly increase to accommodate the increased tidal prism. However, the increased flow (2,500 to 5,000 cfs) is insignificant compared to the approximately 100,000 cfs tidal exchange that occurs in Cache Slough on a daily basis (Figure 3.1-3 and Figure 3.1-4). Therefore, any velocity increases associated with the flow increases are expected to have no impact on the operations of the Ryer Island Ferry crossing.

Impact significance

No impact

Impact 3.1-9: Potential impacts to water rights from diversion of surface water

Breaching the Prospect Island Miner Slough levee would create tidal conditions within the island, with water flowing freely into both breach locations during flood tides and out of both breach locations during ebb tides. As such, the water will flow uncontrolled and the restored site would not behave as a true flow-through system possessing a dedicated inlet and outlet. For this reason, the Proposed

Project would not represent a diversion of water from Miner Slough into Prospect Island[4].

Compared with existing conditions, changes in consumptive water use under the Proposed Project would be due to changes in evaporative losses from open-water areas and/or evapotranspiration (ET) losses from wetland and riparian areas within Prospect Island. In general, because evaporation from open-water areas is lower than adjacent vegetated areas, including wetlands, the amounts of open-water and vegetated habitats under the Proposed Project have direct bearing on projected ET losses. For example, a study to determine patterns of ET water loss from salt and tidal freshwater marshes in Chesapeake Bay indicated that tidal freshwater marsh ET losses were approximately 2.2 times greater than evaporative losses from nearby tidal freshwater open-water areas (Hussey and Odum 1992).

Under the Proposed Project, freshwater wetland and riparian habitat (higher intrinsic ET rate) would decrease by approximately 76 ac (i.e., 48 ac of wetland plus 28 ac of riparian) and freshwater tidal open-water habitat (lower intrinsic evaporation rate) would increase by approximately 122 ac (Table 2.2-2). The decrease in consumptive water use due to ET losses from wetland and riparian habitats under the Proposed Project would be expected to offset increases due to evaporative losses from open-water habitat such that overall consumptive use would be generally similar to or less than existing conditions.

Overall, given the lack of water diversion and the anticipated lack of increase in consumptive water use due to ET losses, there would be no impact to existing downstream water rights under the Proposed Project.

Impact significance

No impact

Impact 3.1-10: Potential construction related impacts to groundwater supplies and third-party wells

Dewatering will be required during Proposed Project site preparation, as well as during construction for a period of approximately two years. This dewatering will

[4] "Diversion" is defined as taking water by gravity or pumping from a surface stream or subterranean stream flowing through a known and definite channel, or other body of surface water, into a canal, pipeline, or other conduit, and includes impoundment of water in a reservoir (California Water Code Section 5100).

result in a temporary lowering of groundwater levels below the Proposed Project site. If dewatering wells are employed for this purpose, the relatively low permeability of fine-grained materials (i.e., clay and silt) within the Upper Clay Hydrogeologic Unit underlying the Proposed Project site (DWR 2014b) are expected to limit the radius of influence to a short distance from these wells. Therefore, potential groundwater extraction from the shallow subsurface of the Proposed Project site for dewatering purposes would not result in overdraft of local groundwater supplies nor would it impact the water levels or yield of any third-party wells within the vicinity of Prospect Island.

Impact significance

No impact

3.2 Water Quality (Surface and Groundwater)

Water quality consists of physical, chemical, and biological characteristics of water. This section describes existing water quality conditions at the Proposed Project site and potential project-related impacts to water quality. It also reviews water quality plans and regulations pertinent to the Prospect Island area and describes mitigation measures to address potential impacts.

3.2.1 Setting

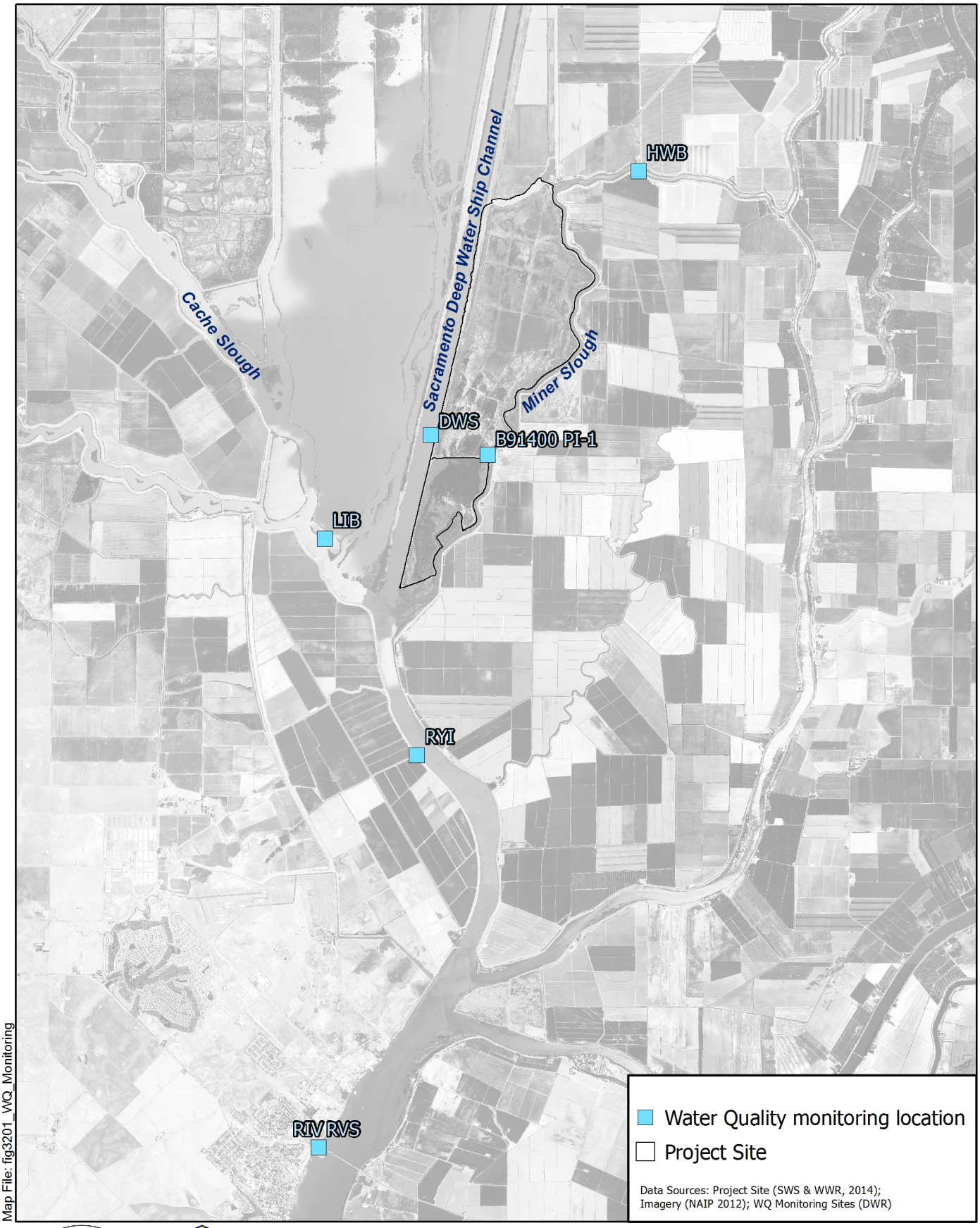
Environmental setting

Surface water on the Proposed Project site originates from precipitation, Miner Slough, the Sacramento Deep Water Ship Channel (DWSC), and groundwater seepage (Section 3.1.1 *Hydrology – Setting*). *In situ* water temperature, dissolved oxygen, pH, electrical conductivity, turbidity, and chlorophyll have been continuously monitored (e.g., 15-minute intervals) by the U.S. Geological Survey (USGS), U.S. Bureau of Reclamation (USBR), and California Department of Water Resources (DWR) in the Proposed Project site and in surrounding waterways (Table 3.2-1). Existing surface water and groundwater quality conditions are described in the sections that follow.

Table 3.2-1. Key Water Quality Monitoring Stations

Station Name (ID)	Latitude/ Longitude	Selected Parameters Monitored	Data Collected Since	Collected By
Prospect Island Tide Station 1 (B91400 PI-1)	38°15'12.30"N 121°39'24.90"W	water temperature	1/12/2011	DWR
Miner Slough at Hwy 84 Bridge (HWB)	38°17'30.12"N 121°37'50.88"W	electrical conductivity water temperature turbidity	12/02/2009	USGS
Sacramento Deep Water Ship Channel (DWS)	38°15'22.00"N 121°40'0.01"W		1/15/2011	
"Liberty Island at Approx Cntr S End" (LIB)	38°14'31.56"N 121°41'5.64"W		12/20/2010	
Cache Slough at Ryer Island (RYI)	38°12'46.08"N 121°40'9.12"W		12/02/2009	
Sacramento River at Rio Vista Bridge (RVB) and Rio Vista (RIV)	38°9'35.05"N 121°41'10.88"W	electrical conductivity	1/01/1984	DWR and USBR
		water temperature	2/22/1999	
		turbidity	1/29/2008	
		chlorophyll	1/29/2008	
		dissolved oxygen	5/30/2007	
		pH	1/29/2008	

Source: http://cdec.water.ca.gov/; for Station B91400, http://www.water.ca.gov/waterdatalibrary/docs/Hydstra/index.cfm?site=B91400



Map File: fig3201_WQ_Monitoring

Figure 3.2-1

Key Surface Water Quality Monitoring Stations Near Prospect Island

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Surface water quality near Prospect Island

Salinity

Salinity is the measure of total dissolved solids (TDS) concentration in water determined by passing a sample through a filter, evaporating the water, and determining the mass of the salts left behind. Because the analytical methods used to measure salinity are time consuming and expensive, direct electrical conductivity (EC) measurements coupled with region-specific relationships between EC and TDS are often used as an analog. For the purposes of this document, correlations of TDS and EC measurements from the Sacramento River Watershed were used for salinity conversions (Systech Water Resources 2011). For reference, fresh water is considered to have a dissolved salt content of less than one part salt per thousand parts water (ppt), while brackish water has from one to 25 ppt dissolved salt content. In comparison, ocean water has a dissolved salt content of approximately 35 ppt.

One measure of saline intrusion from the San Francisco Bay into the Sacramento-San Joaquin River Delta (Delta) is the “X2 point”—the distance measured in kilometers from the Golden Gate Bridge upstream to where salinity measured one meter off the river bottom is 2 ppt. Over a 40-year period, from 1988 to 2007, the X2 point has averaged 74 kilometers (USBR et al. 2011) (Figure 3.2-2). However, when tides are particularly strong and/or downstream flows particularly weak, the X2 point may extend inland to 98 km, approximately the distance (by water) to Rio Vista on the Sacramento River, just downstream of the Proposed Project site.

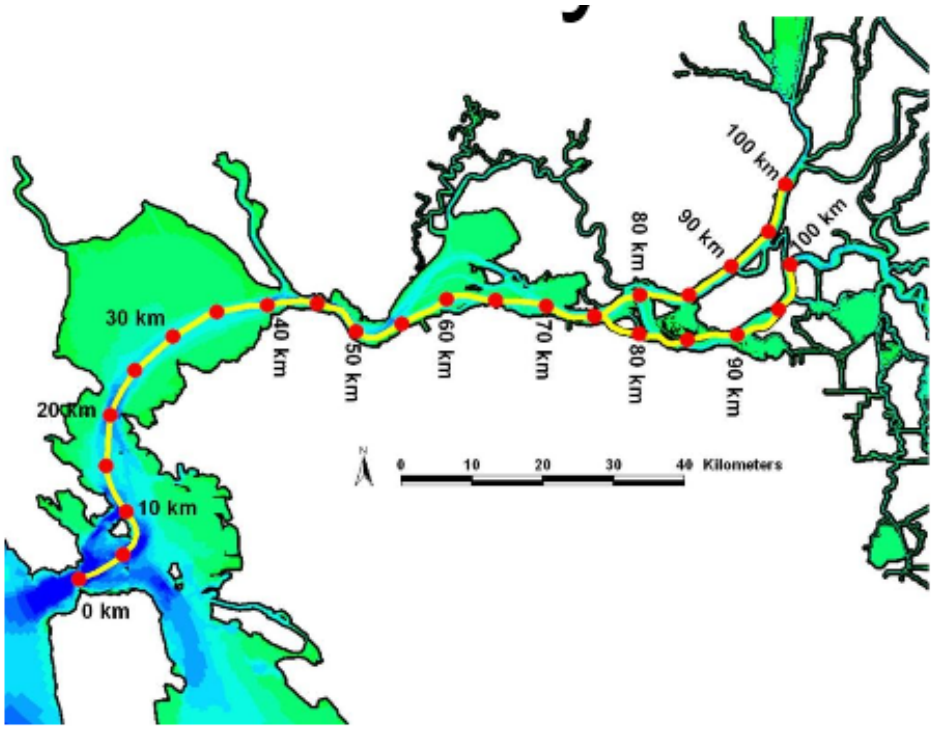


Figure 3.2-2. Distances (in 5-km Increments) from the Golden Gate Bridge (located at 0 km) to Various Points in the Bay-Delta.

In the Proposed Project vicinity, continuous electrical conductivity measurements were analyzed for water year 2012 since it represents the most recent near-normal hydrologic conditions based on classification indices for the Sacramento Valley (http://cdec.water.ca.gov/cgi-progs/iodir_ss/wsihist). Measurements indicate generally low (<0.5 ppt) average salinity that varies seasonally with hydrologic regime (Table 3.2-2). Periodic instances of relatively higher electrical conductivity and salinity were observed during the winter and late fall months. As compared to other sites in the vicinity, salinity was generally lower in Miner Slough at the Highway 84 Bridge (HWB) and higher in the DWSC and Liberty Island (LIB).

Table 3.2-2. Monthly Mean Electrical Conductivity and Salinity for Water Year 2012

Month	Year	Conductivity (uS/cm) and Salinity (ppt)									
		HWB		DWS		LIB		RYI		RIV	
		uS/cm	ppt	uS/cm	ppt	uS/cm	ppt	uS/cm	ppt	uS/cm	ppt
Oct	2011	180	0.12	257	0.17	265	0.18	232	0.15	216	0.14
Nov	2011	200	0.13	301	0.20	301	0.20	271	0.18	221	0.15
Dec	2011	156	0.10	304	0.20	294	0.20	259	0.17	173	0.12
Jan	2012	137	0.09	328	0.22	297	0.20	248	0.17	139	0.09
Feb	2012	126	0.08	259	0.17	200	0.13	222	0.15	155	0.10
Mar	2012	144	0.10	193	0.13	173	0.12	186	0.12	156	0.10
Apr	2012	121	0.08	159	0.11	141	0.09	165	0.11	127	0.08
May	2012	140	0.09	168	0.11	152	0.10	179	0.12	144	0.10
Jun	2012	167	0.11	213	0.14	208	0.14	211	0.14	192	0.13
Jul	2012	119	0.08	187	0.12	168	0.11	174	0.12	133	0.09
Aug	2012	145	0.10	194	0.13	190	0.13	192	0.13	158	0.11
Sep	2012	162	0.11	220	0.15	225	0.15	214	0.14	181	0.12

Source: California Data Exchange Center online database: http://cdec.water.ca.gov/

Water temperature

The range and patterns of water temperature play a vital role in determining physiological processes and behavior of aquatic species. Species-specific water temperature ranges for fish species associated with Prospect Island are discussed in Section 3.2 *Water Quality*.

Data from the Cache Slough at Ryer Island (RYI) and HWB monitoring stations were examined for water year 2012 in order to characterize typical water temperature patterns in Miner Slough adjacent to the Proposed Project site (http://cdec.water.ca.gov/cgi-progs/iodir_ss/wsihist). Water temperature was generally lower at the Miner Slough stations (HWB) as compared to the Ryer Island station (RYI), and varied from approximately 47 to 74 ºF (8 to 23 ºC) (Table 3.2-3). Water temperatures follow a seasonal pattern, tending to be coolest in the late fall and winter and gradually increasing to peak in the summer. As these two monitoring stations, located upstream and downstream of Prospect Island, exhibit similar seasonal temperature patterns, Miner Slough adjacent to Prospect Island is expected to experience them as well (Figure 3.2-1).

Table 3.2-3. Monthly Mean Water Temperature for Water Year 2012

Month	Year	Temperature in °F (°C)	
		HWB	RYI
Oct	2011	62 (17)	63 (17)
Nov	2011	54 (12)	56 (13)
Dec	2011	48 (9)	47 (8)
Jan	2012	48 (9)	49 (9)
Feb	2012	52 (11)	54 (12)
Mar	2012	53 (12)	59 (15)
Apr	2012	59 (15)	64 (18)
May	2012	66 (19)	68 (20)
Jun	2012	70 (21)	72 (22)
Jul	2012	70 (21)	74 (23)
Aug	2012	70 (21)	73 (23)
Sep	2012	68 (20)	72 (22)

Dissolved oxygen

Dissolved oxygen is an important environmental water quality parameter routinely monitored for the protection of aquatic organisms, including fish and benthic macro-invertebrates. The closest dissolved oxygen monitoring station to the Proposed Project site is located at the Sacramento River Highway-12 Bridge in Rio Vista (RVB). For water year 2012, dissolved oxygen ranged from 6.9 milligrams per liter (mg/L) to 10.9 mg/L, with an overall mean of 9 mg/L. Seasonally, dissolved oxygen concentrations were generally higher (> 9 mg/L) with increased solubility due to lower water temperatures during late fall and winter, and correspondingly lower (< 8 mg/L) due to higher water temperatures during the summer (Figure 3.2-3).

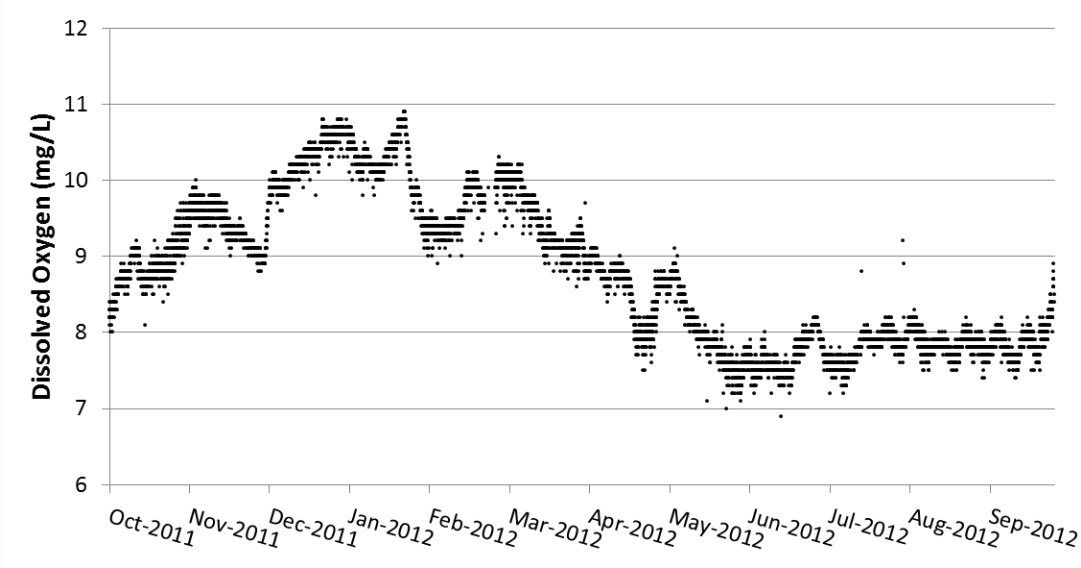


Figure 3.2-3 Hourly Dissolved Oxygen (mg/L) Measured at the Sacramento River at the Highway-12 Bridge in Rio Vista (RVB) Monitoring Station in Water Year 2012 (Below Normal Water Year Type1F[5]).

Turbidity

Water in the natural environment commonly carries with it some measurable load of suspended particles of varying sizes. This material may be composed of inorganic and organic materials, originating from sediment erosion and resuspension, algae, and other microscopic organisms. Turbidity is the relative measurement of water clarity in standard Nephelometric Turbidity Units (NTU). Water quality standards for turbidity are generally intended to minimize the amount of turbidity for protection of beneficial uses (Table 3.2-7).

Turbidity measurements have been collected on a continuous basis at several locations and for extensive periods in the Proposed Project vicinity (Table 3.2-1, Table 3.2-5). These data, in addition to observations of local suspended sediment flux, indicate seasonal and storm event variation. In general, high concentrations of suspended sediments have been observed in Miner Slough during the first significant surface flush of the rainy season and when Sacramento River flow exceeds 560 cubic meters per second (m^3s^{-1}) (20,000 cubic feet per second [cfs]) (Morgan-King and Schoellhamer 2013). Turbidity measurements collected both upstream (HWB) and downstream (RYI) of the Proposed Project site show generally low turbidity throughout the late fall and winter with periods of elevated turbidity readings in the spring and summer

[5] Sacramento Valley Water Year Hydrologic Classification (http://cdec.water.ca.gov/cgi-progs/iodir_ss/wsihist).

(Figure 3.2-4, Figure 3.2-5). Comparatively, turbidity in HWB is lower than that of RYI, except during storm events.

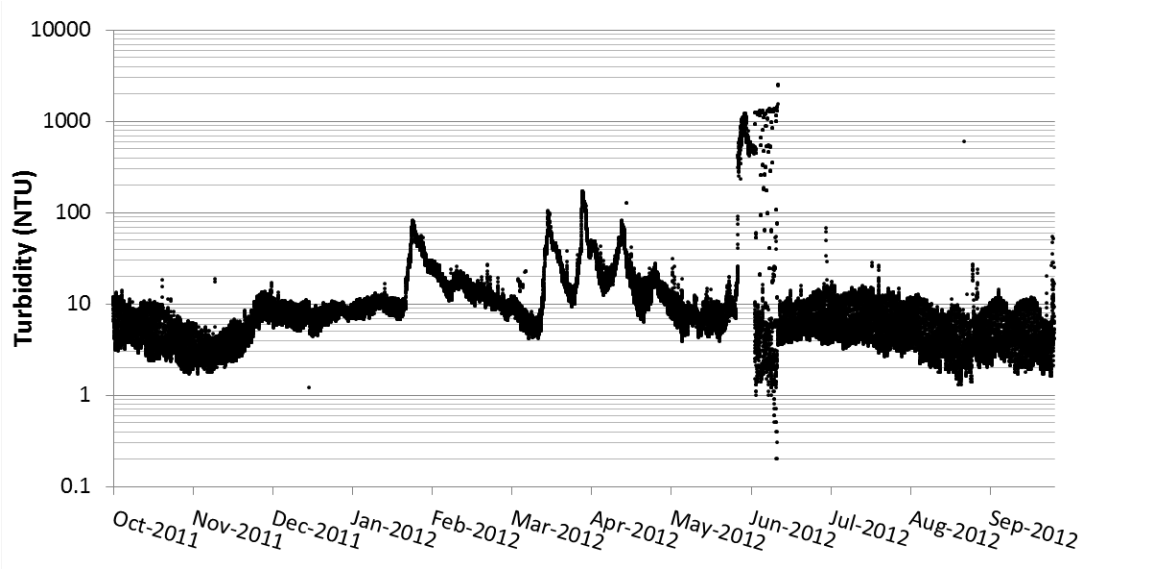


Figure 3.2-4. Turbidity Measured in Miner Slough at Hwy 84 Bridge (HWB) during Water Year 2012 (Below Normal Water Year Type[6])

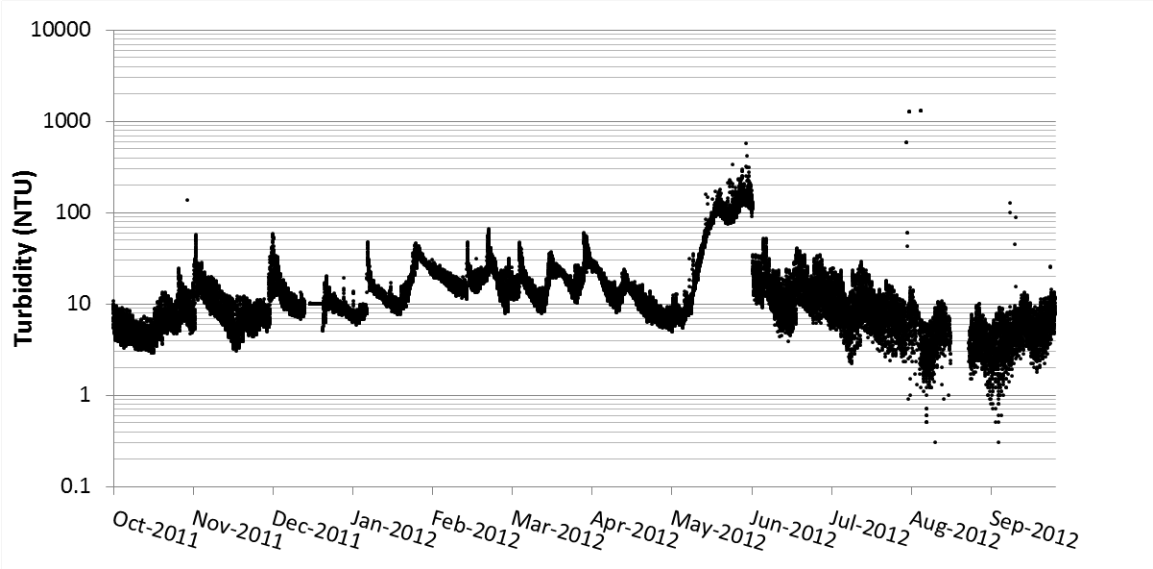


Figure 3.2-5. Turbidity Measured in Cache Slough at Ryer Island (RYI) during Water Year 2012 (Below Normal Water Year Type[Error! Bookmark not defined.])

[6] Sacramento Valley Water Year Hydrologic Classification (http://cdec.water.ca.gov/cgi-progs/iodir_ss/wsihist).

Methylmercury

Methylmercury (chemical formula: $[CH_3Hg]^+$) is the organic form of mercury most commonly found in the environment and is associated with neurological and other toxicity in humans and animals. Original sources of inorganic mercury to the Central Valley are upstream tributaries where historical mining of mercury in the Coast Ranges and gold in the Sierra Nevada and Klamath-Trinity Mountains caused contamination of water and sediment on a regional scale (Alpers et al. 2008). Methylation of inorganic mercury occurs in the aquatic environment under low oxygen conditions by naturally occurring sulfur- and iron-reducing bacteria (Gilmour et al. 1992, Benoit et al. 2003, Kerin et al. 2006). Because of the strong affinity of mercuric (Hg^{2+}) ion with sulfur containing thiols (R-SH), a predominant methylmercury formation pathway includes substitution of mercury for sulfur and bonding in many biomolecules, forming chemical homologues that can behave similarly to the parent thiol-containing biomolecules in cellular functioning. This process allows organic mercury (methylmercury) to enter the aquatic and terrestrial food web where it can be toxic at elevated tissue concentrations. Since methylmercury tissue concentrations tend to biomagnify within the food web, higher-trophic level species (e.g., fish, birds, mammals) can have mercury levels several orders of magnitude greater than those at lower trophic levels (e.g., algae, zooplankton, small invertebrates). Furthermore, since methylmercury can be retained in tissue (rather than being readily excreted or broken down), higher trophic level species may experience toxic tissue concentrations even when ambient water concentrations are hundreds of times lower and at otherwise non-toxic concentrations (Weiner et al. 2003). Developing fetuses, young humans, and piscivorous wildlife are primarily at risk from consumption of mercury-contaminated fish (Fitzgerald et al. 1998).

Elevated fish tissue mercury levels have been found throughout the Delta (Melwani et al. 2007). Under the Fish Mercury Project and Surface Water Ambient Monitoring Program (SWAMP), fish tissue samples collected from 18 locations in the vicinity of Prospect Island are shown Table 3.2-4. The majority of fish sampled from 1998 to 2007 exhibited methylmercury tissue concentrations higher than applicable water quality objectives of 0.03 miligrams per kilogram (mg/kg) wet weight (fish less than 50 milimeter [mm] in length), 0.08 mg/kg wet weight (trophic level 3 [TL3] fish), and 0.24 mg/kg wet weight (trophic level 4 [TL4] fish) (Table 3.2-4).

The California State Lands Commission (CSLC) has jurisdiction over ungranted tidelands, submerged lands, and beds of navigable lakes and waterways, including Miner Slough, and manages them for statewide Public Trust purposes.

As such, the Central Valley Regional Water Quality Control Board (CVRWQCB) requires CSLC to fund studies to identify potential mercury and methylmercury control methods in the Delta, and participate in an Exposure Reduction Program.

Table 3.2-4. Exceedance Frequency of Basin Plan Methylmercury Objectives, per Trophic Level, for Fish Sampled in the Vicinity of Prospect Island

Sample Location Name	Sample Date	Small Fish[1] (<50 mm)	Trophic Level 3 Fish[1,2] (secondary consumers)	Trophic Level 4 Fish[1, 2] (primary consumers)
Bypass Slough	Jan. 1999	9 out of 9	6 out of 11	N/A
Cache Slough	Jan. 1998	7 out of 8	0 out of 9	N/A
Cache Slough (lower)	Jan. 1999	1 out of 1	0 out of 1	N/A
Cache Slough near Ryer Island Ferry	Jan. 2000	N/A	1 out of 1	0 out of 1
Liberty Island	Jan. 1998	11 out of 12	1 out of 21	20 out of 30
Lindsey Slough	Jan. 1999	8 out of 11	4 out of 14	0 out of 2
Little Hastings Tract	Jan. 1999	3 out of 4	0 out of 3	N/A
Little Holland Tract (north)	Jan. 1999	48 out of 49	0 out of 4	0 out of 1
Little Holland Tract (south)	Jan. 2000	N/A	2 out of 2	15 out of 15
Miner Slough	Jan. 1999	1 out of 1	N/A	N/A
Old Prospect Slough	Jan. 1998	41 out of 45	3 out of 12	N/A
Prospect Island	Jan. 1999	7 out of 8	1 out of 11	0 out of 10
Prospect Slough (mid-Prospect)	Aug. 2005	N/A	38 out of 39	40 out of 72
Sacramento River at Cache Slough	Nov. 2006	N/A	N/A	7 out 12
Sacramento River at Rio Vista	Aug. 2005	N/A	51 out of 56	39 out of 59
Sacramento Deep Water Ship Channel	Jan. 1999	2 out of 2	0 out of 1	N/A
Sacramento River/Rio Vista	Jan. 1999	1 out of 1	1 out of 4	1 out of 1
Upper Cache Slough (McAvoy Fish Derby)	Feb. 2007	N/A	1 out of 1	N/A
	Totals:	139 out of 151	109 out of 190	122 out of 203

Source: California Environmental Data Exchange Network online database: http://www.ceden.org.

[1] Exceedances (based on wet-weight concentrations) are 0.03 mg/kg for small fish (<50 mm), 0.08 mg/kg for TL 3 fish, and 0.24 mg/kg for TL 4 fish.

[2] TL 3 fish generally consume zooplankton whereas TL 4 fish often prey on smaller fish.

Surface water quality in Prospect Island

The Proposed Project site is currently flooded on both the north and south properties. The north property experiences roughly 0.05 ft of daily tidal exchange immediately next to a small culvert when the flap gate is open (Section 3.1.1 *Hydrology – Setting*). Though no measurements have been made, field observations suggest that the south property experiences a limited tidal exchange with Miner Slough through a porous breach repair of the south levee.

Since January 2011, daily water temperatures have been measured at the Prospect Island Tide Station (B91400 PI-1) located at the pump house on the southeast corner of the north property (Figure 3.2-1). Daily water temperatures have ranged from approximately 41°F to 76°F (5 to 24°C) and monthly water temperatures varied seasonally, with cooler temperatures in the winter and warmer temperatures in the summer (Table 3.2-5).

As part of the Prospect Island Ecosystem Restoration Project Initial Study (USACE and DWR 2001), water quality data was collected on the north property from May through November 1997 and June through September 1998 (Table 3.2-5). During this period, electrical conductivity ranged from 113 microSiemens (uS/cm) to 235 uS/cm (0.10 to 0.20 ppt salinity). Dissolved oxygen concentrations ranged from 6.3 mg/L to 11.8 mg/L, well above the 5 mg/L Basin Plan minimum for supporting warm freshwater habitat beneficial uses. Turbidity ranged from 12 NTU to 144 NTU, which is typical for a Delta location undergoing varying seasonal weather and flow conditions, including storm and flood events.

Table 3.2-5. Mean Monthly *In Situ* Water Quality Parameters for the Proposed Project Site during 1997–1998 and 2011–2014

Month	Water Temperature in °F (°C) 2011–2013[b]	Electrical Conductivity (uS/cm) 1997–1998[a]	Dissolved Oxygen (mg/L) 1997–1998[a]	Turbidity (NTU) 1997–1998[a]
Jan	46 (8)	-	-	-
Feb	50 (10)	-	-	-
Mar	53 (12)	-	-	-
Apr	59 (15)	-	-	-
May	64 (18)	201.4	7.6	67.0
Jun	66 (19)	144.2	8.7	68.4
Jul	67 (19)	146.5	7.9	71.0
Aug	68 (20)	164.5	7.7	68.1
Sep	66 (19)	193.6	8.3	81.1
Oct	62 (17)	171.2	9.0	40.0
Nov	54 (12)	183.1	10.2	30.0
Dec	47 (8)	-	-	-
Overall Minimum:	41 (5)	112.9	6.3	12.0
Overall Mean:	59 (15)	174.3	8.1	61.4
Overall Maximum:	77 (25)	235.0	11.8	144.0
Overall Sample Size:	Continuous	88	88	62

[a] Continuous (15-minute intervals) *in situ* measurements.

[b] Individual measurements taken from each of eight sites over one or two days in a given month (1997–1998), such that reported monthly mean values represent n=16 for May, August, and September and n=8 for all other months (adapted from Table 5, USACE and DWR [2001]).

Groundwater

Groundwater quality information for Prospect Island is limited to electrical conductivity measurements collected in 2012 from the periphery of the north property as part of the Prospect Island Site Characterization and Groundwater Monitoring Program (Figure 3.1-7). TDS concentrations, calculated from conductivity, indicate an average concentration of 0.46 ppt TDS (Table 3.2-6).

Table 3.2-6. Well Depths and Estimates of Total Dissolved Solids at the Proposed Project Site

		Well Categorization[1]			All
		Shallow (23-48 ft)	Intermediate (49-74 ft)	Deep (75-100 ft)	
Sample Size (n)		9	7	4	20
Estimated TDS (ppt)	Minimum	0.14	0.11	0.10	0.10
	Average	0.75	0.16	0.31	0.46
	Maximum	2.18	0.23	0.62	2.18

Source: C. Bonds (DWR) pers. comm., 2014.

[1] Well depths are relative to ground surface.

Legal and regulatory setting

The primary laws governing water quality in California are the federal Clean Water Act of 1972 (CWA) (United States Code (USC) Title 33, Section 1251 *et seq.*) and the state Porter-Cologne Water Quality Control Act (California Water Code, Section 13000 *et seq*.). States, tribes, and jurisdictional territories are granted regional authorities and responsibilities for water quality control by the federal law. Within California, the Porter-Cologne Act established the State Water Resources Control Board (SWRCB) and nine Regional Water Quality Control Boards (RWQCBs) as the lead water quality agencies for implementation of those federal water quality programs allocated to the states, and for state water quality control programs and processes.

Water quality control consists primarily of identifying and protecting water quality standards through various planning, regulatory (permitting), and implementation/ enforcement programs. This section outlines pertinent aspects of federal, state, and local laws, regulations, and policies that pertain to water quality in the vicinity of Prospect Island.

Federal laws

Unless otherwise noted, the Proposed Project would comply with the following federal laws.

Clean Water Act

The CWA is intended to help safeguard the quality of the Nation's waterbodies from point and nonpoint source pollution. Under this law the U.S. Environmental Protection Agency (USEPA) has primary administrative and scientific authority, while the U.S. Army Corps of Engineers (USACE) implements an important CWA permit program (see reference to CWA Section 404, below). The CWA contains

several sections directly or indirectly applicable to surface water quality control at Prospect Island, which are detailed below.

CWA Section 303 (USC Section 1313)

CWA Section 303(d) and accompanying federal agency (USEPA) regulations require states, tribes, and territories to biennially list their jurisdictional waterbodies that fail to satisfy minimum water quality standards due to one or more pollutants. These governments must then develop Total Maximum Daily Loads (TMDLs) for those pollutant-waterbody combinations. TMDLs are estimated maximum daily loadings of a particular pollutant that a waterbody can theoretically withstand, while still meeting pertinent water quality standards. Inclusion on the "303(d) list" means that water quality permits and certifications issued for projects in the subject area should be appropriately stringent to ensure no additional significant release of problem pollutants.

CWA Section 401 (USC Section 1341)

CWA Section 401 establishes the Water Quality Certification program. It requires that applicants for federal licenses or permits also seek certification from the Regional Water Quality Control Board (i.e., CVWRQCB) that their proposed projects would not violate federal and state water quality standards. Dredging project applicants are required to test sediments to be dredged for possible toxic contaminants and for general sediment characterization before applying for water quality certification and permits. In general agencies are concerned with the potential discharge of toxic contaminants (in sediments) and the discharge of otherwise "clean" sediments themselves (e.g., resulting in increased turbidity).

CWA Section 402 (USC Section 1342)

CWA Section 402 is primarily concerned with the National Pollutant Discharge Elimination System (NPDES) permit program. For many years the most well-known water quality regulatory tool, it is intended to regulate the discharge of pollution from "point sources"—defined in the CWA as "discernable, confined and discrete" (USC Section1362(14)) conveyances (e.g., pipes, tunnels, ditches, vessels, and such). As in other regulatory programs, permits may be *individual* (project-specific) or *general* (issued for a broader category of activities or for a specific geographic region). A specialized portion of the NPDES program focuses on regulating stormwater discharges from municipal, industrial, and construction sites.

The Proposed Project should not require an individual NPDES permit. However, excavation or other construction-related activities must comply with general

NPDES construction stormwater permit requirements, intended to prevent or limit stormwater runoff, including sediment discharge, from construction areas into waters of the state.

CWA Section 404 (USC Section 1344)
CWA Section 404 establishes a permit program to control the discharge of dredged or fill materials to waters of the United States. The Proposed Project involves excavation and dredging activities that require a Section 404 permit from USACE. As noted above, the need to acquire a Section 404 permit normally triggers a requirement to seek Section 401 water quality certification.

Rivers and Harbors Act Section 10 (33 USC Section 403)
The federal Rivers and Harbors Act (RHA) allows the USACE to control, improve, and regulate constructed structures that might impede navigation along the Nation's waterways for the benefit of commerce, recreation, and public safety. Authorization from the USACE is required for construction in, dredging from, or deposition of material (see CWA Section 404, above) into waters of the United States. The specific activity of dredging from a navigable waterway is what may trigger the need for a Section 10 permit, which, if required, is issued by USACE in conjunction with, or in addition to, a Section 404 permit (see above). Upon application for 404 or RHA permits, the USACE initiates consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service to help ensure minimal impacts to sensitive species, including migratory fish.

Safe Drinking Water Act
The federal Safe Drinking Water Act establishes drinking water standards in order to safeguard public health. Delta water downstream of Prospect Island is taken in by various municipalities for treatment for drinking water. Therefore, any pollutants discharged from the Prospect Island area may potentially impact downstream drinking water quality.

State laws and regulations
The Porter-Cologne Water Quality Control Act of 1969, promulgated within California Water Code, authorizes the state water quality agencies to implement pertinent federal CWA programs (see California Water Code Division 7, Section 13160). In addition, Porter-Cologne also establishes separate, autonomous state water quality planning, permit, and enforcement programs that may affect the Proposed Project. Unless otherwise noted, the Proposed Project would comply with the following state laws and regulations.

Sacramento and San Joaquin River Basin Water Quality Control Plan (Basin Plan) (CWC Section 13240)

Water quality control plans are developed by the California water quality agencies (State Water Resources Control Board [SWRCB] and Regional Water Quality Control Boards [RWQCBs]) to outline steps to help ensure that state waters would be suitable and safe for use. These plans may be statewide, regional, or waterbody-specific in scope, and they may address all or any number of pollutants. The primary water quality control plan covering the Prospect Island vicinity is the Sacramento and San Joaquin River Basin Plan (Basin Plan). As outlined in the Basin Plan, water quality control consists primarily of protecting and maintaining water quality standards. Standards consist of (a) designated beneficial uses of water, (b) water quality objectives, and (c) the anti-degradation policy. In addition to identification and establishment of water quality standards, the Basin Plan outlines implementation, regulatory (permit), and enforcement programs.

Designated beneficial uses of water

Designated beneficial uses in the Delta include Municipal and Domestic Supply (MUN), Industrial Service Supply (IND), Industrial Process Supply (PRO), Agricultural Supply (AGR), Ground Water Recharge (GWR), Navigation (NAV), Water Contract Recreation (REC-1), Non-Contract Water Recreation (REC-2), Shellfish Harvesting (SHELL), Commercial and Sport Fishing (COMM), Warm Freshwater Habitat (WARM), Cold Freshwater Habitat (COLD), Migration of Aquatic Organisms (MIGR), Spawning, Reproduction, and/or Early Development (SPWN), Estuarine Habitat (EST), Wildlife Habitat (WILD), and Rare, Threatened, or Endangered Species (RARE) (SWRCB 2006).Beneficial uses of water in the vicinity of Prospect Island are set forth in Table 3.2-7.

Table 3.2-7. Beneficial Uses of Water

Human Activity-related	Natural Habitat-related
SURFACE WATER	
• Municipal and Domestic Supply (**MUN**) • Agricultural Supply (**AGR**) • Industrial Process Supply (**PRO**) • Industrial Service Supply (**IND**) • Water Contact Recreation (**REC1**) • Noncontact Water Recreation (**REC2**) • Commercial and Sport Fishing (**COMM**) • Navigation (**NAV**) • Shellfish Harvesting (**SHELL**)	• Warm Freshwater Habitat (**WARM**) • Cold Freshwater Habitat (**COLD**) • Fish Migration **(MIGR**) • Fish Spawning (**SPWN**) • Wildlife Habitat (**WILD**) • Estuarine Habitat (**EST**) • Rare, Threatened, or Endangered Species (**RARE**)

Human Activity-related	Natural Habitat-related
GROUNDWATER	
• Municipal and Domestic Supply (**MUN**) • Agricultural Supply (**AGR**) • Industrial Process Supply (**PRO**) • Industrial Service Supply (**IND**)	(not applicable)

Source: SWRCB 2006; CVRWQCB 2011.

Water quality objectives

Water quality objectives have been established by the CVRWQCB to protect the designated beneficial uses listed in Table 3.2-7. These protective limits are achieved primarily through the combined, collective issuance of individual water quality permits (and certifications) for significant human-caused sources of pollution. Permits may contain specific numeric limits (i.e., effluent limitations) on pollutant quantities to be discharged or regulate other (e.g., construction) activities in order to help ensure that, collectively and with the benefit of dilution, water quality objectives would be achieved. Table 3.2-8 lists applicable narrative and numeric surface water and groundwater quality objectives for waterbodies in the vicinity of Prospect Island.

Table 3.2-8. Water Quality Objectives Applicable to Waterbodies at or Near the Proposed Project Site

Pollutant	Narrative Objective	Numeric Objective	
SURFACE WATER			
Bacteria	-	**Water Contact Recreation MCLs**	
		Fecal Coliform	< 200/100 mL (geometric mean of at least five samples, 30 day period)
			< 10% of the total number of samples taken shall exceed 400/100 mL
Biostimulatory Substances	Water shall not contain biostimulatory substances which promote aquatic growths in concentrations that cause nuisance or adversely affect beneficial uses.	–	

Pollutant	Narrative Objective	Numeric Objective	
Chemical Constituents	Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses.	**Constituent**	**MCL (mg/L dissolved)**
		Arsenic	0.01
		Barium	0.1
		Copper	0.01
		Cyanide	0.01
		Iron	0.3
		Manganese	0.05
		Silver	0.01
		Zinc	0.1
Color	Water shall be free of discoloration that causes nuisance or adversely affects beneficial uses.	–	
Dissolved Oxygen	–	A lower limit of 5.0 mg/L	
Floating Material	Water shall not contain floating material in amounts that cause nuisance or adversely affect beneficial uses.	–	
Methylmercury	–	**Fish Size/Trophic Level[1]**	**MeHg Objective (mg/kg wet-weight)**
		any fish <50 mm in length	0.03
		Trophic Level (TL) 3	0.08
		Trophic Level (TL) 4	0.24
Oil and Grease	Waters shall not contain oils, greases, waxes, or other materials in concentrations that cause nuisance, result in a visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.	–	
pH	–	The pH shall not be depressed below 6.5 nor raised above 8.5.	

Pollutant	Narrative Objective	Numeric Objective	
Pesticides	No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. Discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses. Pesticide concentrations shall not exceed the lowest levels technically and economically achievable. Pesticide concentrations shall not exceed those allowable by applicable antidegradation policies	Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of pesticides in excess of the MCLs set forth in California Code of Regulations (CCR), Title 22, Division 4, Chapter 15	
		Pesticide	**MCL**
		Chlorpyrifos	0.025 ug/L ; 1-hour average (acute)
			0.015 ug/L ; 4-day average (chronic)
		Diazinon	0.16 ug/L ; 1-hour average (acute)
			0.10 ug/L ; 4-day average (chronic)
		Thiobencarb	1.0 ug/L for municipal and domestic supply
Radioactivity	Radionuclides shall not be present in concentrations that are harmful to human, plant, animal or aquatic life nor that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal or aquatic life.	At a minimum, waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of radionuclides in excess of the MCLs specified in CCR Title 22	
Salinity	–	**Beneficial Use**	**Criteria**
		Agricultural supply (AGR)	Vary by water year type[2] and D-1641 compliance location (SWRCB 2000)
		Fish (WARM, COLD, MIGR, SPWN) and Wildlife (WILD) habitat	
		Municipal (MUN) and Industrial (IND) supply	250 mg/L maximum mean daily chloride concentration
Sediment	The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.	–	
Settleable Material	Waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses.	–	

Pollutant	Narrative Objective	Numeric Objective	
Suspended Material	Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.	–	
Taste and Odors	Water shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to domestic or municipal water supplies or to fish flesh or other edible products of aquatic origin, or that cause nuisance, or otherwise adversely affect beneficial uses.	–	
Temperature	The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.	A maximum increase of no more than 5°F.	
Toxicity	All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances.	–	
Turbidity	For Delta waters, the general objectives for turbidity apply and except for periods of storm runoff, the turbidity shall not exceed 150 NTUs. Exceptions would be considered when a dredging operation can cause an increase in turbidity (allowable zone of dilution may apply).	**Existing Turbidity (NTU) Range**	**Maximum Allowed Increase**
		< 1	Total shall not exceed 2 NTU
		1 to 5	1 NTU
		5 to 50	20%
		50 to 100	10 NTU
		> 100	10%
GROUNDWATER			
Bacteria	–	In ground waters used for domestic or municipal supply (MUN) the most probable number of coliform organisms over any seven day period shall be less than 2.2 per 100 ml.	
Chemical Constituents	Ground waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses.	Where designated for domestic or municipal supply (MUN) must not exceed pertinent MCLs defined in CCR Title 22	

Pollutant	Narrative Objective	Numeric Objective
Radioactivity	–	Where designated for domestic or municipal supply (MUN) must not exceed pertinent MCLs
Tastes and Odors	Ground waters shall not contain taste- or odor producing substances in concentrations that cause nuisance or adversely affect beneficial uses.	–
Toxicity	Ground waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life associated with designated beneficial use(s).	–

Source: CVRWQCB 2011.

[1] Trophic Level 3 fish generally consume zooplankton whereas Trophic Level 4 fish often prey on smaller fish.

[2] Sacramento Valley Water Year Hydrologic Classification (http://cdec.water.ca.gov/cgi-progs/iodir_ss/wsihist).

Drinking water objectives

The Sacramento-San Joaquin Delta is recognized as a source of drinking water for approximately 60% of California's population. SWRCB Resolution Number 88-63 states that (with certain exceptions) "all surface and ground waters of the state are to be protected as existing or potential sources of municipal and domestic supply" (Page IV-9.00, CVRWQCB 2011). The exceptions include waters with existing high TDS concentrations greater than 3,000 mg/L, low sustainable yield, or contamination that cannot be reasonably treated. CVRWQCB Resolution R5-2013-0098, adopted in 2013, adds drinking water policy for Delta surface waters (including at Prospect Island) into the Basin Plan. The Policy focuses on salinity, excess nutrients, organic carbon, and pathogens (especially *Cryptosporidium* and *Giardia*) as drinking water constituents of particular concern. This Policy is awaiting, but expected to receive, final State and federal authorization.

Taken together, these policies mean that the quality of water in Miner Slough and nearby waterbodies must satisfy drinking water standards. Additionally, the Barker Slough Pumping Plant, located approximately eight mi due west of Prospect Island, is a current drinking water intake for the State Water Project's (SWP) North Bay Aqueduct (NBA) (Figure 3.1-2). The NBA supplies water to Napa, Vallejo, and Benicia, as well as to the cities of Fairfield and Vallejo in Solano County, and American Canyon and Calistoga in Napa County.

The Basin Plan incorporates State Water Resources Control Board (SWRCB) Division of Drinking Water numeric drinking water standards—maximum contaminant levels (MCLs)—which apply to source (ambient) waters as well as treated water systems (Table 3.2-9). Primary MCLs protect environmental health, while secondary MCLs address the aesthetics of drinking water, such as odor, color, and taste.

Table 3.2-9. Selected SWRCB-Division of Drinking Water Maximum Contaminant Levels (MCLs) for Drinking Water

Contaminant		MCLs
PRIMARY MCLs - mg/L		
Inorganic Chemicals		
Arsenic		0.01
Cadmium		0.005
Hex. Chromium		0.01
Copper		1.3
Lead		0.015
Inorganic Mercury		0.002
Nickel		0.1
Selenium		0.05
Organic Chemicals		
Benzene		0.001
PCBs		0.0005
Toluene		0.15
SECONDARY MCLs		
Color (color units)		15
Foaming Agents		0.5
Odor (odor units)		3
Turbidity (NTU)		5
TDS (mg/L)	Recommended	500
	Upper	1,000
	Short Term	1,500
Specific Conductance (uS/cm)	Recommended	900
	Upper	1,600
	Short Term	2,200

All metals expressed as total concentrations.

Source:

http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/MCLsandPHGs.shtml

In addition to the inorganic and organic contaminants and physical characteristics covered by primary and secondary MCLs, high levels of dissolved organic carbon (DOC) can lead to the formation of disinfection byproducts during potable water treatment. These include trihalomethanes, haloacetic acids, and other carcinogenic compounds formed during chlorine or ozone disinfection. The USEPA has established an MCL of 80 ppb for trihalomethanes in drinking water (USBR and DWR 2005). Potential sources of DOC to the Delta include storm water runoff, wastewater discharges, agriculture and animal husbandry, as well as any dead organic (plant) material entering a waterbody and the erosion or discharge of soils containing large concentrations of organic materials (Chapter 8 of DWR and USBR 2016).

Antidegradation policy

Federal (CWA-based) regulations require the states to develop an antidegradation policy (CFR, Title 40, Section 131.12). Such policy is intended to maintain already existing high-quality water conditions, and to prevent purposeful degradation of otherwise high water quality to allowable minimum standards. Per those federal requirements, the State of California antidegradation policy (CVRWQCB 2011; Page IV-8.00) is intended to maintain already existing high water quality conditions. The policy states that whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies (SWRCB Resolution, pp. 68-16).

303(d) list of water quality-limited segments

Northern Delta surface waterbodies, including the channels around Prospect Island (e.g., Miner Slough, the DWSC), are currently listed as impaired in multiple pollutant categories (Table 3.2-10).

Table 3.2-10. Pollutants Included on the 2008–2010 CWA Section 303(d) List of Water Quality Limited Segments for the North Delta

Pollutant	Pollutant Category
Chlordane	Pesticide
Chlorpyrifos	Pesticide
DDT	Pesticide
Diazinon	Pesticide
Dieldrin	Pesticide
Group A pesticides	Pesticide
Invasive Species	Miscellaneous
Mercury	Metals
PCBs	Other organic compounds
Unknown Toxicity	Toxicity

Total maximum daily loads

A particular TMDL usually targets a specific pollutant or suite of similar, related (physical, chemical, or biological) pollutants affecting a single waterbody or waterbody segment. TMDLs take into account existing total pollutant loads from human and natural causes; point source and nonpoint source pollutant discharges; and a margin-of-error safety factor value. Existing TMDLs that apply to Prospect Island area waterbodies include diazinon and chlorpyrifos and mercury, which are described briefly below.

Diazinon and chlorpyrifos

The Sacramento San Joaquin Delta Diazinon and Chlorpyrifos TMDL is approved and effective as of October 10, 2007. Diazinon is a fat-soluble, non-systemic organophosphate insecticide. Though banned for residential use in 2004, it may still be used by agriculture. Chlorpyrifos is also an organophosphate insecticide, used commonly on crops such as cotton, corn, almonds, and other fruit trees. Both compounds have the potential to cause acute toxicity in invertebrates and vertebrate organisms (especially fish and amphibians), including humans (in large enough doses).

The TMDL for these two pesticides applies specifically to Miner Slough, the DWSC, Prospect Slough, and Cache Slough (Appendix 42 in CVRWQCB 2011).

Diazinon water quality objectives, not to be exceeded more than once in a 3-year period, are the following:

- 0.16 micro-grams per liter (ug/L) (1-hour average) (acute)
- 0.10 ug/L (4-day average) (chronic)

Chlorpyrifos objectives, not to be exceeded more than once in a 3-year period, are the following:

- 0.025 ug/L (1-hour average) (acute)
- 0.015 ug/L (4-day average) (chronic)

The Proposed Project does not involve the use, application, or discharge of these chemicals. Therefore, this TMDL is not applicable to the Proposed Project and is not discussed further.

Methylmercury

A Sacramento-San Joaquin Delta methylmercury TMDL was approved and effective as of October 20, 2011. This TMDL applies specifically to Miner Slough, the DWSC, Prospect Slough, and Cache Slough (Appendix 43 in CVRWQCB 2011). The current TMDL target is in the form of maximum average fish tissue concentration levels for animals in various trophic levels and at different sizes (Table 3.2-8). Multiple environmental factors affect mercury bioaccumulation and trophic transfer through the Delta food web, including physical-chemical properties of the habitat that affect the formation and degradation (e.g., photodemethylation) of methylmercury, exposure time to methylmercury (via diet for higher trophic levels), and the mobility, longevity, and growth rate of organisms ingesting it. Factors controlling methylmercury production and export from restored Delta freshwater tidal wetlands have yet to be fully investigated. Import and export loads of methylmercury have never been quantified in freshwater tidal wetlands, and only one study has been done of methylmercury loads in a saltwater tidal marsh (Mitchell et al. 2012).

Because the cycle of methylmercury formation, transport, transformation, and fate within the Delta is not fully understood, the Basin Plan requires that regulated dischargers to Delta waters participate in control studies intended to investigate (a) the production of methylmercury in, and downstream transport from, key habitats and (b) practical management practices that may reduce production and export of this compound. Currently, DWR and California Department of Fish and Wildlife (CDFW) are developing ambitious methylmercury control studies, as approved by the Central Valley Water Board, to assist in determining freshwater tidal wetland imports and exports of methylmercury. These studies would help DWR and CDFW determine whether tidal wetlands are a significant source or sink (or both) of methylmercury and total

mercury, and may help inform restoration plan designs and management practices that could be used to lessen any impacts of methylmercury production in freshwater tidal wetlands.

Waste discharge requirements (WDRs)

As established by the Porter-Cologne Act, WDRs are water quality permits issued by the California Water Boards to dischargers of pollution into State waters (California Water Code, Section 13260). The Water Boards maintain the authority to issue WDRs to any suspected discharger. However, if Water Quality Certification is issued to an applicant seeking a federal license/permit, WDRs are not normally issued separately. WDRs may be required for some aspects of dredging. See the discussion below on possible federal and state dredging requirements.

California Toxics Rule

California adopted the California Toxics Rule in 2000, based on the USEPA's prior issuance of the National Toxics Rule in 1982. As the "Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California" (amended in 2005), the rule adopts and implements priority pollutant criteria; establishes standardized approach for permitting discharges of toxic pollutants to California's non-ocean waters; and generally updates, refines, and standardizes a pattern for water quality control that would be absorbed into the regional basin planning and water quality control efforts. This policy influences regulatory programs, such as water quality certification, that may be applied to the Proposed Project by the RWQCB.

State Water Resources Control Board

Water Rights Decision 1641 (D-1641) (SWRCB 2000), as amended, is part of SWRCB's implementation of the 1996 and 2006 Bay-Delta Plans. The decision amends water rights by assigning responsibilities to persons or entities holding said rights, thereby affecting permits and licenses.

D-1641 sets standards for outflow, EC and chloride, at compliance stations for municipal and industrial, agricultural and fish and wildlife beneficial uses (*See* SWRCB 2006 Bay-Delta Plan Tables 1, 2 and 3, or Table 3.2-11 and Table 3.2-12 below). Standards are differentiated by water-year type.

Table 3.2-11. Water Rights D-1641 Electrical Conductivity (EC) Standards for Agricultural, and Fish and Wildlife Beneficial Uses

Station	Water Year Type[1]	Fish and Wildlife		Agriculture			
		Value[2]	Time Period	Value[2]	Time Period	Value[2]	Time Period
Sacramento at Emmaton (D22)	Wet	not applicable		0.45	Apr 1–Aug 15	not applicable	
	Above Normal			0.45	Apr 1–Jun 30	0.63	Jul 1–Aug 15
	Below Normal			0.45	Apr 1–Jun 19	1.14	Jun 20–Aug 15
	Dry			0.45	Apr 1–Jun 14	1.67	Jun 15–Aug 15
	Critical			not applicable		2.78	Apr 1–Aug 15
San Joaquin at Jersey Point (D15)	Wet	0.44	Apr 1–May 31	0.45	Apr 1–Aug 15	not applicable	
	Above Normal	0.44	Apr 1–May 31	0.45	Apr 1–Aug 15	not applicable	
	Below Normal	0.44	Apr 1–May 31	0.45	Apr 1–Jun 19	0.74	Jun 20–Aug 15
	Dry	0.44	Apr 1–May 31	0.45	April 1–June 14	1.35	Jun 15–Aug 15
	Critical	not applicable		not applicable		2.20	Apr 1–Aug 15
San Joaquin at Prisoners Point (D29)	Wet, Above Normal, Below Normal, Dry	0.44	Apr 1–May 31	not applicable			

[1] Sacramento Valley Water Year Hydrologic Classification (http://cdec.water.ca.gov/cgi-progs/iodir_ss/wsihist).
[2] Maximum 14 day running average of mean daily EC (mmhos/cm).

Table 3.2-12. Water Rights D-1641 Chloride Standards for Municipal and Industrial Beneficial Uses

Station	Water Year Type[1]	Municipal and Industrial	
		(Cl^-) Value[2]	Days of the Calendar Year
Contra Costa Canal at Pumping Plant 1 (C5)	Wet	less than or equal to 150	240
	Above Normal		190
	Below Normal		175
	Dry		165
	Critical		155
Contra Costa Canal at Pumping Plant 1 (C5)	All	250	Oct-Sep
West Canal at mouth of Clifton Court Forebay (C9)			
Delta-Mendota Canal at Tracy Pumping Plant (DMC1)			
Barker Slough NBA intake (SLBAR3)			
Cache Slough at City of Vallejo Intake (19)			

[1] Sacramento Valley Water Year Hydrologic Classification (http://cdec.water.ca.gov/cgi-progs/iodir_ss/wsihist).
[2] Maximum mean daily value in mg/L.

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, the following have been considered in the analysis of potential impacts and identification of mitigation, as needed.

Solano County General Plan ordinances and policies

Prospect Island is located in Solano County; and is upstream of Contra Costa and San Joaquin County waterbodies. Chapter 4 of the Solano County General Plan (Solano County Board of Supervisors 2008) includes the following water quality related goal and associated policies:

Goal:

RS.G-10: Foster sound management of the land and water resources in Solano County's watersheds to minimize erosion and protect water quality using best management practices and protect downstream waterways and wetlands. (Page RS-6)

Associated Policies:

RS.P-28: Protect long-term water quality in the Delta in coordination with water agencies at local, state, and federal levels for designated beneficial uses, including agriculture, municipal, water-dependent industrial, water-contact recreation, boating and fish and wildlife habitat. (Delta policies; Page RS-29)

RS.P-73: Use watershed planning approaches to resolve water quality problems. Use a comprehensive stormwater management program to limit the quantity and increase the water quality of runoff flowing to the county's streams and rivers. (Page Rs-77)

3.2.2 Significance criteria

Criteria for determining significant impacts on water quality are based upon the Appendix G *Environmental Checklist* of the CEQA Guidelines and professional judgment. Effects on water quality are considered significant if the Proposed Project would:

- Result in substantial adverse effects on beneficial uses of water.
- Violate existing water quality standards, waste discharge requirements, or otherwise substantially degrade water quality.
- Result in substantial adverse effects on public health or environmental receptors.

- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff.

3.2.3 Impacts and mitigation

Impact 3.2-1: Short-term construction-related water quality impacts

Dewatering discharges, stormwater run-off and erosion, leaking construction equipment, and accidental spills occurring during site preparation and construction of the Proposed Project could result in short-term discharges of salinity, turbidity, petroleum-based products, and floating materials to receiving waters. These potential short-term discharges could cause exceedances of Basin Plan water quality objectives and impact associated beneficial uses.

Salinity of surface water at Prospect Island was previously shown to be on the order of 0.05–0.11 ppt (Table 3.2-5), with salinity ranges in shallow groundwater wells on the order of 0.1–2.2 ppt (Table 3.2-6). While dewatering activities may potentially result in discharges of waters with elevated salinity in excess of the 0.25 ppt thresholds for municipal (MUN) and industrial (IND) supplies (Table 3.2-8), existing salinity levels on-site are well below the 4–12 ppt toxicity thresholds to support aquatic life (CVRWQCB 2000). Further, because there are no water diversions for MUN and IND water supplies within the vicinity of Prospect Island, it is expected that no measurable increases in salinity or salinity-related impacts to these uses will result from potential discharges of dewatering operations under the Proposed Project.

For discharges of pollutants listed above other than salinity, implementation of Mitigation Measures 3.2-1.1, 3.2-1.2 and 3.2-1.3 would reduce these potential short-term impacts to *less than significant*.

Mitigation Measure 3.2-1.1
A site dewatering plan shall be developed by the construction contractor and submitted to DWR for approval prior to commencement of construction activities. The site dewatering plan shall include items such as the following:

1. Detailed description of work to be performed to control surface water at the Project site.
2. Detailed description of methods, installation and details of the dewatering systems proposed to be used.

3. Drawings showing the detailed layout of dewatering systems including pumps, ditches, berms, discharge lines, Best Management Practices (BMPs), and barriers to shield or divert flow.
4. Supporting design information including design calculations prepared by a California Registered Civil Engineer, type of systems, sizes, capacities, proposed number and layout of pumps, depths, filters, other needed equipment, and power supply.
5. Information related to backup pumping systems, backup power systems, and warning systems to protect against power failure, system failure, and high groundwater.
6. Information related to operation, maintenance, monitoring, removal, decommissioning pumps, and system abandonment procedures.
7. Information related to discharge, including methods to monitor turbidity and water treatment if necessary.
8. Provisions for handling significant rainfall events (greater than 0.5 in predicted in a 24-hour period as described in the Stormwater Pollution Prevention Plan [SWPPP]). This shall also include procedures to be followed prior to the forecasted significant rain events.
9. Provisions for handling emergency situations such as power outages, equipment failures, pumping system shutdowns and the proposed response.
10. Information on schedule and sequencing of dewatering activities.
11. Information on dewatering operations shall be coordinated with other construction operations including placement of compacted soil, removal and placement of pipe, and other miscellaneous items.

Mitigation Measure 3.2-1.2

Upland areas of the Project associated with staging activities shall be covered by a Stormwater Pollution Prevention Plan (SWPPP). All contractors working in a capacity that could increase the potential for adverse water quality impacts would receive training regarding the need to minimize impacts. Contractors would also be familiar with general storm water construction-site BMPs for the protection of water quality. The SWPPP may include, but would not be limited to, the following:

1. Use of vegetated buffers, hay wattles or bales, sandbags, silt screens, or other erosion control measures to intercept runoff from construction, excavation, or staging areas to adjacent waterbodies.
2. BMPs for staging of construction supplies and waste management.

Mitigation Measure 3.2-1.3

A Spill Prevention, Control, and Response Plan shall be developed by the construction contractor and submitted to DWR for approval prior to commencement of construction activities. Spill prevention and cleanup kits, equipment, and materials shall always be in close proximity to locations of hazardous materials (e.g., at fueling and staging areas) and conveniently located to allow rapid response. Prior to entering the work site, all field personnel would be informed of the location of the spill prevention and cleanup kits and appropriately trained in spill prevention, hazardous material control, and spill cleanup. The work site would be routinely inspected to verify that the Plan is properly implemented. The Plan would include:

1. A vehicle inspection and fueling plan.
2. BMPs for spill prevention and containment.
3. Locations and uses of spill prevention materials, cleanup kits, and equipment.
4. Qualification and reporting requirements for a federal reportable spill (CFR, Title 40, Section 110) including contact information for the RWQCB and the California Department of Toxic Substances Control (DTSC).

Impact significance

Less than significant with mitigation

Impact 3.2-2: Short-term construction-related increases in turbidity and/or mobilization of contaminants from dredging and excavation of levee breaches

The Proposed Project has potential to increase turbidity and suspended sediment levels within Miner Slough and in downstream waters during mechanical dredging of the spur channel on the south property and excavation of two levee breaches along Miner Slough on both the north and south properties. Short-term increases in turbidity in Miner Slough and downstream waters would potentially occur at levels that could exceed Basin Plan water quality objectives during, and in the immediate days following, these construction activities. Additionally, sediment-associated contaminants may be present in the spur channel sediments and/or in the Miner Slough levees and these contaminants could be mobilized into Miner Slough and downstream waters during dredging and excavation activities.

Mechanical dredging of Miner Slough spur channel

Mechanical dredging of the Miner Slough spur channel using a clamshell dredge would remove 47,000 cubic yards (cy) of material at a depth of 8–11 ft to allow unimpeded tidal exchange to occur through the southern breach to Miner Slough. Clamshell dredging can re-suspend sediments during bucket lifting and can generate a temporary plume that increases suspended sediment concentrations above background measurements by 150-900 milligrams per liter (mg/L) and turbidity by 5-40 NTU in the general vicinity of the dredge site (Palermo et al. 1990, USACE 1987).

Mechanical dredging would occur during the in-water work window of July 1 through October 31 (Section 2.2.2 *Proposed Project Actions – Description of Project components and construction activities*), when flows in the Delta are typically lowest. At low tide water levels would expose the greatest fraction of material to be excavated above the water line. In addition, because the Miner Slough spur channel is a dead-end channel with limited tidal exchange, suspended sediment generated by the dredging activities would most likely settle within the channel and would not move into Miner Slough, minimizing the potential for violation of turbidity standards or substantial degradation of water quality in the slough.

Given that background turbidity during the in-water work window (July 1 through October 31) is typically low (Section 3.2.1 *Water Quality – Setting*), the use of turbidity controls (e.g., silt curtains) during dredging activities is included in Mitigation Measure 3.2-2.1 to decrease the potential for short-term increases in suspended sediments or turbidity in Miner Slough that may exceed Basin Plan water quality objectives. Implementation of Mitigation Measure 3.2-2.1 would reduce potential turbidity impacts from dredging to *less than significant*.

To assess the potential for sediment-associated contaminants present in the Miner Slough spur channel to be mobilized during dredging activities, DWR undertook physical and chemical analyses of five composite sediment samples collected in 2015 from ten locations in the spur channel (Kinnetic Laboratories 2016b). Underwater sampling of the spur channel used boat-mounted vibratory coring equipment and small diameter (4 in) cores. Sampling and testing were carried out with guidance from the *Inland Testing Manual* (USEPA and USACE 1998) for dredge materials and the *Upland Testing Manual* (USACE 2003) for the upland disposal of dredge materials, with further guidance from the *Delta Dredging and Reuse Strategy Report* (CVRWQCB et al. 2002). Analyses included grain size distribution, total organic carbon (TOC), percent solids, as

well as a number of potential contaminants of concern (i.e., aluminum [Al], antimony [Sb], arsenic [As], barium [Ba], beryllium [Be], boron [B], cadmium [Cd], cobalt [Co], chromium [Cr], copper [Cu], mercury [Hg], manganese [Mn], molybdenum [Mo], lead [Pb], nickel [Ni], selenium [Se], silver [Ag], titanium [Ti], vanadium [V], zinc [Zn], polycyclic aromatic hydrocarbons [PAHs], polychlorinated biphenyls [PCBs], butyltins, hexavalent chromium, ammonia, organochlorine pesticides, organophosphate pesticides) (Kinnetic Laboratories 2016a, b). The Miner Slough spur channel sediment samples also were analyzed for acid generation/neutralization potential (NP: AGP ratio) and cation exchange capacity (CEC) (Kinnetic Laboratories 2016b). Further, a Standard Elutriate Test (SET) was conducted on the spur channel samples to conservatively simulate the action of the clamshell dredge that might cause mobilization of contaminants present in sediment porewaters during the dredging process. The SET extracts were analyzed for much of the same set of constituents analyzed in the sediment samples (see above list). The SET extracts also underwent multiple-dilution acute toxicity testing using Fathead Minnows (*Pimephales promelas*) (Kinnetic Laboratories 2016b). Lastly, 10-day toxicity testing was conducted using the freshwater amphipod *Hyalella azteca* and the freshwater midge *Chironomus dilutes* (Kinnetic Laboratories 2016b).

Results of the sediment testing indicate that while some contaminant concentrations in the Miner Slough spur channel exceeded screening values for adverse biological effects to benthic organisms, as well as screening values for terrestrial plants and animals, the contaminants were not toxic to benthic organisms and are generally within the range of background concentrations for sediments in the Delta (Kinnetic Laboratories 2016b). Further, SET testing of sediment porewaters indicate that while Basin Plan water quality objectives could be exceeded directly at the dredge site with no dilution for aluminum (Al), barium (Ba), and manganese (Mn) at all sampling sites, and for zinc (Zn) at one sample site, a small dilution factor (i.e., 6:1) would bring all concentrations in line with water quality objectives. There was no evidence of toxicity to Fathead Minnows in the SET samples (Kinnetic Laboratories 2016b).

Overall, as sediment-associated contaminants found in the Miner Slough spur channel sediments were not toxic to benthic organisms and are generally within the range of background concentrations, and because dilution factors of sediment porewater within the spur channel would be very likely to exceed 6:1 during clamshell dredging, there is minimal potential for mobilization of contaminants during dredging of the Miner Slough spur channel. However, since some mobilization could occur, implementation of turbidity controls included in

Mitigation Measure 3.2-2.1 would be required to reduce this potential impact to *less than significant*.

Excavation of Miner Slough levee breaches

Excavation of two levee breaches to Miner Slough totaling 1,060 ft in length and 50,800 cy in volume (above and below mean higher high water [MHHW]) (Table 2.2-3) would occur under the Proposed Project in order to reconnect the site to tidal action. Levee breaches would occur at the end of the Proposed Project from August to mid-November ~~2018~~of construction Year 3.

The potential for short-term, sediment re-suspension from levee excavation would be minimized by working from the dewatered landward side toward tidal waters in Miner Slough to breach the levee, such that water would slowly equilibrate on both sides of the levee and avoid a surge of turbidity into Miner Slough. For necessary in-water work, excavation of the levee breaches would occur over a maximum period of a few hours to one day at each location and would mostly occur during slack low tide and early flood tide periods. This would allow the greatest fraction of material to be excavated above the water line and also allow suspended sediments to settle within Prospect Island prior to the following ebb tide. Therefore, any increases in turbidity in Miner Slough as a result of levee breach excavation would be temporary and localized.

Results of sediment testing in numerous locations on Prospect Island and the adjacent Miner Slough spur channel indicate that while some contaminant concentrations exceeded screening values for adverse biological effects to benthic organisms, as well as screening values for terrestrial plants and animals, the contaminants were not toxic to benthic organisms and are generally within the range of background concentrations for sediments in the Delta (Kinnetic Laboratories 2016a, b). Thus, levee sediments would not be likely to mobilize contaminants during excavation as described for the spur channel dredge materials. Additionally, because the majority of excavation work would be completed on the dewatered landward side, with necessary in-water work conducted at times (i.e., ebb tide) when the majority of mobilized sediments would settle within Prospect Island, there is minimal potential for mobilization of contaminants into Miner Slough during excavation of the levee breaches.

Lastly, DWR is currently working with the CVRWQCB to obtain a Clean Water Act Section 401 Certification for the Proposed Project. The conditions set forth in the certification would be followed to prevent adverse effects to water quality. Water quality monitoring would occur for dredging and excavation activities, as

required by 401 Certification conditions. Coordination with the CVRWQCB would establish construction requirements to prevent violation of water quality standards set forth in the Basin Plan and to ensure that water quality is not substantially degraded through Proposed Project activities. These activities, along with implementation of Mitigation Measure 3.2-2.1 would reduce potential impacts from dredging and excavation to *less than significant*.

Mitigation Measure 3.2-2.1

1. Appropriate turbidity control measures (e.g., silt curtains) shall be required during all dredging operations. Selection of appropriate turbidity control measures would consider tidal forces in Miner Slough and would be designed to be robust and effective. Turbidity measures would be in place 1–2 days prior to commencement of dredging operations and would be positioned slightly above the bottom sediments allowing aquatic species to escape entrapment.
2. The cycle time of the ascending loaded dredging bucket shall be limited to a velocity that reduces the potential to wash sediment out of the bucket.
3. The number of bites performed per cycle shall be limited to one to reduce sediment re-suspension from opening and closing the dredging bucket.

Impact significance

Less than significant with mitigation

Impact 3.2-3: Short-term construction-related effects from application of aquatic herbicides

The Proposed Project includes application of aquatic herbicides for invasive plant species control to approximately 504 ac of the Proposed Project site. The potential effects of herbicides and/or adjuvants in the Proposed Project area on water quality are assessed by considering herbicide type, product, application method, frequency, and amount applied (Table 3.2-13), as well as location of application (i.e., aquatic, riparian, upland), toxicity potential and exposure levels of concern, and consideration of DWR's approach to herbicide transport. As there are no specific water quality standards for aquatic herbicides included in the Basin Plan (Table 3.2-8), a significant water quality impact is defined as one that would result in toxicity to aquatic species and substantially adverse effects on fisheries-related beneficial uses of water.

Application method and frequency

Under the Proposed Project, following dewatering of the site, herbicides approved for aquatic uses would potentially be applied to broad areas within Prospect Island (i.e., up to 411 ac within agricultural ditches and in moderate subtidal [< 0 ft NAVD 88] habitats). Where possible, spot application, allowing the greatest control over and least possible impact from herbicide application, would be used to target particular plants. However, given the large area of potential application, aerial application may be required to most effectively target invasive species at the Proposed Project site. To ensure their efficacy, herbicides would be applied to dewatered areas of Prospect Island previously colonized by invasive plant species following initial drawdown (Table 2.2-6). As a conservative estimate, the amount to be applied corresponds to the maximum allowable rate per ac for aquatic applications, as published on product labels (Table 3.2-13). Because aquatic herbicide application would occur on dewatered soils, water quality impacts would be limited. However, herbicides have the potential to be transported into surrounding waterways via spills, aerial drift during application, runoff, and via pumped discharge during intermittent site dewatering. Thus, toxicity potential and exposure levels of concern are considered for each of the herbicide types that may be used under the Proposed Project.

Table 3.2-13. Aquatic-approved Herbicides, Application Method, Frequency, and Amount, Which May Be Used for Control of Invasive Emergent Vegetation on Prospect Island

Herbicide Type	Product	Application Method	Application Frequency	Amount to be Applied[1]
Imazapyr	Habitat, Polaris	Spot application (backpack), aerial spray (fixed-wing aircraft or helicopter)	Once following initial dewatering (October)	Approximately 6 pts/ac for up to 411 ac
Glyphosate	Roundup Custom, AquaMaster			Approximately 7.5 pts/ac for up to 411 ac
Aminopyralid	Not specified[2]			

Source: (DWR and CDFW 2014).

[1] Maximum allowable rate per acre for aquatic applications as published on the product labels.

[2] Awaiting USEPA and California Department of Pesticide Regulation (CDPR) approval for aquatic use prior to Proposed Project implementation.

Toxicity potential

The toxicity potential of herbicides and surfactants is determined using results of USEPA standardized acute and chronic toxicity tests, which are typically performed on broad taxonomic groups of organisms (i.e., birds, mammals, freshwater fish, freshwater invertebrates, estuarine/marine fish, estuarine/marine invertebrates, terrestrial plants, and algae and aquatic plants). Acute and chronic endpoints for the toxicity tests are generally selected based on the most sensitive

species tested within the organism group and provide a concentration or dose at which the laboratory test organisms are significantly affected. A common toxicity test metric is the "LC50", or lethal concentration at which half of the test organisms are killed; LC50 values are reported for a particular exposure time (e.g., 96 hours). Toxicity categories, which are qualitative descriptors of acute toxicity to test organisms, have been adopted by the USEPA for fish and aquatic invertebrates based on Zucker (1985, as cited in USEPA 2002) (Table 3.2-14).

Table 3.2-14. USEPA Aquatic Toxicity Characterizations Based on Results of Acute Aquatic Toxicity Test Results (estimated concentrations that would result in 50% mortality) for Fish, Invertebrate, and Plant (algae) Species

Lethal Concentration (LC50)	Toxicity Characterization
>100	"Practically Non-toxic"
10–100	"Slightly Toxic"
1.0–10	"Moderately Toxic"
0.1–1.0	"Highly Toxic"
<0.1	"Very Highly Toxic"

Source: http://www.epa.gov/espp/litstatus/effects/ne_paraquat.pdf

The following is a brief review of the herbicides and surfactants anticipated for aerial application on Prospect Island for invasive plant species control, along with the associated USEPA toxicity characterization and mobility in the environment.

Imazapyr

Imazapyr, a member of the imidazolinone class of herbicides, is a non-selective, broad-spectrum, systemic herbicide. Imazapyr is relatively mobile in the environment since it is readily transported through soil leaching and surface runoff (USEPA 2007). Primary degradation products of imazapyr are pyridine hydroxy-dicarboxylic acid and pyridine dicarboxylic acid. Habitat and Polaris, the imazapyr-containing products proposed for use on Prospect Island, are both categorized as "practically non-toxic" to fish and invertebrates (BASF Corporation 2014, Nufarm Americas 2012). Algal toxicity has not been tested for these products, however various other imazapyr-containing products are categorized as slightly toxic to algae (SERA 2011b, USEPA 2006). Given its relative mobility in soils and runoff, imazapyr and/or its primary degradation products may be present in runoff and/or pumped discharge from the Proposed Project site following its application.

Glyphosate

Glyphosate is a broad-spectrum, systemic herbicide. Glyphosate is immobile in the soil and is rendered inactive over a period of several weeks through microbial degradation (Schuette 1998). Reported soil half-life values range from approximately 2 to 197 days; in water from approximately 3 to 91 days. Its primary degradation product is aminomethylphosphonic acid. There are approximately 50 or more commercial formulations (SERA 2011a), each with potentially differing toxicity. Both glyphosate-containing products, Round-up Custom and Aquamaster, proposed for use on Prospect Island are categorized as “practically non-toxic” to fish and invertebrates and “slightly toxic” to algae (Monsanto 2012). Given the low soil mobility of glyphosate, there is a low likelihood that residue would be present in runoff and/or pumped discharge from the Proposed Project site following its application.

Aminopyralid

Aminopyralid is a selective, systemic herbicide (in the pyridine class) intended for use against broadleaf weeds such as thistles and clovers (SERA 2007). Currently four aminopyralid products are registered in California (CDPR 2013). Although a specific aminopyralid-containing product has not been named in the Proposed Project Description, this herbicide may be used in place of others mentioned above if approved by USEPA and California Department of Pesticide Regulation (CDPR). Products that contain aminopyralid are generally categorized as “practically non-toxic” to fish and invertebrates and “slightly to moderately toxic” to algae (SERA 2007). Aminopyralid is mobile in the aqueous phase and is considered non-persistent in soil (EUFootprint 2011, as cited in Newhart 2013).

Surfactants

Herbicides are often mixed with surfactants to ensure greater plant membrane penetration and effectiveness. When added to liquids, surfactants form films consisting of both hydrophilic and hydrophobic molecular layers, which act to lower the surface tension between otherwise incompatible liquids (oil and water, for example) or between a liquid and an otherwise more impermeable solid (e.g., a waxy plant leaf surface). While ecological toxicities for the proposed herbicides are low (“practically non-toxic” to “slightly toxic”), the toxicities of the various surfactant products can range from “practically non-toxic” to “highly toxic” (SERA 2011b). Although herbicide surfactants are generally used at a very low tank mix concentration (0.5%), this may increase toxicity of the final herbicide mixture.

Overall, herbicide type (i.e., aquatic-approved), application method (i.e., to dewatered soils), application frequency (i.e., once immediately following

dewatering), amount applied (i.e., according to label specifications), and toxicity potential (i.e., slightly toxic to practically nontoxic), suggest that there is a low likelihood of toxicity- and/or beneficial use-related water quality impacts due to aquatic herbicide application within Prospect Island. This is particularly true for glyphosate, which exhibits low soil mobility and is not likely to be present in runoff and/or pumped discharge following application. Despite this, given the broad-scale application involving aerial spraying and the potential for off-target spray drift and accidental spills, application of aquatic herbicides under the Proposed Project could result in a substantially adverse effect on beneficial uses of water. Implementation of Mitigation Measures 3.2-3.1 and 3.2-3.2 would reduce these impacts to *less than significant*.

Mitigation Measure 3.2-3.1

Best Management Practices (BMPs) shall be employed in order to minimize potential impacts to water quality from accidental spills. All contractors working shall receive training regarding the need to minimize impacts. Contractors shall be experienced and compliant in the environmentally safe application of herbicides. BMPs shall include, but not be limited to, the following:

1. Areas for storage, mixing, and loading of herbicides shall be located where accidental spills to nearby waterbodies cannot occur.
2. Applicators shall be trained in proper spill response, and rapidly report any spill to the appropriate agencies.
3. Applicators shall maintain on-site (near herbicide storage and loading equipment) appropriate initial spill-response items (e.g., absorbent materials).

Mitigation Measure 3.2-3.2

In order to minimize off-target spray drift and impacts to water quality from herbicide application, aerial pesticide application by helicopter shall be preferred (over fixed wing aircraft). In addition, all appropriate, standard BMPs for aerial application of pesticides shall be followed, including but not limited to, the following:

1. Applicators shall develop an application plan--including maps of the Project site showing general spotter and flight plans with application areas clearly indicated--to be approved by the Lead Agency, before any application of herbicides.
2. Applicators shall adhere strictly to proper mixing and application guidelines as presented on herbicide labels and in product instructions.

3. Application of herbicides on levee vegetation shall not take place by air and otherwise avoided unless necessary, when it would be executed using spot application techniques.
4. Herbicide application by air shall only take place during the in-water work window from July 1 to October 31 of any one year, in order to reduce potential impacts to migrating fish species of concern.
5. Applicators shall maintain records of herbicide applications—including dates, times, weather conditions, amount of herbicide applied, problems experienced, etc.—in addition to or as required by federal, state, and/or local agencies.
6. Spraying shall at all times be halted when flying over levees, adjacent waterbodies (e.g., Miner Slough, DWSC), and agricultural fields.
7. Aerial application would occur only during light winds, non-gusty, relatively cool weather conditions.
8. Application would involve the use of appropriate spray nozzles, nozzle configurations, and nozzle orientations that minimize atomization of herbicide mixtures and production of fine droplets that tend to drift.
9. Herbicide tanks would not be operated at excessively high pressures.
10. If conditions require the use of aerial spray by fixed-wing aircraft, pilots shall be instructed to include an appropriate spray buffer (in addition to the width of the levee) where, to the extent possible, no herbicides would be directly applied (subject to overriding safety concerns).

Impact significance

Less than significant with mitigation

Impact 3.2-4: Short-term construction-related effects on water temperature in adjacent waterbodies due to dewatering activities

Applicable Basin Plan water quality objectives stipulate that natural receiving water temperatures shall not be altered unless beneficial uses would not be adversely affected, with a maximum increase of no more than 5 °F (Table 3.2-15). Prospect Island monthly average water temperatures appear to be similar or slightly cooler than those measured in Miner Slough at the HWY 84 Bridge for the period 2011-2013 (Table 3.2-15). Although there may be daily variations in water temperature within Prospect Island that could affect water temperature at the dewatering discharge point, the dewatering pump discharges are only expected to be a small fraction of the daily tidal flow range within Miner Slough (Section 3.1.1 *Hydrology – Setting*). Therefore, the potential for warming

of the receiving waters from dewatering activities is expected to be minimal and there would be no impact.

Table 3.2-15. Monthly Measured Water Temperatures in Miner Slough and Prospect Island 2011–2013

Month	Average Temperature (°F)		
	Miner Slough Measured[a]	Prospect Island Measured[b]	Difference
Jan	47.3	46.0	1.3
Feb	50.1	49.7	0.4
Mar	53.3	53.4	-0.1
Apr	59.6	59.2	0.4
May	64.4	63.7	0.7
Jun	68.0	66.2	1.9
Jul	70.5	67.4	3.1
Aug	70.8	67.6	3.2
Sep	68.5	66.4	2.1
Oct	62.6	61.6	1.0
Nov	55.4	54.3	1.1
Dec	48.4	47.1	1.3

[a] Continuous (15 minute intervals) *in situ* measurements from CDEC HWB station located in Miner Slough at the Highway 84 Bridge. http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=HWB

[b] Continuous (15 minute intervals) *in situ* measurements from the Prospect Island Tide Station located at the pump house in the southeast corner of the north property (CDEC station B91400), http://www.water.ca.gov/waterdatalibrary/docs/Hydstra/index.cfm?site=B91400

Impact significance

No impact

Impact 3.2-5: Long-term effects on salinity in waterbodies near Prospect Island

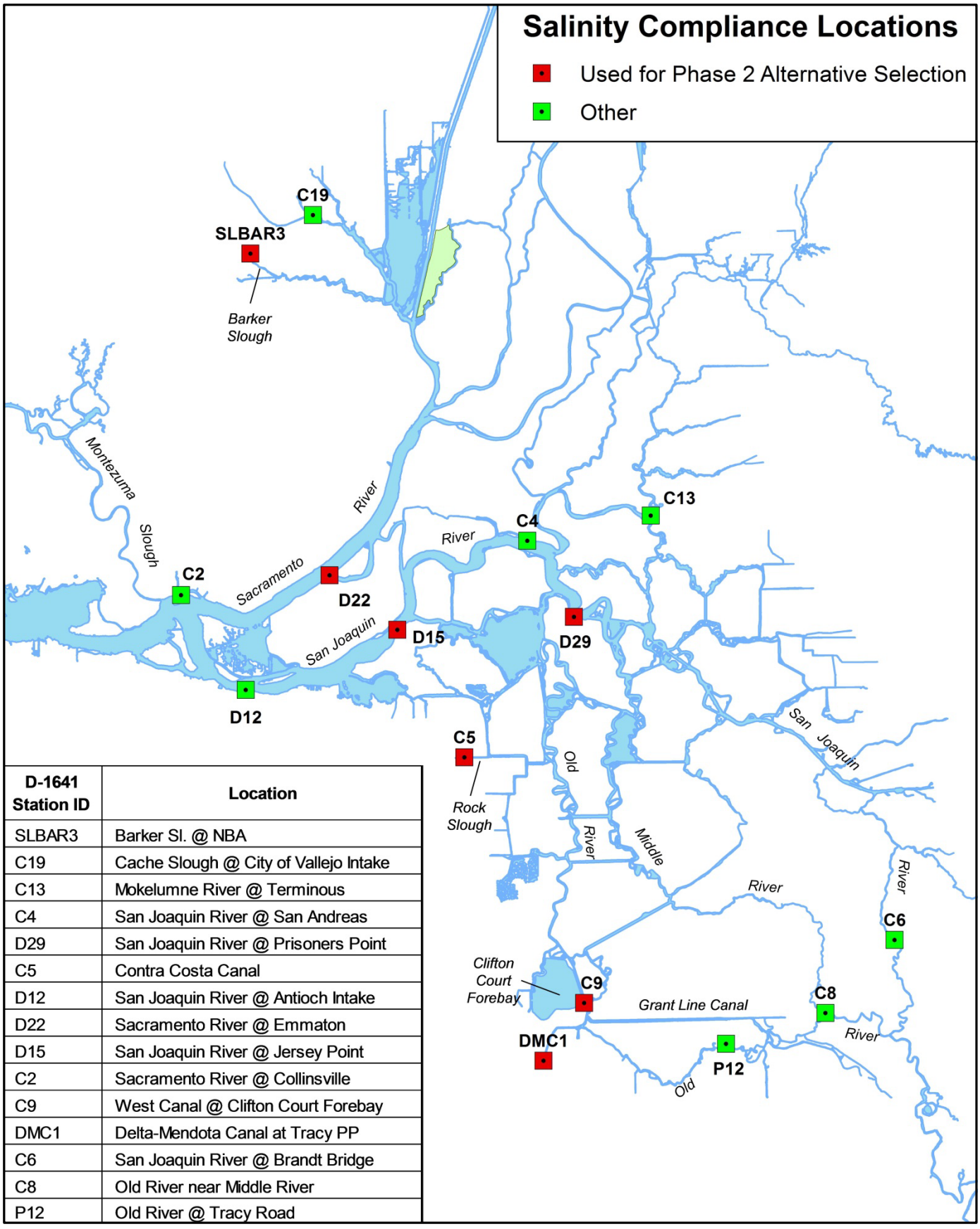
Breaching the levees in the north and south properties, and breaching the interior cross-levee, would subject much of Prospect Island to daily tidal flows and inundation. This would alter hydrology, and could affect salinity, in the vicinity of Prospect Island. Salinity increases are of concern to various municipalities, industry, agriculture, recreationalists, resource agencies, as well as to fish and wildlife in the Delta that depend on availability of freshwater to maintain existing beneficial uses.

Phase 2 hydrodynamic modeling for the Prospect Island Tidal Habitat Restoration Project was conducted to support selection of final restoration alternatives, inform environmental impact assessments, and inform engineering design of the selected alternative (Appendix D in WWR and SWS 2014). The modeled conceptual alternatives included a variety of configurations with varying numbers and locations of weirs and breaches along both Miner Slough and the DWSC. Although the design configurations for EIR alternatives were still being considered when WWR and SWS (2014) was prepared, the alternatives considered in Phase 2 modeling correspond to alternatives in this 2019 FEIR as follows:

- No restoration project (existing conditions);
- Proposed Project (two breaches) = Alternative 26 of the Phase 2 modeling;
- Alternative 2 (two breaches and weir) = Alternative 4 of the Phase 2 modeling; and
- Alternative 3 (three breaches) = Alternative 31 of the Phase 2 modeling.

Phase 2 hydrodynamic modeling for the Prospect Island Tidal Habitat Restoration Project includes an assessment of compliance with D-1641 standards (SWRCB 2000). D-1641 standards were established by the SWRCB, after hearings, to adequately protect water quality for entities, including *agricultural*, *municipal and industrial*, and *fish and wildlife* beneficial uses. D-1641 remains the operable regulatory protections for beneficial uses of water in the region. The analysis considered whether D-1641 water quality standards were exceeded and whether present and anticipated beneficial uses would be unreasonably affected or would result in water quality less than that prescribed in the policies such that D-1641 exceedance is more likely.

Salinity changes were modeled and reported at 15 compliance locations established by D-1641, including seven modeled and reported locations, and eight supplementary locations to support the environmental impact analyses (Figure 3.2-6), under both dry and below-normal / near-normal hydrologic conditions (Appendix D in WWR and SWS 2014) (SWRCB 2000). The seven modeled and reported locations were selected to provide broad spatial representation to provide coverage near Prospect Island and to assess the potential for the Project to affect salinity in intrusion in the Delta (Appendix D in WWR and SWS 2014, page 71). The effects of the restoration project at the locations reported in Appendix D of WWR and SWS 2014 are considered representative of the effects of the project at those locations and of the Delta as a whole.



D-1641 Station ID	Location
SLBAR3	Barker Sl. @ NBA
C19	Cache Slough @ City of Vallejo Intake
C13	Mokelumne River @ Terminous
C4	San Joaquin River @ San Andreas
D29	San Joaquin River @ Prisoners Point
C5	Contra Costa Canal
D12	San Joaquin River @ Antioch Intake
D22	Sacramento River @ Emmaton
D15	San Joaquin River @ Jersey Point
C2	Sacramento River @ Collinsville
C9	West Canal @ Clifton Court Forebay
DMC1	Delta-Mendota Canal at Tracy PP
C6	San Joaquin River @ Brandt Bridge
C8	Old River near Middle River
P12	Old River @ Tracy Road

Figure 3.2-6

SWRCB D-1641 Compliance Locations Used for Salinity Impacts Modeling

Designated beneficial uses in the Delta include *municipal and industrial*, *agricultural*, and *fish and wildlife* objectives and are shown in Table 3.2-7. For the purposes of water quality objectives for beneficial uses, MUN, IND, PRO, REC-1, REC-2, and GWR are grouped together in the *municipal and industrial* objectives (i.e., the same water quality objectives achieve all these beneficial uses). EST, COLD, WARM, MIGR, SPWN, WILD, RARE, SHELL, COMM, and NAV are also grouped together in the *fish and wildlife* objectives (SWRCB 2006). For each modeled and reported compliance location, as well as for each supplemental location, the designated beneficial uses are shown in Table 3.2-16. Because the D-1641 standards are protective of designated beneficial uses in the Delta the primary goal was to determine potential for non-compliance at the compliance locations listed.

D-1641 compliance for stations with *agricultural*, and *fish and wildlife* beneficial use designations (D22, D15, D25, D29, C9, DMC1, C2, C13, C4, C6, C8, and P12; see Table 3.2-16) was determined by comparing the modeled EC values against the D-1641 14 day running average of mean daily EC objective during the specified compliance period (SWRCB 2000). Compliance for stations with *municipal and industrial* beneficial use designations (SLBAR3, C5, C9, DMC1, D12, and C19; see Table 3.2-16) was determined by computing the mean daily value of chloride concentration from the modeled EC values, and comparing the calculated value to the chloride objective (maximum = 250 mg/L; Table 3.2-8). Phase 2 modeling results showed that salinity at the modeled compliance locations in the vicinity of Prospect Island met EC compliance objectives under the Proposed Project, with consistent decreases at Barker Slough (SLBAR3) in the Cache Slough Complex (CSC). Results for breach configurations corresponding to the Proposed Project and Alternatives generally showed decreases in computed electrical conductivity (EC) in the western Delta, with only small increases for central and south Delta locations. During summer and fall when Delta outflows are lowest, results showed less than 1% increase in salinity (EC values ranging from 0 to 32 uS/cm) for the majority of the modeled compliance locations.

Maximum salinity increases during a dry-year hydrology (2009) are less than 6% at all seven modeled and reported D-1641 compliance locations within the Delta, and salinity is only modeled to increase more than a maximum of 3.2% at the San Joaquin river at Prisoners Point (D29), which is not designated for *municipal and industrial*, or *agricultural* beneficial uses (see Executive Summary Table i in Appendix D in WWR and SWS 2014). During a below-normal / near-normal-year hydrology (2010), modeled salinity increases are considerably less, and

modeling shows that they would not exceed 2% for the Proposed Project at any of the seven modeled and reported locations during any month. All of the seven modeled and reported locations are within D-1641 salinity (EC / chloride) compliance limits for all beneficial uses (Appendix D in WWR and SWS 2014), and the Proposed Project or Alternatives do not cause any of the locations to approach exceedance levels during relevant compliance periods.

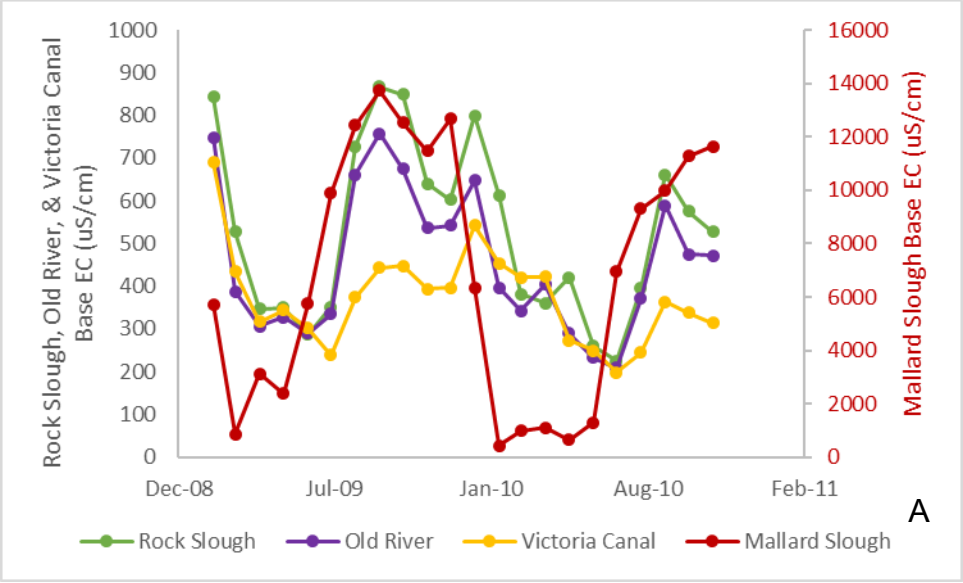
For the eight supplemental compliance stations modeled, maximum salinity increases under the Proposed Project are less than 1% for all locations except for the San Joaquin River at San Andreas (C-4), located on the San Joaquin River to the southeast of the Proposed Project site, which shows a potential maximum salinity increase up to 7.8% during a dry-year hydrology, and up to 2.9% during a below normal-year hydrology (Tables 34 and 35 of Appendix D in WWR and SWS 2014). The C-4 location is an *agricultural* beneficial use site within the Interior Delta and is not near municipal intakes. The Proposed Project or Alternatives would not increase the number of days of non-compliance with D-1641 salinity (EC / chloride) standards from existing conditions at any of the eight supplemental locations (Appendix D in WWR and SWS 2014).

To address concerns raised by Contra Costa Water District (CCWD) in initial comments on the 2016 DEIR (DWR and DFW 2016) related to potential salinity changes at their municipal intakes, supplemental timeseries of modeled EC at four locations have been generated (Figure 3.2-7). A description of the potential changes to CCWD water supplies at each of the four locations is provided below.

Table 3.2-16. SWRCB D-1641 Compliance Monitoring Stations Used to Evaluate the Possibility of Increased Salinity Under the Proposed Project

D-1641 Station ID	Location	Designated Beneficial Uses[1]	
Original 7 D-1641 Compliance Locations Modeled			
SLBAR3	Barker Slough at the North Bay Aqueduct Intake	Municipal and Industrial	MUN, IND, PRO, REC-1, REC-2, GWR
D22	Sacramento River at Emmaton	Agricultural	AGR
D15	San Joaquin River at Jersey Point	Agricultural, Fish and Wildlife	EST, WARM, COLD, MIGR, SPWN, WILD, SHELL, COMM, NAV; AGR
D29	San Joaquin River at Prisoners Point	Fish and Wildlife	EST, WARM, COLD, MIGR, SPWN, WILD, SHELL, COMM, NAV
C5	Contra Costa Canal at Pumping Plant #1 (Rock Slough)	Municipal and Industrial	MUN, IND, PRO, REC-1, REC-2, GWR
C9	West Canal at mouth of Clifton Court Forebay	Municipal and Industrial, Agricultural	MUN, IND, PRO, REC-1, REC-2, GWR; AGR
DMC1	Delta-Mendota Canal at Tracy Pumping Plant	Municipal and Industrial, Agricultural	MUN, IND, PRO, REC-1, REC-2, GWR; AGR
Supplemental 8 D-1641 Compliance Locations Modeled			
C2	Sacramento River at Collinsville	Fish and Wildlife	EST, WARM, COLD, MIGR, SPWN, WILD, SHELL, COMM, NAV; AGR
C13	South Fork Mokelumne River at Terminous	Agricultural	AGR
C4	San Joaquin River at San Andreas Landing	Agricultural	AGR
C6, C8, P12	South Delta locations	Agricultural	AGR
D12	San Joaquin River at Antioch Intake	Municipal and Industrial	MUN, IND, PRO, REC-1, REC-2, GWR
C19	Cache Slough at City of Vallejo Intake	Municipal and Industrial	MUN, IND, PRO, REC-1, REC-2, GWR

1. Designated Beneficial Uses defined in Table 3.2-7.



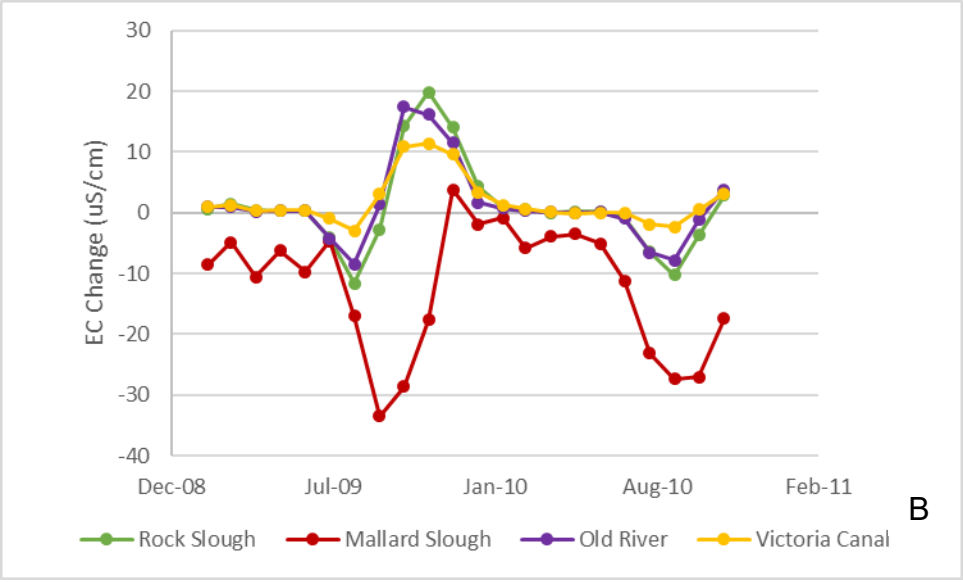


Figure 3.2-7. (A) Base Electrical Conductivity (EC) for CCWD Intakes at Rock Slough, Old River, Victoria Canal, and Mallard Slough; (B) Modeled Change in EC at CCWD Intakes Following Implementation of the Proposed Project.

Rock Slough: EC was modeled and reported at Rock Slough for the Proposed Project (Appendix D in WWR and SWS 2014). Under the Proposed Project, EC at CCWD intakes is modeled to increase by a maximum of 19.9 uS/cm (Figure A-1 [B]), and this is only for CCWD's Rock Slough intake in October, when Base EC is already in the range of 800-900 uS/cm (Figure A-1 [A]), equating to a maximum and seasonal (Fall) 3.1% increase on top of Base EC. The modeled change at Rock Slough has been quantified in terms of chloride as: an average

increase of 0.3 mg/L on top of an existing average of 83 mg/L; and a maximum increase of 6 mg/L on top of an existing maximum of 188 mg/L. Therefore, the Proposed Project would not unreasonably affect municipal beneficial uses at Rock Slough or degrade water quality such that non-compliance with D-1641 is more likely.

Mallard Slough: Mallard Slough has a Base EC (without a restoration project) significantly higher than the other CCWD intake locations (Figure A-1 [A]) and well above drinking water guidelines (RMA 2018), indicating that this intake would not be suitable for future use regardless of tidal restoration projects. Under the Proposed Project, Mallard Slough EC is modeled to decrease in all months except December of a below-normal water year hydrology (Figure A-1 [B]). The modeled change has been quantified in terms of chloride as: an average decrease of 3.7 mg/L out of an existing average of 2028 mg/L; and a maximum chloride increase of 1.2 mg/L on top of an existing maximum of 4169 mg/L. Therefore, the Proposed Project would not unreasonably affect municipal beneficial uses at Mallard Slough or degrade water quality such that existing non-compliance with D-1641 is more likely.

Old River: Base EC at the Old River intake ranged from approximately 200 to 800 µS/cm in 2009 and 2010. Modeled change in EC with the Proposed Project ranged from 11.5 to 17.4 µS/cm (2−3%) in October to December 2009 (dry-year hydrology), but other months modeled showed a decline in EC or < 1% modeled increase (Figure A-1 [B]). The modeled change at Old River under the Proposed Project has been quantified in terms of chloride as: an average decrease of 0.38 mg/L on top of an existing average of 83 mg/L; and a maximum chloride increase of 5.4 mg/L on top of an existing maximum of 154 mg/L. Therefore, the Proposed Project would not unreasonably affect municipal beneficial uses at Old River or degrade water quality such that non-compliance with D-1641 is more likely.

Victoria Canal: Base EC at Victoria Canal ranged from about 200 to 700 µS/cm during the modeling period. Under the Proposed Project, modeled increases in EC ranged from 9.6-11.4 µS/cm (2−3%) from October to December 2009 (dry-year hydrology), but other months showed a decline in EC or negligible < 1% modeled increase (Figure A-1 [B]). The modeled change at Victoria Canal has been quantified in terms of chloride as: an average increase of 0.55 mg/L on top of 35 mg/L; and a maximum chloride increase of 3.5 mg/L on top of an existing maximum of 133 mg/L. Therefore, the Proposed Project would not unreasonably affect municipal beneficial uses at Victoria Canal or degrade water quality such that non-compliance with D-1641 is more likely.

At all of these locations, the Proposed Project or Alternatives would continue to meet the reasonable protection of beneficial uses established by D-1641.

Recent modeling developed as part of the CWA Section 401 permitting, confirms the results of the earlier studies, and shows that modeled changes in salinity for Alternative 2 are similarly small, and in compliance with D-1641 standards (RMA 2018). Please refer to *Alternatives* Section 4.5.2 *Environmental impacts [Water Quality]* for a more detailed summary of RMA (2017).

Modeling results show that projected salinity changes under the Proposed Project would result in small increases and decreases depending on water-year type and time of year. Such changes were small, and would not exceed D-1641 salinity standards at compliance locations and thus avoid unreasonable effects on beneficial uses of water. The changes would not unreasonably affect present and anticipated beneficial uses or result in water quality degradation such that D-1641 exceedance is more likely. Furthermore, these small increases and decreases are consistent with maximizing the beneficial use of water for the State based upon the additional benefits to fish and wildlife from the Proposed Project. There would be a *less than significant* effect on salinity in nearby waterbodies.

Impact significance
Less than significant

Impact 3.2-6: Long-term effects on water temperature within Prospect Island and in nearby waterbodies

Breaching the levees in the north and south properties and breaching the interior cross-levee would subject much of Prospect Island to daily tidal flows and inundation. This would alter hydrology in the vicinity of Prospect Island and could affect water temperature within Prospect Island and in nearby waterbodies.

For temperature-sensitive fishes in the Delta (e.g., Delta Smelt, Chinook Salmon, Steelhead), desirable water temperatures are less than 68°F (20°C). Water temperatures in the range of 68 to 77°F (20–25°C) are considered to be sub-optimal, whereby fish may be stressed physiologically, and reproductive, foraging, and other behaviors may be detrimentally affected (Myrick and Cech Jr. 2001, Appendix B in WWR and SWS 2014). Temperatures above 77°F (25°C) are considered lethal to eggs, fry, and/or adult Delta Smelt and Chinook Salmon (Appendix B in WWR and SWS 2014). If water temperatures are supportive for

these sensitive species, it is generally assumed that they are adequate for other wildlife-related beneficial uses of water.

During the conceptual planning phase of the Proposed Project, Phase 2 modeling of water temperatures was conducted using the aforementioned sub-optimal and lethal thresholds and compared with actual measured water temperatures for 2010 (Appendix B in WWR and SWS 2014). Results for the model configuration most similar to the Proposed Project indicated that waterbodies near and within Prospect Island would not experience sub-optimal or lethal water temperatures during March through May 2010. However, during June through September 2010, actual and modeled sub-optimal water temperatures were exhibited in nearby waterbodies. No lethal temperatures were exhibited (Table 3.2-15 and Table 3.2-16). For waterbodies near Prospect Island, including Miner Slough (HWB), South Miner Slough, Cache Slough at Miner Slough, and Cache Slough at Ryer Island (RYR), the number of days exhibiting actual sub-optimal water temperatures ranged 79–86 out of 122 days, with only slight reductions projected under the Proposed Project (Table 3.2-17). At two sites (South Miner Slough and Cache Slough (RYR)), slightly fewer (1–2) days of sub-optimal temperatures were projected under the Proposed Project as compared with actual conditions, suggesting the potential for slight improvements in seasonal water temperatures under the Proposed Project. Within Prospect Island, Phase 2 modeling results indicated a lesser number of days of sub-optimal water temperatures than in nearby waterbodies (i.e., 69–80 out of 122 days, see Table 3.2-17).

Table 3.2-17. Numbers of Actual and Modeled Days (June to September 2010) Exhibiting Sub-optimal Water Temperatures for Selected Waterbodies near Prospect Island

Waterbody	Existing Conditions	Phase 2 Alt 26
Miner Sl. (HWB)	79 out of 122	79 out of 122
South Miner Sl.	83 out of 122	81 out of 122
Cache Sl. (at Miner Sl.)	86 out of 122	86 out of 122
Cache Sl. (RYR)	86 out of 122	85 out of 122

Source: (Appendix B in WWR and SWS 2014).

Table 3.2-18. Numbers of Modeled Days (June to September 2010) with Sub-optimal Water Temperatures for Selected Habitats on Prospect Island

Habitat	Phase 2 Alt 26
Channels	70 out of 122
Open-water	80 out of 122
Emergent Vegetation	69 out of 122

Source: (Appendix B in WWR and SWS 2014).

Based on the Phase 2 modeling results, projected changes in seasonal water temperatures (June through September) under the Proposed Project in nearby waterbodies would be minor and would not result in substantial adverse effects on beneficial uses of water, in particular the support of habitat for sensitive fish species. Conversely, model results indicate the potential for slight improvements in seasonal water temperatures under the Proposed Project. There would be a beneficial effect on long-term water temperature.

Impact significance

Beneficial

Impact 3.2-7: Long-term effects on primary productivity and dissolved organic carbon (DOC) within and near Prospect Island

The Proposed Project, through the enhancement of subtidal habitat and development of intertidal wetlands, would support beneficial levels of primary productivity on Prospect Island, with subsequent export to the greater Delta as a food source for fisheries (WWR and SWS 2014). During the conceptual planning phase of the Proposed Project, particle tracking simulations were used to model selection for various algal species as well as potential export of primary productivity for a variety of project configurations with varying numbers and locations of breaches and weirs along Miner Slough. One of the modeled conceptual alternatives was similar to the Proposed Project (Phase 1 Alternative 23).

Based on estimated particle exposure times within Prospect Island, model results indicate that the Proposed Project may produce high primary productivity with greater abundance of diatom-based phytoplankton than blue-green algal species associated with harmful blooms (WWR and SWS 2014). Model results also suggest that on a continuing basis, productivity from the Proposed Project would be exported primarily to the surrounding CSC sites in the lower Sacramento

River and the Sacramento DWSC, with lower export potential to Cache Slough and Miner Slough. Overall, export would generally be dominated by preferred diatom-based algal species with high food value to pelagic species (SWS and WWR 2012). This would be consistent with maximizing the beneficial use of water for the State based upon the additional benefits to fish and wildlife from the Proposed Project.

Algae produced at the restored Proposed Project site could also be a source of dissolved organic carbon (DOC) to nearby waterbodies. DOC is a potentially significant problem for water treatment facilities because elevated concentrations can result in the formation of carcinogenic disinfection by-products during chlorination. The intake for the State Water Project's NBA is located in the western CSC at the upper end of Barker Slough, and roughly 9 RMs from the southern end of Prospect Island. Treated water is delivered to Napa, Vallejo, and Benicia municipalities.

Phase 1 modeling simulated potential changes in DOC at the Barker Slough Pumping Plant intake using conservative particle tracking models for 2010 hydrology (Appendix G in SWS and WWR 2012). Modeling results indicated that a small amount (0.9–1.6%) of the total simulated DOC generated at the Proposed Project site was subsequently transported to Barker Slough. Overall, simulated DOC increases at the Barker Slough Pumping Plant intake for the period of July 2010 were largely influenced by increased tidal exchange provided by the Proposed Project, which resulted in Sacramento River water from Miner Slough, Steamboat Slough, and the lower Sacramento River being drawn north into Lindsey Slough on flood tide.

Based on the Phase 1 modeling results, simulated changes in potential DOC increases in nearby waterbodies under the Proposed Project would be low. This would not result in substantial adverse effects on beneficial uses of water, in particular municipal drinking water supply at the Barker Slough Pumping Plant. There would be a *less than significant* effect on long-term DOC concentrations.

Impact significance
Less than significant

Impact 3.2-8: Long-term effects on methylmercury production, bioaccumulation, and export

The Proposed Project would convert existing perennially flooded freshwater emergent marsh to tidal freshwater emergent marsh, which may affect the rate of

methylmercury production and degree of bioaccumulation in higher trophic level organisms resident at the Proposed Project site and may result in subsequent transport of methylmercury to downstream waterbodies. If methylmercury production increases, and depending on the magnitude of the increase, this could result in adverse, few, or no effects on public health or environmental receptors due to elevated methylmercury concentrations in the tissue of fish, birds, mammals, and humans that consume contaminated organisms.

Factors controlling the production and bioaccumulation of methylmercury and its ability to be transported from tidal wetlands into downstream waterbodies are complex and not yet fully understood (Section 3.2.1). Inorganic forms of mercury are present in Prospect Island sediments and levee soils due to upstream historical mining practices in the Sierra Nevada range and the steady passive transport of inorganic mercury downstream through foothill and Valley tributaries to aquatic environments in the Bay-Delta system (Domagalski 1998, 2001; Rytuba 2000; Choe and Gill 2003; Choe et al. 2003; Weiner et al. 2003). In addition, relatively high levels of suspended sediments in the Proposed Project vicinity may contain total mercury from these upstream sources.

Based upon the CALFED Science Program Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) conceptual model of methylmercury production, habitat flooding frequency corresponds with a methylmercury gradient, from relatively low methylmercury concentrations in the overlying water column of perennially flooded habitats (e.g., open-water areas), low to moderate concentrations in habitats that flood frequently and do not fully dry between inundation events (e.g., low elevation tidal marsh), and potentially higher concentrations in areas that flood less frequently and dry out between inundation events (e.g., seasonal floodplains or wetlands and high elevation tidal marsh) (Alpers et al. 2008).

Restoration of tidal action to the site would result in the conversion of existing perennially flooded emergent marsh (i.e., associated with low to moderate methylmercury concentrations) to open-water habitat (i.e., associated with low methylmercury concentrations). The Proposed Project would create a small area of infrequently flooded habitat (i.e., associated with higher methylmercury concentrations) between mean high water (MHW) and MHHW on the landward side of the perimeter levees. Within these habitats, the Proposed Project would accumulate sediment under existing sediment supply conditions, with deeper areas of the Proposed Project site accreting more rapidly than those at higher elevations (see also Impact 3.5-2). Maximum sediment deposition would likely

occur near the breaches and in the deeper central portion of Prospect Island. Although the incoming sediments have the potential to contain mercury from upstream sources, sediment deposition in the infrequently flooded habitat associated with higher methylmercury production is expected to be low.

Because the Proposed Project site would be open to tidal action, any methylmercury produced on-site could be exported to surrounding waterways. The expected habitat changes would increase the area of infrequently flooded habitat and higher methylmercury production, but this would be offset by an increase in open-water habitat and lower methylmercury production. Overall, relatively little, if any, increases in methylmercury export would occur from the restored Proposed Project site as compared to existing conditions.

With respect to bioaccumulation, patterns in biosentinel fish data collected in the Delta suggest that perennially flooded wetlands would likely present a relatively low risk of mercury bioaccumulation through transfer from obligate wetland species residing or feeding in the wetlands to the greater Delta food web. Sites experiencing episodic flooding of normally dry soils exhibited much higher methylmercury in biosentinel fish tissue, an observation that was particularly evident following seasonal flooding events at sites located on the perimeter of the Bay-Delta. In contrast, vegetated, perennially flooded wetlands such as sites in the nearby CSC (i.e., Liberty Island, Little Holland Tract) showed statistically lower biosentinel fish mercury than adjacent non-vegetated sites (Melwani et al. 2007).

Consistent with the Delta Methylmercury TMDL (Section 3.2.1 *Water Quality – Setting*), DWR and CDFW are currently engaged in compliance control studies for methylmercury and total mercury loads from several tidal wetlands in the Delta and Suisun Marsh. These studies are investigating (a) the levels of production, import, and export of methylmercury at and from tidal and open-water habitats in the northern Delta, and (b) potential mechanisms to alleviate, if necessary, methylmercury production and export from these habitats. For example, although several recent studies have suggested that methylmercury water column concentrations in tidal wetlands can be elevated (e.g., Bergamaschi et al. 2012, 2011, Windham-Myers et al. 2009, Mitchell and Gilmour 2008), these studies are based predominantly on data from salt marshes, with limited consideration of non-tidal freshwater wetlands and agricultural wetlands (e.g., rice fields) and no instances of freshwater tidal wetlands, such as the Proposed Project. Further, a recent study in Chesapeake Bay indicates that tidal marshes may not be large contributors when considered

on the basis of mercury loading rather than water column concentrations (Mitchell et al. 2012). The DWR and CDFW compliance control studies would contribute to knowledge that can be used to better understand the potential contributions of freshwater tidal wetlands to Delta methylmercury loading and to inform future restoration project planning efforts such as the Proposed Project.

Overall, the small increase in the area of infrequently flooded habitat associated with higher methylmercury production, would be offset by a large increase in open-water habitat associated with lower methylmercury production and little, if any, increases in methylmercury export and bioaccumulation would occur as a result of the Proposed Project. This would be a *less than significant* impact. Accordingly, the Proposed Project would not affect the CSLC ability to comply with TMDL requirements.

Impact significance
Less than significant

Impact 3.2-9: Long-term effects on groundwater quality

Surface water on Prospect Island is separated from surrounding groundwater flows by an average 25 ft thick, low-permeability clay layer underlying the Proposed Project site (DWR 2014b). As any long-term water quality effects on surface waters due to the Proposed Project would be *less than significant* or *less than significant with mitigation*, and as there is little to no direct connection for surface water to interact with groundwater at the Proposed Project site, the Proposed Project would not affect groundwater quality.

Impact significance
No impact

3.3 Aquatic Biological Resources

This section addresses aquatic biological resources that are likely to occur on or near the Proposed Project site and that could be affected by the Proposed Project. Aquatic biological resources include resident and anadromous fish occurring in water bodies within and adjacent to the Proposed Project site (in the Cache Slough Complex (CSC) and north Sacramento-San Joaquin River Delta [Delta]), invertebrate communities in these water bodies, and aquatic and riparian habitat used by these aquatic organisms.

The impact analysis is based on expert opinion in combination with current sampling efforts including California Department of Fish and Wildlife (CDFW) Interagency Ecological Program (IEP) monitoring programs, and California Department of Water Resources (DWR) Environmental Monitoring Program; a review of relevant environmental documents including the Lower Yolo Ranch Environmental Impact Report (EIR) (SFCWA 2013), Lindsey Slough MND (CDFW 2013), and Dutch Slough EIRs (DWR and California State Coastal Conservancy 2008, 2014); and professional publications.

3.3.1 Setting

Environmental setting

Fish resources

The CSC, Miner Slough, and Prospect Island provide aquatic habitat for at least 44 fish species (Table 3.3-1), all of which have the potential to occur in the Proposed Project area (Sommer et al. 2003). Of the 17 native fish species potentially occurring near Prospect Island, 11 have been designated as special-status species under the federal Endangered Species Act (ESA) or California Endangered Species Act (CESA):

- Pacific Lamprey (*Entosphenus tridentata*; federal species of concern).
- River Lamprey (*Lampetra ayresii*; state species of special concern).
- North American Green Sturgeon (*Acipenser medirostris;* southern Distinct Population Segment [DPS]; federally threatened, state species of special concern).
- Sacramento Splittail (*Pogonichthys macrolepidotus*; state species of special concern).
- Delta Smelt (*Hypomesus transpacificus*; federally threatened, state endangered).
- Longfin Smelt (*Spirinchus thaleichthys*; state threatened).
- Steelhead (*Oncorhynchus mykiss*; federally threatened).
- All four runs of Chinook Salmon (*Oncorhynchus tshawytscha*) occurring in the Central Valley: spring-run (state and federally threatened), fall-run (state and federal species of concern), late fall-run (state and federal species of concern), and winter-run (state and federally endangered).

Additional details on each of the special-status fish species, including status, life history, and habitat requirements, are provided in the sections below.

Table 3.3-1. Fishes Occurring in the Sacramento-San Joaquin Delta and Potentially Occurring at the Proposed Project Site[1]

Common Name	Scientific Name	Native/Introduced	Federal/State Status[2]
PETROMYZONTIDAE—LAMPREYS			
Pacific Lamprey	*Entosphenus tridentata*	Native	SC/--
River Lamprey	*Lampetra ayresii*	Native	--/SSC
ACIPENSERIDAE—STURGEONS			
North American Green Sturgeon	*Acipenser medirostris*	Native	T/SSC
White Sturgeon	*Acipenser transmontanus*	Native	--/--
CLUPEIDAE—HERRINGS			
Threadfin Shad	*Dorosoma petenense*	Introduced	--/--
American Shad	*Alosa sapidissima*	Introduced	--/--
CYPRINIDAE—MINNOWS			
Common Carp	*Cyrpinus carpio*	Introduced	--/--
Fathead Minnow	*Pimephales promelas*	Introduced	--/--
Golden Shiner	*Notemigonus crysoleucas*	Introduced	--/--
Goldfish	*Carassius auratus*	Introduced	--/--
Sacramento Hitch	*Lavinia exilicauda*	Native	--/--
Red Shiner	*Cyprinella lutrensis*	Introduced	--/--
Sacramento Blackfish	*Orthodon microlepidotus*	Native	--/--
Sacramento Pikeminnow	*Ptychocheilus grandis*	Native	--/--
Sacramento Splittail	*Pogonichthys macrolepidotus*	Native	--/SSC
CATOSTOMIDAE—SUCKERS			
Sacramento Sucker	*Catostomus occidentalis*	Native	--/--
ICTALURIDAE—BULLHEAD CATFISH			
Black Bullhead	*Ameiurus melas*	Introduced	--/--
Brown Bullhead	*Ameiurus nebulosus*	Introduced	--/--
Channel Catfish	*Ictalurus punctatus*	Introduced	--/--
White Catfish	*Ameiurus catus*	Introduced	--/--
OSMERIDAE—SMELTS			
Delta Smelt	*Hypomesus transpacificus*	Native	T/E
Longfin Smelt	*Spirinchus thaleichthys*	Native	--/T

Common Name	Scientific Name	Native/Introduced	Federal/State Status[2]
Wakasagi	*Hypomesus nipponensis*	Introduced	--/--
SALMONIDAE—SALMON AND TROUT			
Chinook Salmon (spring-run)	*Oncorhynchus tshawytscha*	Native	T/T
Chinook Salmon (fall-run and late fall-run)	*Oncorhynchus tshawytscha*	Native	SC/SSC
Chinook Salmon (winter-run)	*Oncorhynchus tshawytscha*	Native	E/E
Steelhead (Central Valley)	*Oncorhynchus mykiss*	Native	T/--
ATHERINOPSIDAE—SILVERSIDES			
Mississippi Silverside	*Menidia beryllina*	Introduced	--/--
POECILIIDAE—LIVEBEARERS			
Western Mosquitofish	*Gambusia affinis*	Introduced	--/--
GASTEROSTEIDAE—STICKLEBACKS			
Threespine Stickleback	*Gasterosteus aculeatus*	Native	--/--
COTTIDAE—SCULPINS			
Pacific Staghorn Sculpin	*Leptocottus armatus*	Native	--/--
Prickly Sculpin	*Cottus asper*	Native	--/--
MORONIDAE—STRIPED BASSES			
Striped Bass	*Morone saxatilis*	Introduced	--/--
CENTRARCHIDAE—SUNFISH AND BASSES			
Black Crappie	*Pomoxis nigromaculatus*	Introduced	--/--
Bluegill	*Lepomis macrochirus*	Introduced	--/--
Green Sunfish	*Lepomis cyanellus*	Introduced	--/--
Largemouth Bass	*Micropterus salmoides*	Introduced	--/--
Redear Sunfish	*Lepomis microlophus*	Introduced	--/--
Smallmouth Bass	*Micropterus dolomieu*	Introduced	--/--
Spotted Bass	*Micropterus punctatus*	Introduced	--/--
Warmouth	*Lepomis gulosus*	Introduced	--/--
White Crappie	*Pomoxis annularis*	Introduced	--/--
PERCIDAE—PERCHES			
Bigscale Logperch	*Percina macrolepida*	Introduced	--/--
EMBIOTOCIDAE –SURFPERCHES			
Tule Perch	*Hysterocarpus traskii*	Native	--/--

Common Name	Scientific Name	Native/Introduced	Federal/State Status[2]
GOBIIDAE—GOBIES			
Yellowfin Goby	*Acanthogobius flavimanus*	Introduced	--/--
Shimofuri Goby	*Tridentiger bifasciatus*	Introduced	--/--

[1] Likelihood of occurrence is based on documented observations of species during surveys conducted by DWR in 2009, presence and extent of known habitat, and proximity to known occurrences in CNDDB (CDFW 2014c), and CDFW and USFWS fish survey programs.

[2] T—Listed as threatened under the State (CESA) or Federal (ESA) Endangered Species Act

E—Listed as endangered under CESA or ESA

SC—Considered a Federal Species of Concern

SSC—Considered a State Species of Special Concern

CDFW performed electrofishing surveys in August 2013 and January 2014 to determine the types of fish present on the site (Table 3.3-2). The two sampling efforts used different equipment, water temperatures were drastically different, and culvert operation differed, so the surveys cannot be directly compared; however, results serve as an indication of the dominant species currently within Prospect Island. Of the 13 species collected within the island, three were native species (Sacramento Blackfish, Prickly Sculpin, and Hitch) and these were relatively abundant compared to the non-native species. No special-status fish species were found within Prospect Island. Overall, the island appears to host native and sport fishes important to fisheries and the health of the Delta.

Table 3.3-2. Representative Fish Species Collected Using Electrofishing in Prospect Island During August 2013 and January 2014

Species	Native/Invasive	CPUE (fish/hour) August 2013	CPUE (fish/hour) January 2014
American Shad	Invasive	49	0
Sacramento Blackfish	Native	24	7
Largemouth Bass	Invasive	23	13
Goldfish	Invasive	21	1
Common Carp	Invasive	18	1
Golden Shiner	Invasive	17	0
Sacramento Hitch	Native	9	1
Redear Sunfish	Invasive	2	0
Black Crappie	Invasive	2	3
Mosquitofish	Invasive	2	0
Prickly Sculpin	Native	2	0
Black Bullhead	Invasive	1	3

Special-status fish

Pacific Lamprey

Adult Pacific Lampreys are the largest lampreys in California. They are distributed from Japan, through Alaska, and south to Baja California. Like other lampreys in California, Pacific Lampreys are anadromous and spawn in gravelly streams, including tributaries of the San Francisco Estuary and the Central Valley. There are no surveys that regularly monitor or catch Pacific Lampreys, and the extent of their distribution within Miner Slough is unknown. Because juveniles and larvae rear in silty backwater habitats, it is unlikely that Miner Slough would provide adequate habitat for anything but adult and juvenile migration (Moyle 2002).

Adults spend their predatory phase of life in the ocean where they parasitize a variety of fish species. Upstream migration to spawning habitat begins as early as January; however most upstream migrants arrive between March and late June. Ammocoetes, the larval stage of lampreys, are washed downstream to silty backwaters where they feed on algae and microorganisms until they metamorphose into juvenile macropthalmia. Upon completion of metamorphosis, downstream migration occurs during high outflow events.

The ecology of the Pacific Lamprey has not been extensively studied. Populations appear to have declined based on anecdotal observations, but Pacific Lampreys still occur in most of their native areas (Moyle 2002). Pacific Lampreys are considered a federal species of concern.

River Lamprey

The River Lamprey is an anadromous species found in coastal streams from north of Juneau, Alaska to the San Francisco Estuary and Central Valley (Moyle 2002). Individuals are recovered annually from the state and federal fish collection facilities in the South Delta. In California, most records are from streams in the lower portion of the Sacramento-San Joaquin River system, but their distribution is poorly understood because they have not been studied extensively. There are no surveys that regularly monitor or catch River Lampreys, and the extent of their distribution within Miner Slough is unknown. Because juveniles and larvae rear in silty backwater habitats, it is unlikely that Miner Slough would provide adequate habitat for anything but adult and juvenile migration (Moyle 2002).

Adults migrate into freshwater in fall after spending only 3–4 months in the ocean. Spawning takes place in February through May in gravelly riffles of

tributary streams. Ammocoetes remain in the substrate in silty backwaters and eddies of streams where they feed on algae and microorganisms. River Lampreys are presumed to remain as ammocoetes in freshwater for 3–5 years before emigrating to the ocean in late spring (Moyle 2002).

Population trends for River Lampreys in California are not known, but are presumed to have declined as the amount of spawning and rearing habitat in the lower reaches of rivers has been reduced (Moyle 2002). River Lampreys are considered a Watch List species among the California Species of Special Concern (Moyle et al. 1995). Watch List species are those that occupy much of their native range, but are now less widespread and abundant.

Green Sturgeon

The North American Green Sturgeon is an anadromous species that primarily inhabits estuarine and coastal waters but migrates into freshwater to spawn. The species occurs in rivers from British Columbia south to the San Joaquin River (Jackson and Van Eenennaam 2013) and in the Pacific Ocean from the Bering Sea to Baja California, Mexico (Moyle 2002). There are two populations, each of which qualifies as a species under the ESA: (1) the Northern distinct population segment (DPS), consisting of populations in coastal watersheds northward of and including the Eel River; and (2) the Southern DPS consisting of populations south of the Eel River (Klimley et al. 2007). Currently the only known spawning population in the Southern DPS occurs in the Sacramento River. Spawning migrations take place from February through July, with a peak spawning period of mid-April to mid-June (Moyle 2002).

Preferred spawning habitat is often characterized by deep, swiftly flowing water over substrate of large cobble where eggs are broadcast and fertilized externally. Larvae presumably hatch in 7–9 days, depending on temperature, and juveniles spend from one to four years in fresh and estuarine waters before dispersing into the ocean at lengths of 1–2.5 ft (Beamesderfer and Webb 2002). Juveniles begin moving downstream toward the ocean primarily in summer, with outmigrant abundance in the lower Sacramento River and Delta likely peaking from June through November (Adams et al. 2002). Both adult and juvenile Green Sturgeons are benthic feeders, consuming shrimp, amphipods, clams, other invertebrates, and small fish (Moyle 2002). Green Sturgeons are periodically entrained into the state and federal fish collection facilities in the south Delta; individuals taken at the facilities are juveniles, generally in the 28 to 38-centimeter (cm) fork length size range (Adams et al. 2002).

Little is known about the life history of Green Sturgeons (Klimley et al. 2007), and few studies catch them regularly. The CDFW Striped Bass Study and Sturgeon Study catch Green Sturgeons (CDFW 2014a), but those surveys are limited to Suisun and San Pablo Bay. Miner Slough is a tributary to the Sacramento River and thus considered critical habitat, but sightings of Green Sturgeons in Miner Slough are limited and unsubstantiated (Adams et al. 2002).

The southern DPS was listed in 2006 as threatened pursuant to the federal Endangered Species Act (NMFS 2006b). Threats to the population cited as reasons for listing the southern DPS of Green Sturgeons include loss of spawning habitat, adult migration barriers, insufficient flow, increased water temperatures, water diversions, non-native species, poaching, pesticides and heavy metals, and overfishing. Green Sturgeons are also considered a California Species of Special Concern by CDFW (Moyle et al. 1995). Critical habitat was designated in 2009 and includes all waters of the legal Delta (NMFS 2009b).

Sacramento Splittail

Sacramento Splittail are endemic to the Central Valley and San Francisco Estuary. In the San Joaquin River they were once distributed as far south as Friant, but their current breeding range in the San Joaquin basin appears to be much more restricted (Moyle 2002). In the Sacramento River, they have recently been observed as far upstream as Red Bluff Diversion Dam; however, the upstream extent of their spawning migrations is unknown (Feyrer et al. 2005). When flooded, the Yolo Bypass may provide important spawning and rearing habitat, suggesting that Miner Slough may at times be used as spawning and rearing habitat for Splittail (Moyle 2002). When they are not spawning, Splittail are often most abundant in sloughs of Suisun Marsh and the northern portion of the Delta. The CDFW 20-millimeter (mm) survey regularly catches larval Splittail in Miner Slough and throughout the CSC, though not in high numbers (Table 3.3-3).

The U.S. Fish and Wildlife Survey (USFWS) Juvenile Fish Monitoring program regularly catches Splittail at their sampling stations in Suisun Bay and along the Sacramento River (Marshall 2005), and the DWR Yolo Bypass Fish Monitoring Program catches large numbers throughout the year in the toe drain (Table 3.3-3). However, there are no stations within Miner Slough and since Splittail are benthic, many sampling methods are inefficient.

Their tolerance of high salinities, a wide range of temperatures, and low dissolved oxygen levels (<1 milligrams per liter [mg/L]) makes them particularly

well suited to slow-moving sections of rivers and sloughs (Moyle 2002). Individuals can live as long as eight years, with both males and females becoming sexually mature at the end of their second year. Mature Splittail migrate through the northern Delta and lower Sacramento River to spawning areas from January through April and spawn any time from late February to early July (Moyle 2002). Their preferred spawning habitat appears to be inundated floodplains where they spawn over submerged plants and debris, to which their eggs adhere. Embryos hatch in 3–7 days, depending on temperature, and juveniles rear in the floodplain until waters recede or until a late spring flood pulse triggers emigration. Year-class-strength of Splittail is positively correlated to the extent of floodplain inundation and tends to be higher during wetter years (Moyle 2002).

Splittail were listed by USFWS (USFWS) as a threatened species in 1999 because of concerns about apparent long-term abundance declines, but re-analysis of abundance data led Splittail to be de-listed in 2003 (USFWS 2003). However, CDFW still considers Splittail to be a Species of Special Concern (Moyle et al. 1995).

Table 3.3-3. Adult and Juvenile Sacramento Splittail at Stations in the Vicinity of Prospect Island 2011–2013

Location	Average Monthly Catch[1]											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Miner Slough[2] (larval)	N/A	N/A	0	0	1	1	0	N/A	N/A	N/A	N/A	N/A
Lindsey Slough[3]	1	0	0	0	0	1	1	0	0	0	0	0
Cache Slough at Miner[3]	0	0	0	1	0	1	0	0	0	0	0	1
Rio Vista[3,4]	1	1	2	1	1	1	1	1	0	0	0	0
Chipps Island[3,4]	10	7	7	10	6	3	1	30	22	4	2	49
Deep Water Ship Channel[3]	0	1	2	0	0	0	1	0	0	0	0	0

Location	Average Monthly Catch[1]											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Yolo Bypass Toe Drain[5]	16	184	109	332	1643	3384	56	9	1	3	3	21
Total	27	193	120	344	1651	3391	60	40	23	7	5	71

[1] Includes data from beach seines, trawls, rotary screw traps, and fyke traps (P. Poirier, CDFW, pers. comm., 2015).

[2] The Miner Slough data are from CDFW 20 mm Survey 2011 and contains data from a 20 mm larval fish net (P. Poirier, CDFW, pers. comm., 2015).

[3] Data are from CDFW Spring Kodiak Trawl, Summer Townet, and Fall Midwater programs 2011-2013 (P. Poirier, CDFW, pers. comm., 2015).

[4] Data are from USFWS Juvenile Fish Monitoring Program (https://www.fws.gov/Lodi/juvenile_fish_monitoring_program/jfmp_index.htm).

[5] Data are from Yolo Bypass Fish Monitoring Program 2011-2013 (P. Poirier, CDFW, pers. comm., 2015).

Delta Smelt

Delta Smelt are endemic to the Sacramento-San Joaquin Delta, occurring primarily below Isleton on the Sacramento River and below Mossdale on the San Joaquin River. They are tolerant of a wide range of salinities, but adults are mostly found in water of 2-7 parts per thousand (ppt) salinity; however, spawning and rearing mostly occurs in freshwater (Moyle 2002, Sommer and Mejia 2013).

Delta Smelt typically rear in shallow (<3 meters [m]), open-waters of the Delta, San Pablo Bay, Suisun Bay, and Suisun Marsh where they prey on zooplankton, primarily copepods, cladocerans, and amphipods (Moyle 2002). The CDFW 20 mm survey, targeting juvenile Delta Smelt, frequently catches Delta Smelt at sampling stations in Miner Slough, and historically the North Bay Aqueduct Larval Fish Survey occasionally caught high numbers of Delta Smelt at sampling locations in Miner Slough. The species is generally considered to have a 1 year, semelparous life cycle, with most individuals spawning and then dying at the end of their first year. Spawning migrations begin in September or October when Delta Smelt move to the upper portions of the Delta where they spawn between February and July (Table 3.3-4). Delta Smelt spawn in sloughs and shallow edge habitats in the upper Delta, in the Sacramento River above Rio Vista, Montezuma Slough near Suisun Bay, lower Napa River, and possibly Suisun Slough in Suisun Marsh (Moyle 2002).

Declining populations led the USFWS to list Delta Smelt as a federal threatened species in 1993 (USFWS 1993b). Critical habitat was designated for Delta Smelt in 1994 and consists of all water and all submerged lands below ordinary high water in the entire legal Delta, including waters surrounding Prospect Island

(USFWS 1994). The USFWS considers Shallow Water Habitat, which they define as all waters between mean high water (MHW) and 3 m below mean lower low water (MLLW) mark, to be a special element of their habitat (USFWS 2004). The Delta Smelt was also listed in 1993 as a threatened species pursuant to the CESA and up-listed to endangered on January 20, 2010. Abundance indices for Delta Smelt, calculated from IEP monitoring, have been a primary tool in tracking changes in relative abundance for the species. During the 10 years prior to 2005, the Delta Smelt Index had experienced some of the lowest numbers on record, prompting concern that a "step change" had occurred in the population of Delta Smelt and other pelagic-oriented species in the Delta (Armor et al. 2005).

Table 3.3-4. Adult and Juvenile Delta Smelt at Stations in the Vicinity of Prospect Island 2011–2013

Location	Average Monthly Catch[1]											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Miner Slough[2] (larval)	N/A	N/A	2	4	31	22	1	N/A	N/A	N/A	N/A	N/A
Lindsey Slough[3]	2	2	48	3	16	1	2	13	0	0	0	2
Cache Slough at Miner[3]	2	1	14	3	2	4	2	0	1	0	0	0
Rio Vista[3,4]	0	0	13	1	1	1	0	0	0	0	0	0
Chipps Island[3,4]	27	17	13	11	5	13	23	50	36	29	7	30
Deep Water Ship Channel[3]	98	64	26	31	17	30	7	2	0	1	4	2
Yolo Bypass Toe Drain[5]	7	17	30	3	9	31	2	0	0	1	1	0
Total	136	101	146	56	81	102	37	65	37	31	12	7

[1] Includes data from beach seines, trawls, rotary screw traps, and fyke traps (P. Poirier, CDFW, pers. comm., 2015).

[2] The Miner Slough data are from CDFW 20 mm Survey 2011 and contains data from a 20 mm larval fish net (P. Poirier, CDFW, pers. comm., 2015).

[3] Data are from CDFW Spring Kodiak Trawl, Summer Townet, and Fall Midwater programs 2011-2013 (P. Poirier, CDFW, pers. comm., 2015).

[4] Data are from USFWS Juvenile Fish Monitoring Program (https://www.fws.gov/Lodi/juvenile_fish_monitoring_program/jfmp_index.htm).

[5] Data are from Yolo Bypass Fish Monitoring Program 2011-2013 (P. Poirier, CDFW, pers. comm., 2015).

Longfin Smelt

Longfin Smelt is an estuarine species occurring in the San Francisco Estuary, including the Delta, as well as other estuaries along coastal Northern California. Their distribution extends northward to Prince William Sound, Alaska and the

southern extent of their distribution is represented by a single individual collected in Monterey Bay. In the San Francisco Estuary, Longfin Smelt populations are concentrated in Suisun, San Pablo, and North San Francisco bays, and rarely occur upstream of Rio Vista or Medford Island in the Delta (Moyle 2002). The CDFW IEP sampling efforts have occasionally caught adult Longfin Smelt at sampling stations throughout the CSC (Table 3.3-5), but most are captured as larvae during high tides and low flows. An annual abundance index is generated using data from the CDFW Fall Midwater Trawl Survey and Bay-Study Program (Armor et al. 2005).

The distribution of Longfin Smelt depends on salinity and water temperature, as well as on the life stage of individual fish. While Longfin Smelt can tolerate salinities ranging from nearly pure seawater to fresh water, individuals seem to prefer salinities in the range of 15–30 ppt after completing early life stages (Moyle 2002). They often concentrate in San Pablo Bay in April-June and become more dispersed by late summer. Individuals mature by the end of their second year of life and migrate upstream near Rio Vista to spawn in fresh water during fall or winter. In the Delta, Longfin Smelt spawn over sand or gravel substrates, rocks, and aquatic plants at water temperatures of 44–58.1 °F (7–14.5 Degrees Celsius [°C]) (Moyle 2002).

A strong positive correlation has been established between Delta outflow and Longfin Smelt abundance the following year (Moyle 2002). The Longfin Smelt is considered threatened by CDFW because of its declining abundance in the Delta. Low abundance-indices for Longfin Smelt prompted concern that a “step change” had occurred in the population of Longfin Smelt and other pelagic-oriented species in the Delta (Armor et al. 2005). Since 2005, Longfin Smelt abundances have remained low according to IEP abundance indices (CDFW 2014b).

Table 3.3-5. Average Monthly Catch of Adult and Juvenile Longfin Smelt at Stations Within and Near Miner Slough, 2011–2013

Location	Average Monthly Catch[1]											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Miner Slough[2] (larval)	N/A	N/A	3	1	0	0	0	N/A	N/A	N/A	N/A	N/A
Lindsey Slough[3]	0	0	0	1	0	0	0	0	0	0	0	0
Cache Slough at Miner[3]	0	0	0	0	0	1	0	0	0	0	0	0

Location	Average Monthly Catch[1]											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Rio Vista[3,4]	0	0	0	0	0	0	0	0	0	0	0	0
Chipps Island[3,4]	106	10	150	3	4	36	0	0	0	0	0	143
Deep Water Ship Channel[3]	1	0	0	1	0	1	0	0	0	0	0	1
Yolo Bypass Toe Drain[5]	1	0	0	0	1	1	0	0	0	0	0	0
Total	108	10	153	6	5	39	0	0	0	0	0	144

[1] Includes data from beach seines, trawls, rotary screw traps, and fyke traps (P. Poirier, CDFW, pers. comm., August 2015).

[2] The Miner Slough data are from CDFW 20 mm Survey 2011 and contains data from a 20 mm larval fish net (P. Poirier, CDFW, pers. comm., August 2015).

[3] Data are from CDFW Spring Kodiak Trawl, Summer Townet, and Fall Midwater programs 2011-2013 (P. Poirier, CDFW, pers. comm., August 2015).

[4] Data are from USFWS Juvenile Fish Monitoring Program (https://www.fws.gov/Lodi/juvenile_fish_monitoring_program/jfmp_index.htm).

[5] Data are from Yolo Bypass Fish Monitoring Program 2011-2013 (P. Poirier, CDFW, pers. comm., August 2015).

Central Valley Steelhead

Steelhead are the anadromous, or migratory, form of coastal Rainbow Trout (*Oncorhynchus mykiss irideus*), which have extremely variable and flexible life history patterns. Steelhead are not considered to be taxonomically distinct from populations of non-anadromous Rainbow Trout with which they co-occur, but rather they share a common gene pool (Garza and Pearse 2008) and are capable of interbreeding. Coastal Rainbow Trout were originally native to permanent streams along the coast of California, including the Sacramento and San Joaquin rivers and their tributaries (Moyle 2002). In the Central Valley, Steelhead enter freshwater beginning in August with migration peaking in late September through October and then hold until flows are adequate to allow them to enter tributaries for spawning (Moyle 2002).

While there are no sampling programs within Miner Slough focused on Steelhead, the USFWS Juvenile Fish Monitoring Program and DWR Yolo Bypass Fish Monitoring Program sample in locations near Miner Slough or have a connection to Miner Slough (Table 3.3-6). Miner Slough is within the Critical Habitat boundary as designated by the USFWS, and while it is possibly used as a migratory route, the extent to which Steelhead use Miner Slough is unknown.

The Central Valley Steelhead DPS[7] was listed by the National Marine Fisheries Service (NMFS) as threatened in 1998 and the listing status was reaffirmed in 2006 (NMFS 2006a). Critical Habitat for Central Valley Steelhead was originally designated in 2000, but in response to a lawsuit was rescinded in 2002 along with critical habitat for 18 other salmon and steelhead Evolutionarily Significant Units (ESU). Critical habitat for Central Valley Steelhead was re-designated in 2005 and includes the Delta (NMFS 2005).

Table 3.3-6. Monthly Catch of Central Valley Steelhead at Stations Along the Sacramento River and Near Miner Slough, 2011–2013

Location	Average Monthly Catch[1]											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Garcia Bend[5]	13	29	5	2	2	0	0	0	0	0	0	0
Steamboat Slough[5]	0	0	0	0	0	0	0	0	0	0	0	0
Ryde[4,5]	0	1	0	0	0	0	0	0	0	0	0	0
Rio Vista[4,5]	1	2	1	0	0	0	0	0	0	0	0	0
Chipps Island[2,4]	4	5	4	2	1	0	0	0	0	0	0	0
Deep Water Ship Channel[4]	0	1	0	1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Yolo Bypass Toe Drain[5]	0	0	2	0	1	0	0	0	0	0	0	0
Total	18	38	12	5	4	0	0	0	0	0	0	0

[1] Includes data from beach seines, trawls, rotary screw traps, and fyke traps (P. Poirier, CDFW, pers. comm., August 2015).

[2] The Miner Slough data are from CDFW 20 mm Survey 2011 and contains data from a 20 mm larval fish net (P. Poirier, CDFW, pers. comm., August 2015).

[3] Data are from CDFW Spring Kodiak Trawl, Summer Townet, and Fall Midwater programs 2011-2013 (P. Poirier, CDFW, pers. comm., August 2015).

[4] Data are from USFWS Juvenile Fish Monitoring Program (https://www.fws.gov/Lodi/juvenile_fish_monitoring_program/jfmp_index.htm).

[5] Data are from Yolo Bypass Fish Monitoring Program 2011-2013 (P. Poirier, CDFW, pers. comm., August 2015).

[7] California Central Valley Steelhead: This distinct population segment, or DPS, includes all naturally spawned populations of steelhead (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries, excluding steelhead from San Francisco Bay and San Pablo Bays and their tributaries. [NOAA 2019]

Chinook Salmon

The distribution of Chinook Salmon in the Pacific Ocean depends upon ocean temperatures and, off the coast of North America, is generally from Kotzebue Sound, Alaska to south of Monterey Bay, California. Spawning runs of anadromous Chinook Salmon in California occur in rivers of the north and central coast and those draining the Central Valley. The southernmost spawning populations occur in the San Joaquin and Kings rivers of the Central Valley (Moyle 2002). There are four distinct runs of Chinook Salmon in the Central Valley, all of which spend part of their life cycle in the Delta: Sacramento River winter-run Chinook Salmon, Central Valley spring-run Chinook Salmon, Central Valley fall-run Chinook Salmon, and Central Valley late fall-run Chinook Salmon. Adults of all four runs pass through the Delta on their upstream spawning migrations and juveniles spend varying amounts of time rearing in the Delta. Winter-run and spring-run Chinook Salmon populations are considered distinct ESUs that qualify as species under the ESA. The fall-run and late fall-run populations together compose a third ESU of Chinook Salmon in the Central Valley.

The USFWS Juvenile Fish Monitoring Program, Yolo Bypass Fish Monitoring Program, and CDFW Spring Kodiak Trawl monitor juvenile Chinook Salmon outmigration throughout the Delta; however, Miner Slough is not a monitoring site in any of these programs. An acoustic study (Vogel 2008) released tagged juvenile salmon on the Sacramento River and showed evidence of salmon utilizing the Proposed Project site; of the salmon that reached Sutter and Steamboat sloughs, 30% were detected entering Sutter Slough, and then 59% of those were subsequently detected in lower Miner Slough. Thus, while exact numbers of salmon are unknown, Miner Slough is presumed to be used by all runs of Chinook Salmon to some degree. Due to the potential presence of salmon (Table 3.3-7), Miner Slough is designated Critical Habitat for the listed runs of Chinook Salmon, and Essential Fish Habitat (EFH) for all runs of Chinook Salmon. Therefore, projects proposed within EFH that are permitted, funded, or undertaken by a federal agency are also regulated by NMFS. Essential Fish Habitat is defined in the Magnuson-Stevens Fishery Conservation and Management Act as "…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

Table 3.3-7. Average Monthly Catch of Juvenile Chinook Salmon of All Runs at Stations Along the Sacramento River and Near Miner Slough, 2011–2013

Location	Average Monthly Catch[1]											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Garcia Bend[5]	532	167	229	923	403	10	1	1	0	1	22	85
Steamboat Slough[5]	1	125	7	22	0	1	0	0	0	0	0	0
Ryde[4,5]	2	21	19	9	28	0	0	0	0	0	0	8
Rio Vista[4,5]	3	3	4	6	29	0	0	0	0	0	0	9
Chipps Island[2,4]	5	3	12	351	515	72	5	6	4	2	1	19
Deep Water Ship Channel[4]	0	0	0	1	7	0	0	0	0	0	0	0
Yolo Bypass Toe Drain[5]	4	5	35	75	19	2	0	0	0	1	1	1
Total	546	323	306	1386	1000	85	6	7	4	4	24	123

[1] Includes data from beach seines, trawls, rotary screw traps, and fyke traps (P. Poirier, CDFW, pers. comm., August 2015).

[2] The Miner Slough data are from CDFW 20 mm Survey 2011 and contains data from a 20 mm larval fish net (P. Poirier, CDFW, pers. comm., August 2015).

[3] Data are from CDFW Spring Kodiak Trawl, Summer Townet, and Fall Midwater programs 2011-2013 (P. Poirier, CDFW, pers. comm., August 2015).

[4] Data are from USFWS Juvenile Fish Monitoring Program (https://www.fws.gov/Lodi/juvenile_fish_monitoring_program/jfmp_index.htm).

[5] Data are from Yolo Bypass Fish Monitoring Program 2011-2013 (P. Poirier, CDFW, pers. comm., August 2015).

Sacramento River winter-run Chinook Salmon

Winter-run Chinook Salmon are unique to the Sacramento River. They typically migrate upstream as sexually immature fish in winter and spring and then spawn in early summer. Winter-run migrants enter the estuary as early as December; however, the peak migration occurs from January through March. Presently, their spawning habitat is restricted to the Sacramento River below Shasta Reservoir, where hypolimnetic, cool dense waters below the thermocline, releases are used to maintain river temperatures of 10-15˚C. Juveniles spend 5-10 months in streams followed by an intermediate period in the San Francisco estuary, including the Delta (Moyle 2002).

In 1989, declines in the abundance of returning adults led the State Fish and Game Commission to list winter-run Chinook Salmon as endangered (CDFG 2005a), while the NMFS initially listed winter-run Chinook as a threatened species. In 1994 the federal listing status of winter-run Chinook Salmon was

reclassified to endangered. In 1993 Critical Habitat was designated for winter-run Chinook Salmon to include the Sacramento River from Keswick Dam to Chipps Island at the western extent of the Delta (NMFS 1993); the Critical Habitat designation encompasses the Proposed Project site.

Central Valley spring-run Chinook Salmon

Spring-run Chinook Salmon enter the San Francisco Bay as sexually immature fish in spring or early summer and migrate to tributaries of the Sacramento River, where they hold in deep, cold pools for several months prior to spawning in early fall. Spring-run migrants enter the estuary as early as March; however, the peak migration occurs from May through June. Juveniles typically rear in streams for 3-15 months before moving downstream, primarily as smolts that move rapidly through the Delta (Moyle 2002). However, some spring-run Chinook in Butte Creek emigrate as fry and, therefore, the abundance of spring-run Chinook rearing in the Delta may be greater in some years (Moyle 2002).

Historically, spring-run Chinook Salmon migrated far upstream in larger tributaries of the Sacramento and San Joaquin rivers. Due to dam construction, however, spring-run Chinook were eliminated from the San Joaquin River drainage and their spawning populations were greatly reduced in the Sacramento River drainage. Currently, Central Valley spring-run Chinook Salmon are supported primarily by spawning populations in Deer, Mill, and Butte creeks with much smaller runs in streams such as Big Chico, Antelope Creek, and Beegum creeks (CDFG 2005b). Following restoration of lower Clear Creek, spring-run Chinook are once again returning to this historical spawning ground (CDFG 2005b). Spring-run salmon also spawn in the mainstem Sacramento, Yuba, and Feather rivers, but are likely hybridized with fall-run Chinook Salmon.

Spring-run Chinook Salmon in the Central Valley were listed as state and federally threatened in 1999 by the State Fish and Game Commission and NMFS (1999). Critical Habitat for Central Valley spring-run Chinook includes the Delta to the western edge of Sherman Island (NMFS 2005).

Central Valley fall-run Chinook Salmon

Fall-run Chinook Salmon migrate from the ocean in late summer and early fall as sexually mature fish and spawn within days or weeks of reaching their spawning grounds in the lowland reaches of larger rivers and their tributaries (Moyle 2002). Fall migrants enter the estuary as early as June; however peak migration occurs from September through October. Juveniles emerge from gravel in spring and move downstream within a few months to rear in mainstem rivers or estuaries.

Central Valley fall-run Chinook Salmon have the longest estuarine rearing period of the four Chinook Salmon runs in the Central Valley (Moyle 2002).

The fall run is currently the most abundant Chinook Salmon run in the Central Valley (Azat 2014). Currently, fall-run Chinook in the Sacramento and San Joaquin rivers are supplemented by hatcheries on Battle Creek and the Feather, American, Mokelumne, and Merced rivers. Straying by fall-run Chinook, presumably of hatchery origin, has resulted in runs becoming established in Guadalupe River and Coyote Creek in South San Francisco Bay (Moyle 2002). The combined fall-run and late fall-run Chinook Salmon populations are part of a single ESU, which is a federal species of concern and a California Species of Special Concern.

Central Valley late fall-run Chinook Salmon

Late fall-run Chinook salmon typically migrate upstream from the ocean from October through February and hold for 1–3 months prior to spawning in January through March (Moyle et al. 1995). Juveniles spend 7–13 months in freshwater prior to outmigration. No reliable run-size estimates are available since 1994 because the gates of Red Bluff Diversion Dam have been left open during the migration period to allow free passage (Cramer and Demko 1996). Late fall-run Chinook are a California Species of Special Concern and, as part of a single ESU with fall-run Chinook, are a federal species of concern.

Aquatic Invertebrates and Plankton

Algae and diatoms can live in the water column (planktonic), on the bottom of aquatic habitat (benthic), or on submerged plants (epiphytic). Aquatic invertebrates can also be associated with the water column or benthos; those aquatic invertebrates that are found in or on the sediment or other materials lining channels and open-water habitat are called benthic invertebrates, and those more associated with the water column are called zooplankton. Linked together, these groups play vital ecological roles in aquatic environments and make up the food web supporting fish production in the Delta. Phytoplankton and epiphytic algae are primary producers in the food web, capturing solar energy and nutrients to become food for benthic invertebrates and zooplankton, which in turn, are preyed upon by fish, which in turn, are the prey of larger fish or birds.

Phytoplankton plays an important role in primary production, as indicated by chlorophyll production in aquatic systems, particularly in the Delta. As the main source of zooplankton food, phytoplankton anchors the food chain and can greatly affect higher trophic levels (Carpenter et al. 1985). Changes in

phytoplankton community assemblage from one composed largely of diatoms toward a greater proportion of green and blue-green (cyanobacteria) algae can influence the zooplankton community in a way that inhibits the survival of certain species of fish. Over the past few decades this is believed to have led to the decline in numerous species in the Delta, including Delta Smelt (Armor et al. 2005). Increases in turbidity and ammonium are a few factors thought to contribute to the suppression of primary production in the Delta (Jassby et al 2002, Orsi and Mecum 1996).

Mysid shrimp and amphipods are the primary food source for many young-of-the-year fish occurring in the Delta, while smaller zooplankton like calanoid copepods *Eurytemora affinis* and *Pseudodiaptomus forbesi* serve as the primary food source for larger invertebrates and small fish (Moyle 2002). The introduction of invasive invertebrate species is thought to have contributed to regime changes in the dominant zooplankton of the Delta. For decades the non-native *Pseudodiaptomus*, non-native *Eurytemora*, and native mysid shrimp *Neomysis mercedis* were the dominant food sources for fish in the Delta; more recently, non-native copepods like *Limnoithona*, have become increasingly abundant (Armor et al. 2005). Despite their abundance, they may not be readily available as a food source for fish and may be affecting the growth and survival of Delta fish (Mecum 2005).

The CDFW 20 mm Survey is the only known survey that samples zooplankton in Miner Slough. Currently the two stations are sampled every two weeks between March and July; however, those two stations were recently added in 2008 (CDFW 2014b). The most recent data available (2012) show a distinct difference between Miner Slough zooplankton species composition and abundance when compared to other nearby stations in the CSC such as Calhoun Cut, Lindsey Slough, West Cache Slough, and the Sacramento Deep Water Ship Channel (DWSC) (Table 3.3-8). Miner Slough seems to be dominated by more benthic and epiphytic invertebrates that thrive better in cooler, calmer waters, including: Cladocera (*Bosmina* sp., *Ceriodaphnia* sp., other *Cladocera*), cyclopoid copepods, and rotifers. Miner Slough also lacks the abundance of calanoid copepods seen at nearby stations; calanoid copepods are an important food resource for fish. Limited zooplankton sampling by CDFW within Prospect Island shows an aquatic environment dominated by planktonic algae, benthic and epiphytic invertebrates, and insect larvae, demonstrating a habitat more similar to a eutrophic lacustrine habitat (Pinto-Coelho 1998).

Table 3.3-8. Average Zooplankton Density (Zooplankton/deciliter) in Prospect Island and Adjacent Water Bodies During March–July 2012

Species	Calhoun Cut	Lindsey Slough	West Cache Slough	Deep Water Ship Channel	Miner Slough – Hall Island	Prospect Island—North Property
CALANOID COPEPOD						
Eurytemora	96	43	15	18	17	27
Pseudodiaptomus	6,682	5,278	5,507	4,713	99	101
Sinocalanus	11,374	15,451	2,913	3,440	23	21
Diaptomus	19	22	27	21	48	42
CYCLOPOID COPEPOD						
Cyclopoid copepod	2,780	2,105	1,059	1,203	2,182	2,183
Nauplii	2,477	2,865	789	515	47	108
CLADOCERA						
Bosmina	5,253	3,436	584	482	1,955	2,040
Ceriodaphnia	198	112	68	106	451	396
Daphnia	2,534	2,159	193	114	215	195
Diaphanosoma	1,597	2,317	39	18	86	70
Other Cladocera	434	115	154	207	1,045	1,163
ROTIFER						
Other Rotifer spp.	432	708	42	46	484	517

Data from CDFW 20 mm Survey (P. Poirier, CDFW, pers. comm., August 2015).

Nonnative invasive aquatic species

Asian Clam

The Asian Clam (*Corbicula fluminea*) invaded United States waters in 1938 and has since spread to 38 states. It has been known to cause damage to pipes and canals, completely alter benthic substrates and species compositions, and compete with native species for limited resources (Sousa et al. 2008). Their rapid growth rates, high fecundity rates, ability to self-fertilize, and high filtering rates have assisted in the widespread invasion of riverine and lentic environments.

The Asian Clam exhibits a wide range of reproductive strategies; they have been known to reproduce both sexually and asexually and can be oviparous (egg

producing), ovoviviparous (egg brooding). This in combination with a high fecundity and multiple spawns per year results in rapid colonization and growth. While their densities are not as large as *Corbula amurensis* in the Delta, their water column clearance rates are some of the highest per biomass (Cummings and Graf 2010). Because their clearance rates are so high, shallow water habitats are particularly vulnerable to disruptions in the aquatic food web.

The Asian Clam is present in the CSC as evidenced by shell sightings and habitat preference; however, distribution and population density within Miner Slough and on Prospect Island is unknown. The DWR Environmental Monitoring Program collects benthic samples throughout the Delta, but the extent of their north Delta sampling normally stops at Rio Vista. Regular sampling shows abundant populations of Asian Clam throughout the south Delta and up the Sacramento River through Rio Vista where their density is highest. A brief special study by DWR's Environmental Monitoring Program sampled throughout Cache Slough up to Liberty Island and shows that Asian Clam abundance in Cache Slough is comparable to that of other locations throughout the Delta (Table 3.3-9).

Table 3.3-9. DWR Environmental Monitoring Program Catch of Asian Clam During 2011

Asian Clam Abundance (number/sample)			
Station[1]	May	October	Total
Cache Slough	246	49	295
Lower Sherman Island	258	74	342
Rio Vista	392	455	847
Twitchell	118	201	319
Old River	134	388	522

[1] Stations were sampled using benthic grab samples.

Aquatic habitat

Prospect Island has a history of flooding; levees failed and flooded 29 times in the last century (DWR and CDFW 2014). By 2008, Prospect Island was once again dry, and the only connection with the surrounding waterways was a culvert located on Miner Slough that led to the northern portion of Prospect Island. From 2008 to late 2013, the culvert was damaged, ultimately leading to the flooding that occurs today. The erosion of a repair site on Miner Slough resulted in a leak and subsequent flooding of the southern portion of Prospect Island as well. Limited tidal exchange occurs through the culvert and leaky repair site. However, since November 2013 the culvert was repaired, eliminating tidal action that would occur on the northern portion of Prospect Island. Within Prospect Island, aquatic

habitat is a mix of non-tidal perennial aquatic (open-water) and wetlands (Section 3.4.1 *Wetland and Terrestrial Biological Resources – Setting*). Tidal Waters of the U.S. surround Prospect Island, including adjacent sloughs, shipping channels, wetlands, and open-water habitat. Prospect Island is bordered by Miner Slough to the east, Cache Slough and the Miner Slough Wildlife Area to the south, and the DWSC to the west (Figure 2.1-2).

Legal and regulatory setting

This section addresses only laws and regulations that directly affect fish and other aquatic resources. Laws and regulations pertaining to habitat conditions that indirectly affect these resources, such as hydrology and water quality, are mentioned here but described in detail in their relevant sections.

Management of anadromous fish is the responsibility of NMFS, whereas management of non-anadromous fish and other aquatic biological resources in the Proposed Project area is the responsibility of USFWS at the federal level and CDFW at the state level. CDFW also acts as state trustee for aquatic species. These three agencies, either independently or in collaboration with other state and federal agencies, implement numerous fish management and restoration plans and initiatives.

Federal laws and regulations

Unless otherwise noted, the Proposed Project would comply with the following federal laws and regulations.

Federal Endangered Species Act

The federal ESA (16 United States Code [USC] Section 1531 *et seq*.) provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The law requires federal agencies (and other public agencies seeking approval, funding, and/or permitting through federal agencies), in consultation with USFWS and/or the NMFS, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species.

Section 9 of the federal ESA and its regulations prohibit the take of federally listed species. An incidental take permit under ESA Section 10(a) or federal consultation under Section 7 of the ESA is required if the Proposed Project might affect a federally listed species.

ESA compliance for SWP and CVP Coordinated Operations Criteria and Plan
The operation of the Central Valley Project (CVP) and the State Water Project (SWP) is described in the existing Operations Criteria and Plan (OCAP). Updated in 2004, the OCAP provides details of the coordinated operations of the CVP and SWP based on historical data, and serves as a starting point for planning water project operations in the future. Under the federal ESA, USFWS and NMFS must produce formal BiOps analyzing the impact of OCAP implementation on ESA-listed species, and thus pertains to the Proposed Project.

Currently, five species in the Proposed Project area (the winter-run and spring-run Chinook Salmon, Delta Smelt, North American Green Sturgeon, and Central Valley Steelhead) are listed under the ESA. USFWS released an OCAP Biological Opinion (BiOp) for Delta Smelt on December 15, 2008. This BiOp includes the requirement within its Reasonable and Prudent Alternatives, among others, of developing 8,000 ac of tidal restoration.

NMFS released its latest OCAP BiOp on June 4, 2009, concluding that CVP and SWP operations would jeopardize the continued existence of endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook Salmon, threatened Central Valley Steelhead, and threatened Southern DPS of the North American Green Sturgeon. The NMFS BiOp includes by reference the 8,000-ac tidal restoration requirement contained in the USFWS BiOp. Because restoration of tidal habitat would provide access for salmonid rearing at Prospect Island, the Proposed Project would also be consistent with Reasonable and Prudent Alternative (RPA) I.6.1 of the NMFS Salmonid BiOp for SWP/CVP operations.

Magnuson-Stevens Fishery Conservation and Management Act
The federal Magnuson-Stevens Fishery Conservation and Management Act (16 USC Section 1801 *et seq*.) is the primary law governing marine fisheries management in the United States. The purpose of this federal law is sevenfold: conserve fishery resources, support enforcement of international fishing agreements, promote fishing in line with conservation principles, provide for the implementation of fishery management plans to achieve optimal yield, establish regional fishery management councils to steward fishery resources, develop underutilized fisheries, and protect EFH.

The act requires federal agencies to consult with NMFS when a project has the potential to adversely affect EFH. States are not required to consult with NMFS; however, NMFS is required to develop EFH conservation recommendations for

any state agency activity that would affect EFH. Similar in concept to critical habitat of the federal ESA, EFH protection measures recommended by NMFS or a regional fisheries management council are advisory and not prescriptive (NMFS 1998). The Proposed Project area is located in the region identified as EFH for Pacific salmon, which includes all runs of Chinook Salmon.

Clean Water Act

The Proposed Project would need a Section 401 certification from the Central Valley Regional Water Control Board (CVRWQCB) to demonstrate that the Proposed Project would comply with all applicable water quality standards, including meeting standards associated with levels of methylmercury, suspended materials, dissolved oxygen, and chemicals that could be affected by construction equipment during construction, maintenance, and/or operations (see Section 3.2 *Water Quality* for more information).

State laws and regulations

Unless otherwise noted, the Proposed Project would comply with the following state laws and regulations.

California Endangered Species Act

The state counterpart to the federal ESA, CESA (CFG Code Section 2050 *et seq.*) has similar, but distinct requirements and goals. CESA requires state agencies to coordinate with the CDFW to ensure that state-authorized or state-funded actions do not jeopardize a state-listed species. The state list of species classified as rare, threatened, or endangered does not necessarily correspond with the federal list of threatened and endangered species.

The Proposed Project could potentially affect state-listed species and thus must be in compliance with CESA, as applicable.

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne) (California Water Code Title 23) protects California waters. The act gives the State Water Resources Control Board, through the CVRWQCB, the authority to regulate discharges of waste, including dredged or fill material, to any state waters within its jurisdiction. Biological beneficial uses of state waters are subject to regulation through various means, including conditions attached to the certification of federal CWA (Section 401) authorizations (See Section 3.2 *Water Quality* for more information).

Streambed Alteration Agreement

Under Section 1600–1616 of the CFG Code, CDFW regulates activities that would alter the flow, bed, channel, or bank of streams and lakes. The limits are as the "… bed, channel or bank of any river, stream, or lake designated by the department in which there is at any time an existing fish or wildlife resource or from which these resources derive benefit ..." (Section 1601). Undertaking stream-altering activities that may adversely affect fish or wildlife would require an applicant to enter into an agreement with CDFW for authorization for up to five years. The Proposed Project would require a streambed alteration agreement prior to construction.

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, the following have been considered in the analysis of potential impacts and identification of mitigation, as needed.

Solano County General Plan (2008)

The *Resources* section of the Solano County General Plan identifies goals, policies, and implementation actions to protect natural, cultural, and open space resources. Under the current General Plan, Prospect Island is considered agricultural land within a resource conservation overlay. Under goal RS.G-4, the County intends to preserve, conserve, and enhance valuable open space lands that provide wildlife habitat. The Proposed Project is supported by six goals, eleven policies, and two implementation programs within the Solano County General Plan. Some of the key policies applicable to the Proposed Project on aquatic resources are listed in Table 3.3-10.

Table 3.3-10. Solano County General Plan: Goals and Policies Relevant to Aquatic Biological Resources

General Plan Policy/Goal/Program	General Plan Policies and Implementation Programs
RS.P-1	Protect and enhance the county's natural habitats and diverse plant and animal communities, particularly occurrences of special-status species, wetlands, sensitive natural communities, and habitat connections.
RS.P-7	Preserve and enhance the diversity of habitats in delta marshes to maintain these unique wildlife resources.
RS.P-9	Encourage restoration of historic marshes to wetland status, either as tidal marshes or managed wetlands. When managed wetlands are no longer used for waterfowl hunter, restore them as tidal marshes.

3.3.2 Significance criteria

Criteria for determining significant impacts on aquatic biological resources are based upon the Appendix G *Environmental Checklist* of the CEQA Guidelines and professional judgment. In the evaluation that follows, a potential impact to aquatic biological resources would be significant if the implementation of the Proposed Project would:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW, the USFWS, or the NMFS.
- Have a substantial adverse effect on any riparian habitat or other sensitive aquatic community identified in local or regional plans, policies, or regulations, or by the CDFW, the USFWS, or the NMFS.
- Interfere substantially with the movement of any native resident or migratory fish, or impede the use of native fishes nursery sites.
- Conflict with any local policies or ordinances protecting aquatic resources.
- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

3.3.3 Impacts and mitigation

Impact 3.3-1: Short-term loss and degradation of aquatic habitat from construction-related activities

The potential for the Proposed Project to result in construction-related loss or degradation of aquatic habitat was evaluated in terms of:

- the type and magnitude of the area affected;
- the nature and duration of effects; and
- how such habitat alterations could affect resident and migratory fish species and other populations and communities of aquatic life.

Short-term, temporary impacts to aquatic habitat would result from the temporary repair of the south property levee and mechanical dredging of the Miner Slough spur channel to increase tidal exchange capacity of the channel.

The repair of the south property levee would facilitate the dewatering of Prospect Island as needed during the construction period. The temporary levee repair would involve installation of a sheet pile wall with 2:1 slope rock fill on both sides

of the wall. The fill would temporarily cover approximately 0.1 ac of aquatic habitat in the Miner Slough spur channel. The eliminated habitat is considered EFH for spring and winter-run Chinook Salmon and Critical Habitat for Green Sturgeon southern DPS, Central Valley Steelhead, spring-run Chinook Salmon, and Delta Smelt. However, this impact would be temporary as the rock slope would be removed upon completion of the Proposed Project. The habitat would be available to fish immediately following the construction period, along with the newly created tidal habitat within Prospect Island.

Dredging would involve the removal of 47,000 cubic yards (cy) of soil from 2,400 linear ft of the dead-end tidal channel along the southern end of Miner Slough. Approximately 5 ac of bottom habitat would be disturbed near the southern breach location as a result of dredging operations. The habitat that would be disturbed is considered EFH for spring and winter-run Chinook Salmon and Critical Habitat for Green Sturgeon southern DPS, Central Valley Steelhead, spring-run Chinook Salmon, and Delta Smelt. The removal of bottom sediment would impact the benthic community and disturb food and habitat resources that may be beneficial to fish. However, this impact is considered temporary as the benthic community would reestablish and provide the same benefit to fish prior to dredging. There would be no net change in aquatic habitat as a result of dredging operations.

In summary, the Proposed Project would not impact special-status fish, other native fish, or their habitat to an extent that would cause adverse individual or population-level effects because impacts by the Proposed Project would be short-term and temporary. The aquatic habitat effected by the levee repair and dredging activities would be available upon completion of each activity with no net loss in habitat. Therefore, impacts would be *less than significant*.

Impact significance
Less than significant

Impact 3.3-2: Long-term conversion and enhancement of aquatic habitat

The potential effects of long-term conversion and enhancement of aquatic habitat by the Proposed Project was evaluated in terms of:

- the type and magnitude of the area affected;
- a comparison of the amount and type of habitat lost or altered to the amount and type of habitat created by the Proposed Project; and

- how such habitat alterations could affect resident and migratory fish species and other populations and communities of aquatic life.

Long-term, permanent impacts to aquatic habitat would result from the breaching of the Miner slough levees. Breaching of the Miner Slough levees would permanently eliminate 1,060 linear ft (0.2 mi, Table 2.2-2) of aquatic shoreline habitat and shaded riverine aquatic (SRA) habitat within the immediate vicinity of the two breaches along the west levee of Miner Slough. This would remove approximately 4% of the total 5.2 mi of SRA habitat along Miner Slough, which is considered EFH for spring and winter-run Chinook Salmon and Critical Habitat for Green Sturgeon southern DPS, Central Valley Steelhead, spring-run Chinook Salmon, and Delta Smelt. Riparian EFH that would be removed at each of these locations consists of scrub and woodland trees that may provide thermal refuge by means of shade and a source of terrestrial insects to the channel.

It is the ultimate goal of the Proposed Project to increase the quality and quantity of salmonid rearing habitat in and around Prospect Island. The Proposed Project would create up to 472 ac of tidal perennial aquatic and 1,053 ac of tidal freshwater emergent wetland habitats (Table 2.2-2) including access to over 9 mi of SRA habitat along interior levees. The Proposed Project would benefit special-status fish by expanding access to habitat that would develop into critical habitats for winter- and spring-run Chinook Salmon, Steelhead, Green Sturgeon, and Delta Smelt and EFH for winter- and spring-run Chinook Salmon. Therefore, the Proposed Project would result in a substantial benefit to these aquatic biological resources.

Impact significance
Beneficial

Impact 3.3-3: Short-term direct construction-related injury or mortality of fish

The potential for the Proposed Project to result in construction-related injury or mortality of aquatic organisms was evaluated in terms of:

- the timing and duration of construction;
- the spatial scale and nature of disturbance;
- the equipment to be used and construction approach implemented; and
- the organisms likely to occur during construction.

Mortality or direct injury to special-status fish and other native fish may occur as a result of dredging, pile driving, and levee breaching; however, machinery used to dredge and breach the levees and undertake pile driving would be operated between July 1 and October 31. This in-water work window is designated by CDFW, DWR, and NMFS as a time when special status fish are least likely to be present. During the in-water work window, an estimated 50,800 cy of soil would be excavated from the breach locations (Table 2.2-3). In addition, impacts due to in-water work would be minimized by timing excavation activities to coincide with low tides to minimize in-water work.

Further, potential for injury or mortality would be reduced by the ability of fish to avoid construction activities. Construction-related noise associated with dredging and excavation (see Impact 3.3-4) would likely cause fish to physically avoid the two breach locations. The northern breach would be located in an area of Miner Slough that is nearly 200 ft wide, which allows for fish passage opposite the breach site. Any inhibitions to movement would be temporary and localized as construction would primarily take place during low tide. The southern breach is located in the Miner Slough spur channel. Construction noise would likely deter fish from entering the spur channel from Miner Slough, and any fish present during construction would likely leave the channel on their own.

Temporary sheet piles may also be installed as part of the south property levee repair and used in constructing platforms for site dewatering pumps. While sheet piles would most likely be installed out of water using vibratory hammers, an impact pile driver within water may be necessary. Due to the potential for physical injury and mortality to fish from sound attenuation in the water, this would be a potentially significant impact. Sound pressure thresholds set by the Fisheries Hydroacoustic Working Group (2008) could be exceeded by impact pile driving; therefore, implementation of Mitigation Measure 3.3-3.1 would be required to reduce this impact to *less than significant*.

A possibility for fish injury could occur from a surge of water onto the Proposed Project site upon breaching of the levees. However, with high groundwater conditions at the site from seepage and plant management activities, it is anticipated that water surface elevations between the constructed channel network and Miner Slough would equilibrate prior to breaching the levees. Breaching would occur at low tide to minimize any tidal difference and removed from the landward side toward tidal waters in Miner Slough; this would cause the water to gradually fill and not surge into the work areas, thereby minimizing disturbance to fish near the breach site.

Despite the aforementioned information, due to the extensive use of the CSC and DWSC by Delta Smelt of all life stages (Sommer and Mejia 2013), there is potential that Delta Smelt juveniles could be present in Miner Slough during July. Larval and juvenile Delta Smelt do not regularly utilize Miner Slough; the CDFW 20 mm Survey, which monitors post-larval and juvenile life stages of fish twice monthly, has not caught Delta Smelt in Miner Slough since April 2010. However unlikely, there is still potential for Delta Smelt to access Miner Slough during construction activities and be injured or otherwise harmed. Implementation of Mitigation Measure 3.3-3.2 would reduce this impact to *less than significant*.

Overall, due to the implementation of an in-water work window of July 1 to October 31 during low tide (when it corresponds with work hours) and implementation of Mitigation Measures 3.3-3.1 and 3.3-3.2, direct construction-related activities would not cause adverse individual or population-level effects on special-status and other native fish or their habitat to an extent that would cause a reduction in species abundance or long-term population levels. Therefore, impacts would be *less than significant.*

Mitigation Measure 3.3-3.1
Pile driving activities shall be conducted using vibratory hammers, where feasible, to minimize sound attenuation from pile driving activities. If in-water pile driving activities become necessary, underwater sound monitoring shall be performed to ensure that peak sound pressure does not exceed 206 decibels and accumulated sound exposure level does not exceed 187 decibels at 10 meters. If work is performed at a time when special-status fish less than 2 grams are expected near the Proposed Project Site, accumulated sound exposure levels shall not exceed 183 decibels at 10 meters. Underwater sound reduction measures shall be implemented as needed to ensure that sound levels do not exceed the above thresholds. Sound reduction measures may include impact cushions, pipe caissons, bubble curtains, fabric barriers, and limiting operational hours and impact frequency.

Mitigation Measure 3.3-3.2
DWR shall consult with CDFW and USFWS before conducting any in-water work during the month of July. DWR shall determine the extent of Delta Smelt presence in the CSC and Miner Slough by evaluating catch and distribution data

from CDFW's 20 mm Survey[8] and Summer Townet Survey[9]. The results shall be sent to USFWS and CDFW representatives to determine the extent of allowable in-water work.

20 mm Survey Stations 724 and 726 are located in Miner Slough at the lower and upper ends of Prospect Island and shall be used to determine Delta Smelt abundance in Miner Slough during July construction activities. Summer Townet Survey Station 715, just downstream of Miner Slough in Cache Slough; Station 723, just upstream from Miner Slough in the DWSC; and Station 716, just upstream from Miner Slough in Lindsey Slough, shall be used to determine Delta Smelt abundance in the vicinity of Miner Slough when the 20 mm Survey is not active.

Impact significance

Less than significant with mitigation

Impact 3.3-4: Short-term construction-related noise impediments to fish migration

The potential for the Proposed Project to impede fish migration was evaluated in terms of:

- the timing and extent of construction activities;
- the timing of fish migrations;
- the dimensions of Miner Slough; and
- the expected levels of noise generated by construction activities.

Construction activities at levee breach locations, including excavation and sheet pile installation, could generate sufficient noise within Miner Slough to affect the movement or migration of special-status fish species. Miner Slough is a known migratory corridor for many fish species; all four runs of Chinook Salmon, as well as Steelhead, Green Sturgeon, Pacific and River Lamprey, and Sacramento Splittail may migrate past the Proposed Project site in Miner Slough on their way to upstream spawning areas or downstream rearing habitat. While in general, impacts would be minimized through implementation of an in-water work window

[8] The 20 mm Survey is an annual survey conducted by CDFW that monitors post-larval to juvenile Delta Smelt throughout the Delta from March through July. Surveys run every two weeks and include stations in Cache Slough, Lindsey Slough, the DWSC, and Miner Slough.

[9] The Summer Townet Survey is an annual survey that monitors young of the year fish throughout the Delta from June through August. Surveys run every two weeks and include stations in Cache Slough, Lindsey Slough, and the DWSC.

of July 1 to October 31 when special-status fish are less likely to be present at or near the Proposed Project site, migration timing for fall- and late fall-run Chinook Salmon, Central Valley Steelhead, and Green Sturgeon overlaps with the in-water work window.

With respect to excavation activities, fish are expected to simply avoid construction areas by seeking a zone of passage further away from any noise sources (i.e., along the opposite bank of the slough, which is nearly 200 ft wide at the construction-sites). A recent study on barotrauma (i.e., pressure wave) injury and recovery in Chinook Salmon (Casper et al. 2012) showed that sound levels below the current California sound pressure level standards, set by the Fisheries Hydroacoustic Working Group (2008), are not significant enough to cause death or behavior modification in juvenile Chinook Salmon. Salmon exposed to the maximum allowable sound pressure levels showed signs of minor internal injury, but they were not significant enough to discourage normal swimming behavior or feeding activities. Excavation of the levee breaches would initially degrade the levee crown to near MHHW, with final in-water excavation during low and rising tides to minimize turbidity export from the site; therefore, any delays in fish migration would be temporary.

With respect to impact pile driving activities, sound pressure thresholds set by the Fisheries Hydroacoustic Working Group (2008) could be exceeded (see also Impact 3.3-3). Implementation of Mitigation Measure 3.3-3.1 would reduce this impact to *less than significant*.

Overall, due to the in-water work window of July 1 to October 31 during low tide (when it corresponds with work hours) and implementation of Mitigation Measure 3.3-3.1, construction-related noise would not cause adverse individual or population-level effects on the movements or migrations of migratory fish or their habitat to an extent that could cause a reduction in species abundance or long-term population levels.

Impact significance

Less than significant with mitigation

Impact 3.3-5: Impact deleted

Impact 3.3-6: Short-term impairment of essential fish behaviors due to construction-related increases in turbidity

The potential for the Proposed Project to impact fish due to construction-related increases in turbidity was evaluated in terms of:

- construction timing and method of construction activities;
- the extent of disturbance to turbidity and suspended sediment; and
- fish species likely to be present during construction activities.

The Proposed Project has potential to increase turbidity and suspended sediment levels within Miner Slough during repair of the south property levee, dredging of the spur channel, and excavation of levee breaches. Uncontrolled resuspension of sediments during dredging and excavation activities could result in the following direct and indirect adverse effects on fish (Barrett et al. 1992):

- impaired foraging ability of sight-feeding fish;
- impairment to migration up or downstream;
- reduced oxygen uptake and damaged gill filaments; and
- increased predation by piscivorous fish in temporarily turbid areas.

Miner Slough spur channel dredging

The Miner Slough spur channel is a dead-end slough that has limited tidal exchange with Miner Slough. To achieve the intended tidal exchange between Miner Slough and Prospect Island, the spur channel near the southern breach location would be mechanically dredged from its current elevation of -5 to -8 ft NAVD 88 to -16 ft NAVD 88. This would involve the removal of 47,000 cy of soil from 2,400 linear ft of the dead-end tidal slough. Approximately 5 ac of bottom habitat would be disturbed as a result of mechanical dredging operations (see Impact 3.3-1).

Mechanical (i.e., clam-shell) dredging would occur during the in-water work window of July 1 through October 31 and at low tide (when it corresponds with work hours). While in general impacts would be minimized through implementation of the in-water work window, when special-status fish are less likely to be present at or near the Proposed Project site, migration timing for Fall- and late fall-run Chinook Salmon, Central Valley Steelhead, and Green Sturgeon partially overlaps with the in-water work window. Direct injury from clam-shell dredging, while possible, is less of a concern than indirect impacts from sediment release (LaSalle et al. 1991). Thus, clam-shell dredging operations would have the potential to impact these species, as well as other native fish species, by increasing suspended sediment and turbidity.

A localized plume of suspended sediment would be produced by the lowering and raising of the dredge bucket. Palermo et al. (1990) summarized findings of numerous suspended sediment experiments on eggs, larval, juvenile, and adult fish. Larval fish appeared to be the most sensitive life stage to increased suspended sediments; physical damage was apparent at suspended sediment concentrations of over 1,500 milligrams per liter (mg/L) for 24 hours. Depending on conditions, field studies indicate that clam-shell dredging increases suspended sediment concentrations above background measurements by 150-900 mg/L and increases turbidity by 5-150 Nephelometric Turbidity Units (NTU) (Palermo et al. 1990, USACE 1987) within the general vicinity of the dredge site. Since the Miner Slough spur channel is a dead-end channel with limited tidal exchange, the majority of suspended sediment generated by the dredging activities would settle within the spur channel. Additionally, these values are below those associated with physical damage and/or mortality to sensitive life stages and they are within the range of values produced by high winds, storm events, and strong tides in general (Palermo et al. 1990) and in the Delta (DWR 1996). If suspended sediment levels were to reach temporary values sufficiently high to negatively affect fish, individuals would likely avoid the area in favor of the abundance of quality habitat nearby. Therefore, turbidity is not likely to adversely affect migrating adult and juvenile fish present in Miner Slough (See Section 3.2.1 *Water Quality – Setting for more information*).

Overall, despite the low likelihood of significant adverse effects to fish as a result of dredging of the Miner Slough spur channel, the use of turbidity controls (e.g., silt curtains) is included in concept in the Proposed Project Description and detailed in Mitigation Measure 3.2-2.1 to further minimize impacts to special-status fish and aquatic resources. Implementation of Mitigation Measure 3.2-2.1 would reduce potential impairments of essential fish behaviors due to construction activities to *less than significant*.

Miner Slough levee repair and breaching

The south property levee repair would involve installation of a sheet pile with rock slope armoring, which could temporarily increase turbidity within the Miner Slough spur channel. This repair would have a small construction footprint (<0.1 ac).

Breaching of the Miner Slough levee to connect the Proposed Project site to tidal action would affect short-term turbidity levels in Miner Slough. The levee breaches would occur in localized areas totaling 1,060 ft at two locations along

the west levee of Miner Slough. While in general impacts would be minimized through implementation of an in-water work window of July 1 to October 31, when special-status fish are less likely to be present at or near the Proposed Project site, migration timing for Fall- and late fall-run Chinook Salmon, Central Valley Steelhead, and Green Sturgeon partially overlaps with the in-water work window.

The potential for short-term, sediment re-suspension and scouring impacts to these species from levee repair and excavation would be minimized by working during low tide (when it corresponds with work hours) and by working from the landward side toward tidal waters in Miner Slough to breach the levee. For necessary in-water work, excavation of the levee breaches would occur over a maximum period of a few hours to one day at each location. Excavated soils would be moved by bulldozers away from the excavation area or placed into dump trucks to be transported off-site. Therefore, any increases in turbidity in Miner Slough as a result of levee breach excavation would be temporary and localized.

Overall, due to the implementation of an in-water work window of July 1 to October 31 and Mitigation Measure 3.2-2.1, the south property levee repair and subsequent breaching would not cause adverse individual or population-level effects on the movement, migration, or behavior of special-status fish to an extent that could cause a reduction in species abundance or long-term population levels. Therefore, impacts would be *less than significant*.

Impact significance

Less than significant with mitigation

Impact 3.3-7: Short-term fish injury or mortality during dewatering

The potential for fish to be killed or injured as a result of dewatering was evaluated in terms of the rate of dewatering, and the presence and species composition of fish on Prospect Island.

Dewatering of Prospect Island would remove aquatic habitat from the site, which would eventually result in mortality of all fish on the island. As part of the dewatering process, fish could be stranded in isolated pools of water that remain as the surrounding water level is drawn down or they could be entrained in the dewatering pumps. Although there are no special-status fish present on the island (Table 3.3-2), there are native and important sport fish species that are important to the ecology of the Delta.

Prospect Island has a gradual slope from intertidal and upland habitat in the northern portion to subtidal and deep subtidal near the cross-levee and the existing pump location. Due to the length of time required for initial dewatering (10–12 months), fish would have ample opportunity to escape shallow habitat in the northern portion and avoid becoming trapped in isolated bodies of water. Moyle et al. (2007) showed that native fish on a floodplain are highly successful at escaping the floodplain as water recedes, while non-native fish have higher rates of stranding.

Eventually, fish would congregate in the deep subtidal areas at the southern end of the island, near the pumps, where injury or mortality would occur due to continued loss of water or entrainment in the pumps. This would be a significant effect. Development and implementation of fish rescue operations (Mitigation Measure 3.3-7.1) would minimize the direct loss of fish and would result in a *less than significant* impact.

Based on standard practices for other approved plans, the objectives of the fish rescue will be to:

- Remove fish from the areas being dewatered, with emphasis on minimizing adverse impacts on federally listed species and other native species;
- Handle fish in a manner that minimizes mortality; and
- Relocate captured fish to suitable wetted habitat nearby.

Mitigation Measure 3.3-7.1
To minimize mortality due to the dewatering process, a Fish Rescue Plan shall be prepared by DWR for approval by state and federal fish agencies (CDFW, USFWS, NMFS). Development of the Fish Rescue Plan shall include consideration of numerous sampling methods (seines, electrofishing, traps) and events, performed during and potentially after initial site dewatering. Fish would be captured alive and transported to nearby suitable habitat for release. The fish rescue would occur under the direction of CDFW.

Impact significance
Less than significant with mitigation

Impact 3.3-8: Fish injury or mortality due to herbicide application

Although measures have been taken to reduce the potential for off-target spray drift of aerially applied herbicides (see Impact 3.2-3), the potential for the

Proposed Project to result in adverse impacts to non-target organisms was evaluated in terms of:

- the proximity or presence of aquatic biological resources during herbicide application;
- the effects and toxicity of particular herbicides on those resources; and
- the likelihood of chemicals coming into contact with aquatic biological resources.

Herbicides can have a negative effect, both directly and indirectly, on the aquatic biological resources of affected water bodies. These chemical compounds can enter water bodies through a number of different pathways, such as direct application to surface water, surface runoff, spray drift, soil leaching, plant uptake, and volatization (Zhang and Goodhue 2010). Exposure of fish and other aquatic biological resources to herbicides can cause mortality as well as other long-term effects on reproductive success, growth, and survival (Pimentel 2005).

Aquatic-approved formulations containing the active ingredients glyphosate and imazapyr would be the two most utilized herbicides for large scale application under the Proposed Project (Table 3.2-13). Toxicity potential for these herbicides, as well as for aminopyralid and surfactants, is evaluated in Impact 3.2-3, including consideration of herbicide type (i.e., aquatic-approved), application method (i.e., to dewatered soils following fish rescue operations), application frequency (i.e., once immediately following dewatering), amount applied (i.e., according to label specifications), and toxicity (i.e., slightly toxic to practically nontoxic). The analysis suggests that there is a low likelihood of toxicity due to aquatic herbicide application within Prospect Island. This is particularly true for glyphosate, which exhibits low soil mobility and is not likely to be present in runoff and/or pumped discharge following application.

An additional consideration with respect to potential impacts to aquatic species is that of toxicity risk, which takes into account both toxicity and exposure using the hazard quotient calculation. If the ratio of the predicted exposure value and the toxicity reference value (called the Hazard Quotient) is less than 1, then no adverse effects as a result of exposure are expected (SERA 2011a, b). Neither glyphosate nor imazapyr exceed the level of concern for special-status fish species under acute and chronic exposure scenarios reported for a reference study (Table 3.3-11, Table 3.3-12), where exposure estimates are obtained from a single event herbicide runoff model (USEPA 2008). It should be noted that the reference study used formulations of glyphosate and imazapyr that are not wetland approved, so any formulation used under the Proposed Project would

result in even lower hazard quotients than the reference study. Overall, there would be a low toxicity risk to aquatic biological resources from the application of herbicides for invasive plant control at the Proposed Project site.

Table 3.3-11. Acute and Chronic Exposure Scenarios for Glyphosate for Special-status Fish in a Reference Study Using an Application Rate of 3.75 Pounds Acid-Equivalent/Acre (SERA 2011a)

Fish Species	Exposure Scenario[1]	Exposure Estimate (mg/L)	Toxicity Value (mg/L)[2]	Hazard Quotient	Exceed Level of Concern?
Green Sturgeon	Acute	0.04125	0.048	0.9	No
	Chronic	0.00071	0.048	0.015	No
Delta Smelt	Acute	0.04125	0.048	0.9	No
	Chronic	0.00071	0.048	0.015	No
Chinook Salmon, spring-run	Acute	0.04125	0.048	0.9	No
	Chronic	0.00071	0.048	0.015	No
Chinook Salmon, winter-run	Acute	0.04125	0.048	0.9	No
	Chronic	0.00071	0.048	0.015	No
Steelhead	Acute	0.04125	0.048	0.9	No
	Chronic	0.00071	0.048	0.015	No

[1] Acute exposure bioassays = 96 hours. Chronic exposure bioassays = 28 days.

[2] Acute toxicity value is typically the median lethal concentration (LC 50) that is the concentration in water which kills 50% of a test batch of fish within a continuous period of exposure (96 hours). Chronic toxicity value is expressed as the concentration in water which below an unacceptable effect is unlikely to be observed.

Table 3.3-12. Acute and Chronic Exposure Scenarios for Imazapyr for Special-status Fish in a Reference Study Using an Application Rate of 1.5 Pounds Acid Equivalent/Acre (SERA 2011b)

Fish Species	Exposure Scenario	Exposure Estimate (mg/L)	Toxicity Value (mg/L)	Hazard Quotient	Exceed Level of Concern?
Green Sturgeon	Acute	0.015	10.4	0.001	No
	Chronic	0.005	4	0.001	No
Delta Smelt	Acute	0.015	10.4	0.001	No
	Chronic	0.005	4	0.001	No
Chinook Salmon, spring-run	Acute	0.015	10.4	0.001	No
	Chronic	0.005	4	0.001	No
Chinook Salmon, winter-run	Acute	0.015	10.4	0.001	No
	Chronic	0.005	4	0.001	No
Steelhead	Acute	0.015	10.4	0.001	No
	Chronic	0.005	4	0.001	No

[1] Acute exposure bioassays = 96 hours. Chronic exposure bioassays = 28 days.

[2] Acute toxicity value is typically the median lethal concentration (LC 50) that is the concentration in water which kills 50% of a test batch of fish within a continuous period of exposure (96 hours). Chronic toxicity value is expressed as the concentration in water which below an unacceptable effect is unlikely to be observed.

Impact significance

No impact

Impact 3.3-9: Post-construction increased predation on native fish

The potential for the Proposed Project to result in increased predation on native fishes, including special-status fish species, was evaluated in terms of:

- the foraging behavior and habitat preferences of piscivorous fish;
- design features of the Proposed Project intended to minimize the potential for such habitat conditions to occur; and
- the species, life history timing, and avoidance behaviors of fish that would likely be preyed upon.

Restoration of tidal wetlands and their constructed channel network on Prospect Island would have the beneficial effect of increasing the amount of habitat available to aquatic organisms. However, the new habitat could also be used year-round by a wide variety of piscivorous fish, such as Striped Bass (*Morone saxatilis*), Largemouth Bass (*Micropterus salmoides*), and other non-native fishes in the families Centrarchidae (black basses, crappie, and sunfish) and Ictaluridae

(catfish and bullheads). The expanded habitat also may provide the potential for increases in the number of piscivorous wildlife species, such as egrets, herons, raccoons, and otters, which may use the site for foraging.

The presence of piscivorous fish and wildlife throughout the restored wetlands and constructed channel network, but especially in the areas of the levee breaches, would create the potential for the restored tidal wetland habitat to become a biological “sink”. Small fish, including Delta Smelt and juvenile anadromous salmonids, would enter the levee breach areas on tidal inflows and could be preyed upon by piscivorous fish and wildlife. This is because, when high velocity water passes through the breach on flood and ebb tides, it meets low velocity water on the other side and creates turbulent eddies. Predatory fish are known to take advantage of these eddies by congregating near breach locations and preying on disoriented fish (Vogel 2011).

However, the Proposed Project includes “built in” aquatic habitat features designed to favor native fish species, while discouraging the establishment and colonization by non-native, piscivorous fish. A breach velocity dissipater is included in the design of the northern breach location (Figure 2.2-9). The dissipater would help prevent predation by piscivorous fish by reducing the turbulent effects of incoming water. An adaptive management study would be incorporated into monitoring to test the effectiveness of the energy dissipater at reducing predation compared with existing rates in the surrounding waterways and nearby flooded islands and tidal wetlands.

The constructed channel network geometry represents another design feature that favors native fish species. The constructed channels would be excavated to depths that minimize the potential for colonization by aquatic vegetation, which can provide habitat for piscivorous fish; standing dead trees would also be removed to discourage piscivorous fish. Constructed channels would be sized to promote peak tidal flow velocities of approximately 3 ft per second (fps), which is expected to largely preclude invasive Brazilian waterweed (*Egeria densa*) from becoming established on-site. Brazilian waterweed is known to invade natural waterways and substantially impede water flow, reduce turbidity, harbor invasive predator fish species, and decrease the quality of habitat for native resident and anadromous fish (Li and Yang 2009, Grimaldo and Hymanson 1999).

The potential impacts of changes in turbidity on native fish survival have been considered. When waters are too turbid this can affect gill function, but when waters are not turbid enough this can affect the ability of some species, such as

Delta Smelt, to camouflage and avoid predation, as well as feeding functions. Seasonal changes in turbidity may also serve as a functional cue for annual spawning. Modeled low flow turbidities are predicted to decrease by 1−5 NTU (5−15%) compared to baseline conditions in Cache Slough and the DWSC, where mean baseline turbidities in the region are 30−40 NTU (Appendix C in WWR and SWS 2014). Given the natural variability of suspended sediment concentrations in both freshwater and tidally influenced fluvial environments, and the inherent ability of fish to adapt to fluctuating conditions, the Proposed Project would not reduce turbidities to a level that could be considered detrimental for fish. Furthermore, opening Prospect Island to tidal influence would provide additional habitat exhibiting relatively more turbid waters compared to surrounding waterways. The modeled reduction of peak turbidities during high flow conditions in Miner Slough downstream of the northern breach, in Cache Slough and the DWSC, is greater at 5-25 NTU (15 to more than 35%) (Appendix C in WWR and SWS 2014). However, fish behavioral response to high turbidity (i.e., taking shelter from turbid waters during high flows) would not be expected to change with this relatively small reduction in peak turbidities.

The growth benefits of restored wetland habitat have been demonstrated to benefit juvenile Chinook Salmon and Sacramento Splittail (Junk et al. 1989, Moyle et al. 2007, Nobriga and Feyrer 2007, Sommer et al. 2001a, 2001b). The increase in wetland habitat and high food productivity provided by the Proposed Project (WWR and SWS 2014) would result in robust growth rates and larger body sizes of these fish, thereby further increasing their chances to survive predation. Larger fish are stronger swimmers (Videler and Wardle 1991) and can more actively avoid predation. Body size is also important to surpassing the mouth gape of predators (Lundvall et al. 1999), effectively eliminating the potential for predation by piscivorous fish.

Overall, the presence of levee breaches would not cause adverse individual or population-level effects on the survival of special-status fish to the extent that they would cause a reduction in species abundance or long-term population levels. Given the multiple design features inherent to the Proposed Project that favor native fish species, predation levels would be similar to, and potentially lower than, existing rates in the surrounding waterways and nearby flooded islands and tidal wetlands. Therefore, impacts would be *less than significant*.

Impact significance

Less than significant

Impact 3.3-10: Long-term impacts to fish in Prospect Island and adjacent water bodies from changes in water temperature

The potential for the completed Proposed Project to have long-term adverse water temperature impacts to fish and aquatic resources was evaluated in terms of:

- current temperatures within and adjacent to Prospect Island,
- the extent and magnitude of the expected changes, and
- the specific detrimental effects the temperature change would have on aquatic resources.

Shallow water habitats are potentially subject to increased water temperature as a result of direct solar radiation and influence from ambient air temperatures. Increased temperatures can sub-lethally affect aquatic organisms through reduced growth and/or maturation rates, increased vulnerability to predation, increased risk of disease, and in the case of extreme temperatures, can cause mortality (Myrick and Cech Jr. 2001). Of the fish and invertebrate communities potentially occurring on the restored tidal wetland, anadromous salmonids have the lowest temperature tolerances (Myrick and Cech Jr. 2001) and have the potential to occur within the restored wetlands for extended time periods. Therefore, if temperatures on the Proposed Project site and in adjacent water bodies are suitable for Chinook Salmon and Steelhead, they would likewise be suitable for warm water resident fish species, as well as other anadromous or migratory fish (e.g., Green Sturgeon, Delta Smelt, Longfin Smelt).

Juvenile Chinook Salmon show positive growth at temperatures ranging from 46 °F (8 Degrees Celsius [°C]) to 77°F (25°C) (Clarke and Shelbourn 1985, Brett et al. 1982). At 77°F (25°C), there is an imminent risk of mortality of salmon and trout species in natural rivers and streams (Myrick and Cech Jr. 2001). Brett et al. (1982) reared juvenile Chinook Salmon at temperatures ranging from 60°F to 77°F (16°C to 25°C) to monitor growth rates and mortalities and showed temperature related mortalities occurred only in those fish reared at 77°F (25°C). The first death occurred on day 8, with half of the stock dead on day 28. Growth rates were optimal at 69°F (21°C); lower temperatures resulted in slight decreases in growth rates, while higher temperatures resulted in larger declines in growth rates. From these results, suitable (less than 69°F [20°C]), sub-optimal (between 69°F and 77°F [20°C and 25°C]), and lethal (above 77°F [25°C]) temperature categories were applied for interpretation of modeling results on temperature changes due to implementation of the Proposed Project.

Temperatures were examined for Prospect Island and Miner Slough using a sensor located in the southeast corner of the north property and on the Highway 84 Bridge in Miner Slough. These temperatures were then compared to Phase 2 modeling results following restoration to tidal marsh (Table 3.3-13). Results indicate that under existing conditions, temperatures in Prospect Island and Miner Slough are generally suitable (less than 68°F [20°C]), but Miner Slough also experiences sub-optimal (between 68°F and 77°F [20°C and 25°C]) temperatures during warmer months. From January through May, temperatures are almost always in the suitable range for juvenile salmonids, varying from 47.3°F to 70.8°F (8.5°C to 21.6°C), with the highest temperatures occurring for just a few hours a day. June reflects the transition from the cooler temperatures of winter/spring to the warmer temperatures of summer/fall. July and August are dominated by sub-optimal conditions, followed by cooling in September, which is still generally dominated by sub-optimal conditions, but is transitioning to more suitable temperatures. Observed temperatures did not approach or exceed lethal temperatures (greater than 25°C) at any time during the analysis period.

Table 3.3-13. Monthly Measured Daytime Average (2011–2013) and Post-construction Modeled (2010) Water Temperatures for Miner Slough and Prospect Island

Month	Average Temperature °F (ºC)			
	Miner Slough Measured	Prospect Island Measured	Miner Slough Modeled	Prospect Island Modeled
Jan	47.3 (8.5)	46 (7.8)	--	--
Feb	50.2 (10.1)	49.6 (9.8)	--	--
Mar	53.2 (11.8)	53.4 (11.9)	55.6 (13.1)	54.1 (12.3)
Apr	59.5 (15.3)	59.2 (15.1)	58.1 (14.5)	57 (13.9)
May	64.4 (18)	63.7 (17.6)	61.3 (16.3)	61.2 (16.2)
Jun	68 (20)	66.2 (19)	66.4 (19.1)	68.2 (20.1)
Jul	70.5 (21.4)	67.5 (19.7)	70.5 (21.4)	70.3 (21.3)
Aug	70.9 (21.6)	67.6 (19.8)	69.8 (21)	69.3 (20.7)
Sep	68.5 (20.3)	66.4 (19.1)	68 (20)	68.5 (20.3)
Oct	62.6 (17)	61.5 (16.4)	--	--
Nov	55.4 (13)	54.3 (12.4)	--	--
Dec	48.4 (9.1)	47.1 (8.4)	--	--

Measured data are from California Data Exchange Center online database: http://cdec.water.ca.gov/. The Miner Slough station (HWB) is located in Miner Slough at the Highway 84 Bridge, and the Prospect Island Station (B91400 PI-1) is located at the southeast corner of Prospect Island near the pumps (*http://www.water.ca.gov/waterdatalibrary/docs/Hydstra/index.cfm?site=B91400*). Modeled data is from Appendix B in WWR and SWS (2014).

Post-restoration water temperature modeling was performed for Prospect Island and the surrounding waterways when smelt and salmon were most likely present

and when temperatures were the most extreme (March through September) (Appendix B in WWR and SWS 2014). In general, temperatures within the restored Prospect Island would reflect the pre-restoration temperature trends. This indicates that fish would encounter a temperature regime that is conducive to growth during all emigration and rearing periods throughout the year. In addition, the temperatures within the restored island tended to be in the suitable range for longer periods of time than in the surrounding water bodies. Within Prospect Island in July and August, temperature conditions were also within sub-optimal ranges, but included many days in the suitable category, indicating a general cooling effect by the Proposed Project.

In the unlikely scenario in which temperatures in the restored tidal wetland reach critical levels, fish would likely exit Prospect Island in search of cooler water as temperatures began to exceed their thermal preferences. The tidal wetland habitat created by the Proposed Project would not likely increase water temperatures within the constructed channel network or in Miner Slough to levels that would have adverse effects on anadromous salmonids or other resident or migratory fish.

With respect to potential temperature changes in the surrounding waterways, results were modeled for a number of locations throughout the CSC (Appendix B in WWR and SWS 2014). There was no change in the number of suitable days for Miner Slough at the Highway 84 Bridge and Lindsey Slough. Cache Slough at Miner Slough, the Deep Water Ship Channel, and Cache Slough at Ryer Island all showed two fewer suitable days. South Miner Slough resulted in three additional suitable days in July and two fewer suitable days in September. These increases or decreases in temperatures resulting in changes to the number of suitable days are negligible. The magnitudes of deviations from the 2012 temperatures were small, and the effect was localized and temporary. Unfavorable conditions encountered by fish would be avoided in favor of the abundance of suitable habitat nearby.

Modeled temperature changes within Prospect Island, Miner Slough, and the CSC do not indicate a likelihood of adverse individual or population-level effects on the survival of special-status fish, or their associated habitats, to an extent that could cause a reduction in species abundance or long-term population levels. Conversely, model results indicate the potential for slight improvements in seasonal water temperatures within Prospect Island under the Proposed Project. Water temperatures would likely be similar to current temperatures in

surrounding streams and sloughs. Overall, there would be a beneficial effect on long-term water temperatures.

Impact significance
Beneficial

Impact 3.3-11: Altered habitat and food web from invasion by Asian Clam

The potential for the Proposed Project to increase Asian Clam (*Corbicula fluminea*) habitat and impact the aquatic food web was evaluated in terms of the likelihood of expanding the current clam population, the extent of its possible habitat, and the impacts it would have on fish and freshwater tidal marsh habitat. Asian Clams are known to drastically alter natural habitats by increasing water clarity, changing benthic communities, and depressing phytoplankton production (Sousa et al. 2008, Kramer-Wilt 2010, Lopez et al. 2006). This habitat alteration may result in reduced growth rates of special-status fish and increased predation rates by piscivorous fish.

Preliminary sampling by CDFW (March 2014) indicated no evidence that Asian Clams are currently established on Prospect Island. However, the completed restoration would increase connectivity and, accordingly, colonization opportunities for clam larvae. Of the other exotic invasive species (i.e., nonnative fish and aquatic plants) that can or already have established a population on Prospect Island, the Asian Clam is the only species whose establishment is not likely to be prevented through design criteria like flow velocity or water surface elevation (Sousa et al. 2008). Further, design criteria (water temperature, dissolved oxygen) meant to benefit native fish would also benefit Asian Clam survival due to similar physiological survival requirements (Mattice and Dye 1975, Hanson 1997).

Asian Clam growth, density, and survival depend on numerous factors, including substrate, water quality, and flow, but how these factors contribute to the current structure of Asian Clam populations in the Delta is not well understood (Brown et al. 2007). Given its suite of reproductive specializations (Lucas and Thompson 2012), its current establishment in Cache Slough (Section 3.3.1 *Aquatic Biological Resources – Setting*), and the projected level of primary productivity at the restored site (see Impact 3.2-7), there would be an increased likelihood of Asian Clam colonization under the Proposed Project. However, Kramer-Wilt (2010) summarized various studies on Asian Clam, with contradicting results regarding habitat types within which Asian Clams successfully establish.

Therefore, the extent to which this species would colonize within the restored Proposed Project site is speculative.

Currently, most of Prospect Island is isolated and does not export productivity to surrounding waterways. Following restoration, the Proposed Project would likely produce zooplankton similar to that of surrounding waterways (Table 3.3-8) and could be a source of food for Delta Smelt or other special-status fish. Even in the presence of Asian Clam, there would be a net export of primary and secondary productivity to surrounding streams and sloughs compared with existing conditions. Thus, invasion of the restored Prospect Island by Asian Clam would not cause adverse individual or population-level effects on the survival of special-status fish, or their associated habitats, to an extent that could cause a reduction in species abundance or long-term population levels. Overall, impacts would be *less than significant*.

Impact significance
Less than significant

Impact 3.3-12: Food web impacts from increased levels of methylmercury bioaccumulation

The potential for the Proposed Project to have methylmercury bioaccumulation impacts on the food web was evaluated in terms of the likelihood that the Proposed Project would increase methylmercury levels.

As discussed in Section 3.2 *Water Quality*, mercury methylation is a concern for wetland restoration projects in the Bay-Delta because certain types of wetland habitats are known to support the biogeochemical processes that transform the relatively inert forms mercury into the bioavailable form of methylmercury. While total mercury would not change as a result of the Proposed Project, there could be an increase in methylmercury production within Prospect Island and transport to waters surrounding Prospect Island. A localized increase in water column methylmercury could result in increased levels of mercury bioaccumulation in aquatic organisms regularly inhabiting the area, especially top predators like Largemouth Bass and Striped Bass.

Certain aquatic habitats are more likely to serve as sources of methylmercury than others. Mudflats and irregularly inundated areas such as high marsh zones and flooded bypasses seem to have the highest rates of methylmercury export while emergent tidal marshes and open-water habitats appear to have the lowest rates of production, and can even serve as methylmercury sinks (Slotton et al.

2002). Since the Proposed Project would result in primarily open-water habitat (associated with lower methylmercury production) with only fringes of infrequently flooded habitat (associated with higher methylmercury production), it is anticipated that there would be relatively little, if any, increases in methylmercury production and bioaccumulation associated with the Proposed Project (see also Section 3.2.3 *Water Quality – Impacts and mitigation*).

In addition, DWR would be participating in methylmercury control studies (Section 3.2.3 *Water Quality* – Impact 3.2-7) aimed at monitoring methylmercury export from tidal wetlands, potentially including Prospect Island. This monitoring would allow for assessment of conditions following restoration.

Overall, the Proposed Project is not likely to significantly increase levels of methylmercury production and bioaccumulation in or near the Proposed Project site. Therefore, with respect to potential food web impacts due to increased levels of methylmercury bioaccumulation, the Proposed Project would not cause adverse individual or population-level effects on the survival of special-status fish, to an extent that could cause a reduction in species abundance or long-term population levels. Impacts would be *less than significant*.

Impact significance
Less than significant

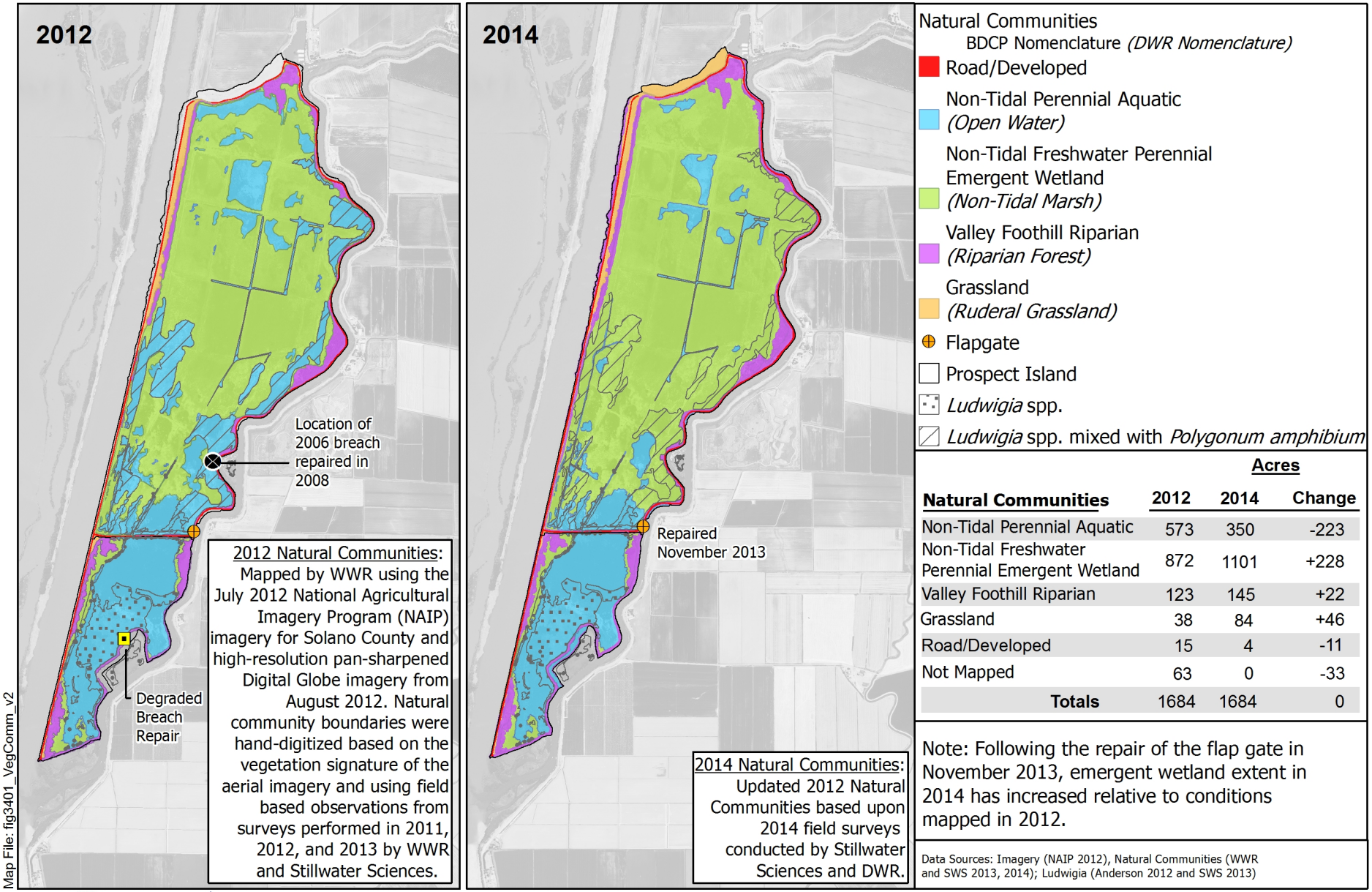
3.4 Wetland and Terrestrial Biological Resources

This section describes wetland and terrestrial habitats in the Proposed Project site and assesses potential impacts to habitats and special-status species resulting from the Proposed Project. The assessment is based on a combination of literature review, database inquiries, mapping, site reconnaissance, U.S. Army Corps of Engineers (USACE) verified wetland delineation, and species surveys. Wetland and terrestrial biological resource issues include potential effects on wetland, open-water, riparian, and terrestrial habitats and species.

3.4.1 Setting

Prospect Island is surrounded by levees and is divided into the north property and the south property by an interior cross-levee (Figure 2.1-1). The interior of the island is flooded. Generally, elevations within Prospect Island range from -3 ft to more than 8 ft (NAVD 88) on the north property and from 0.1 ft to more than 8 ft (NAVD 88) on the south property (DWR and CDFW 2014). The north property primarily consists of freshwater wetlands with riparian and terrestrial habitats

associated with the surrounding levees. The south property is predominantly open-water aquatic habitat with muted tidal influence through gaps in the large rocks of a degraded levee breach repair along Miner Slough. Waterways surrounding Prospect Island are comprised of perennial aquatic (open-water) habitat bordered by valley/foothill riparian, with limited amounts of tidal freshwater emergent wetland habitat within the Miner Slough Wildlife Area as well as along the degraded levee bordering Liberty Island. Agricultural lands are located to the north and east of Prospect Island. Natural communities present at the Proposed Project site are described below based on information provided in the Restoration Plan (DWR and CDFW 2014) and are shown in Figure 3.4-1. Existing acreages of each natural community are also provided in Table 2.2-2.



Acres

Natural Communities	2012	2014	Change
Non-Tidal Perennial Aquatic	573	350	-223
Non-Tidal Freshwater Perennial Emergent Wetland	872	1101	+228
Valley Foothill Riparian	123	145	+22
Grassland	38	84	+46
Road/Developed	15	4	-11
Not Mapped	63	0	-33
Totals	1684	1684	0

Note: Following the repair of the flap gate in November 2013, emergent wetland extent in 2014 has increased relative to conditions mapped in 2012.

Data Sources: Imagery (NAIP 2012), Natural Communities (WWR and SWS 2013, 2014); Ludwigia (Anderson 2012 and SWS 2013)

Map File: fig3401_VegComm_v2

1:48,149 (1 in = 0.8 mile at letter size)

0 0.4 0.8 Mi

0 0.6 1.2 Km

Figure 3.4-1

Vegetation Communities 2012 and 2014 at Prospect Island

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Environmental setting

Natural communities

The Prospect Island vegetation communities described below follow the Bay Delta Conservation Plan natural communities' classification system (Chapter 12 in DWR and USBR 2016).

Non-tidal perennial aquatic

Non-tidal perennial aquatic communities are areas of mostly open-water. Vegetation in this community includes native aquatic plants such as water smartweed (*Persicaria amphibia*), duckweed (*Lemna minor*), and mosquito fern (*Azolla filiculoides*), and non-native plants such as water primrose (*Ludwigia* sp.), parrotfeather (*Myriophyllum aquaticum*), and curlyleaf pondweed (*Potamogeton crispus*). The non-tidal perennial aquatic community is found in lower-elevation areas on the north and south property and in remnant agricultural ditches.

Non-tidal perennial aquatic habitat has the potential to support primary and secondary productivity of plankton and aquatic invertebrates to the aquatic food web, foraging habitat at the margins for reptiles (e.g., giant garter snake, western pond turtle) as well as broad areas of habitat for waterfowl and non-native fish species (Section 3.3.1 *Aquatic Biological Resources – Setting*). Under existing conditions, the levees that surround the property limit hydraulic exchange as well as aquatic species access to non-tidal habitat within the Proposed Project site, including access by native fishes of special concern.

Tidal perennial aquatic

Tidal perennial aquatic habitat surrounding Prospect Island consists primarily of open-water habitat subject to tidal influence. Vegetation is sparse, consisting of floating plants such as water hyacinth (*Eichhornia crassipes*) or submerged plants like Brazilian waterweed (*Egeria densa*).

Tidal perennial aquatic communities have the potential to support primary and secondary productivity and transport; potential foraging habitat at the margins for reptiles (e.g., giant garter snake, western pond turtle); and rearing, foraging, and spawning habitat for native fishes of special concern (Section 3.3.1 *Aquatic Biological Resources – Setting*).

Non-tidal freshwater perennial emergent wetland

Non-tidal freshwater perennial emergent wetlands occur in areas of Prospect Island that are permanently saturated or perennially inundated. This community is dominated by cattails (*Typha latifolia*), common tule (*Schoenoplectus acutus*),

and water smartweed. Common reed (*Phragmites australis*), common rush (*Juncus effusus*), water primrose (*Ludwigia* sp.), and southern bulrush (*Schoenoplectus californicus*) are also interspersed in this community.

Non-tidal freshwater perennial emergent wetlands provide cooler water temperatures to adjacent water bodies through shading and evapotranspiration and also support biogeochemical transformation and sequestration of dissolved nutrients in emergent vegetation and soils (Section 3.2.3 *Water Quality – Impacts and mitigation*). They also have the potential to support primary and secondary productivity of plankton and aquatic invertebrates; nesting, foraging, and roosting habitat for birds (e.g., Northern Harrier, White-tailed Kite, Short-eared Owl, Song Sparrow, Yellow-headed Blackbird); and foraging habitat and cover for reptiles (e.g., giant garter snake, western pond turtle). Under existing conditions, the levees that surround the property limit hydraulic exchange.

Tidal freshwater emergent wetland

A narrow band of wetland vegetation is present along the water side of the west bank of the Miner Slough levee where tidal influence inundates or saturates the soil. This community is dominated by rush and tule, with other species represented within the understory of the valley/foothill riparian community in some locations.

Tidal freshwater emergent wetlands provide cooler water temperatures to adjacent water bodies through shading and evapotranspiration and also support biogeochemical transformation and sequestration of dissolved nutrients in emergent vegetation and soils (Section 3.2.3 *Water Quality – Impacts and mitigation*). They also have the potential to provide primary productivity (e.g., algae, plant litter) and secondary productivity of aquatic invertebrates that support the aquatic food web. In addition, this community type provides potential foraging habitat and cover for reptiles (e.g., giant garter snake, western pond turtle); nesting, roosting, and foraging habitat for birds (e.g., Northern Harrier, White-tailed Kite, Short-eared Owl, Song Sparrow, Yellow-headed Blackbird, California Black Rail); foraging habitat for mammals (e.g., western red bat); and rearing, foraging, and spawning habitat for native fishes of special concern (Section 3.1.1 *Hydrology – Setting*).

Valley/Foothill riparian habitat

The valley/foothill riparian community is a transition zone between aquatic and terrestrial habitats. This community occurs along the higher elevation margins of aquatic and wetland habitats and on upland portions of the levees.

Representative tree species include Gooding's willow (*Salix gooddingii*), arroyo willow (*Salix lasiolepis*), cottonwood (*Populus fremontii*), Oregon ash (*Fraxinus latifolia*), and boxelder (*Acer negundo*). Shrub species making up valley/foothill riparian communities or present as understory plants in riparian woodlands include: sandbar willow (*Salix exigua*), Himalayan blackberry (*Rubus armeniacus*), California blackberry (*Rubus ursinus*), California rose (*Rosa californica*), red-osier dogwood (*Cornus sericea*) and blue elderberry (*Sambucus nigra* ssp. *caerulea*). Numerous snags of relict riparian trees protrude above the water surface in inundated areas of the island that formerly supported riparian woodland.

Valley/foothill riparian communities generally provide habitat for invertebrates (e.g., valley elderberry beetle); basking, overwintering, and nesting habitat for reptiles (e.g., western pond turtle, giant garter snake); nesting, foraging, and roosting habitat for birds (e.g., Northern Harrier, Swainson's Hawk, White-tailed Kite, Yellow Warbler, Yellow-breasted Chat, Song Sparrow, Least Bell's Vireo); roosting and foraging habitat for mammals (e.g., western red bat); and shaded cover and source of terrestrial insects for fish (Section 3.3.1 *Aquatic Biological Resources – Setting*).

Upland communities

Upland communities at the Proposed Project site consist of grasslands and former agricultural/cultivated lands. Grassland is composed of non-native or native annual and perennial grasses and forbs (non-grass herbaceous species). Non-native species include ripgut brome (*Bromus diandrus*), wild oats (*Avena fatua*), rye grass (*Festuca perenne*), Bermuda grass (*Cynodon dactylon*), poison hemlock (*Conium maculatum*), fennel (*Foeniculum vulgare*), wild radish (*Raphanus sativus*), milk thistle (*Silybum marianum*), perennial pepperweed (*Lepidium latifolium*) and white sweetclover (*Melilotus albus*). Native species include western goldenrod (*Euthamia occidentalis*) and mugwort (*Artemisia douglasiana*).

Upland communities generally provide foraging habitat for birds (e.g., White-tailed Kite, Northern Harrier, Swainson's Hawk); basking, overwintering, and nesting habitat for reptiles (e.g., giant garter snake); and foraging habitat for mammals (e.g., western red bat).

Jurisdictional Waters of the United States, including wetlands

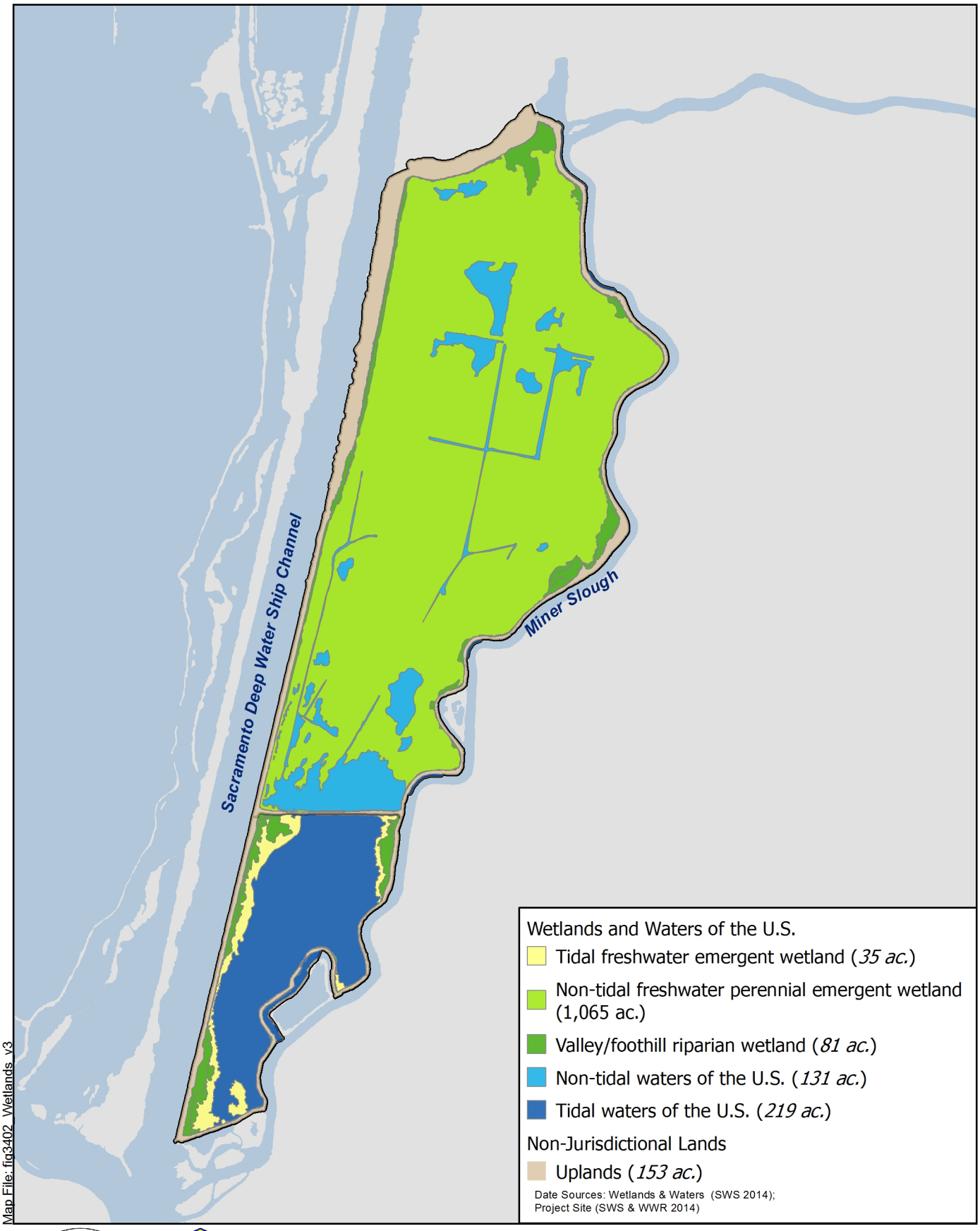
Waters of the U.S., including wetlands, are shown in Table 3.4-1 and Figure 3.4-2 for the Proposed Project site. Additional details on jurisdictional features

within the Proposed Project site are provided in the Preliminary Wetland Delineation (DWR 2014a).

Table 3.4-1. USACE Jurisdictional Waters and Wetlands in the Proposed Project Site

Type of Jurisdictional Feature	Total (Acres)
WATERS OF THE U.S.[a]	
Tidal Waters of the U.S.	219
Non-tidal Waters of the U.S.	131
Total Waters of the U.S., excluding wetlands	**350**
WETLANDS[a]	
Non-tidal freshwater perennial emergent wetland	1,065
Tidal freshwater emergent wetland	35
Valley/foothill riparian wetland	81
Total jurisdictional wetlands	**1,181**
TOTAL USACE JURISDICTIONAL WATERS OF THE U.S., INCLUDING WETLANDS	**1,531**
NON-JURISDICTIONAL UPLANDS	
Uplands	153
TOTAL PROPOSED PROJECT SITE	**1,684**

[a] Subject to Section 404 of the CWA.



Map File: fig3402_Wetlands_v3

1:31,680 (1 in = 0.5 miles at letter size)

0 0.25 0.5 Mi

0 0.5 1 Km

Figure 3.4-2
Waters and Wetlands of the U.S. at Prospect Island

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Tidal Waters of the U.S.

Tidal waters of the U.S. (i.e., traditional navigable waters subject to tidal influence) subject to Section 10 of the Rivers and Harbors Act occur at elevations below the MHW line within Miner Slough, the Sacramento Deep Water Ship Channel (DWSC), as well as within the south property. The Proposed Project site is connected to Miner Slough through a degraded breach repair located south of the cross-levee that currently allows limited tidal exchange. Because this connection provides only limited tidal exchange and does not allow fish passage or fully support associated tidal habitat functions, non-tidal natural community types were assigned to aquatic habitats below mean higher high water (MHHW) within the interior portions of the south property (Table 2.2-2).

Non-tidal Waters of the U.S.

All of the waters of the U.S. within the Proposed Project site are non-navigable, with both tidal and non-tidal waters subject to jurisdiction under Section 404 of the Clean Water Act (CWA). Hydrologic connections between the Proposed Project site waters and Miner Slough occur north of the cross-levee at a flap gate on a culvert (operated intermittently to drain water from the interior), and south of the cross-levee at a levee breach repair site consisting of large boulders. The upper elevational limit of non-wetland waters of the U.S. is either: (1) the transition to non-tidal freshwater perennial emergent wetlands or riparian wetlands, or (2) the transition to uplands (generally at the 6.5 ft elevation contour line [NAVD 88]).

Non-tidal freshwater perennial emergent wetland

Non-tidal freshwater perennial emergent wetlands within the north property are also subject to jurisdiction under Section 404 of the CWA. Indicators of hydric soils present at the site include hydrogen sulfide and loamy gleyed matrix. Indicators of wetland hydrology include high water table, saturation, and hydrogen sulfide odor. The upper limit of this wetland community was either at the transition to valley/foothill riparian wetland or the transition to upland habitats (generally the 6.5 ft elevation contour line [NAVD 88]).

Tidal freshwater emergent wetland

Because the degraded breach repair located south of the cross-levee provides limited tidal exchange between the south property and Miner Slough, portions of the south property at elevations below 6.5 ft (NAVD 88) were mapped as tidal freshwater emergent wetlands subject to jurisdiction under Section 404 of the CWA. Because this connection provides only limited tidal exchange and does not allow fish passage or fully support associated tidal habitat functions, non-tidal

natural community types were assigned to aquatic habitats below MHHW within the interior portions of the south property (Table 2.2-2).

Valley/Foothill riparian wetland

Valley/foothill riparian wetlands within the Proposed Project site are subject to jurisdiction under Section 404 of the CWA because they meet all three wetland criteria; i.e., they have positive indicators of hydrophytic vegetation, hydric soils, and wetland hydrology. Indicators of hydric soils present at the site include loamy gleyed matrix, depleted matrix, redox dark surface, and redox depressions. Indicators of wetland hydrology include high water table, saturated soils, dry-season water table, and oxidized rhizospheres along living roots. Valley/foothill riparian woodland is present on higher elevation areas (> 6.5 ft elevation contour line [NAVD 88]) of the levees, adjacent to Valley/foothill riparian wetlands; however, these areas did not meet the jurisdictional wetlands criteria and were thus not delineated as wetlands.

Special-status species

Special-status plants

Review of the California Natural Diversity Database (CNDDB) (CDFW 2014c), California Native Plant Society's Online Inventory of Rare, Threatened, and Endangered Plants of California (CNPS 2014) and U. S. Fish and Wildlife Service's (USFWS) Species List Generator (USFWS 2013) identified 47 special-status plant species known to occur or with the potential to occur in the vicinity of Prospect Island (Table 3.4-2). Based on the habitat needs of these species, current habitat conditions at the Proposed Project site, and focused botanical surveys conducted in the summer of 2014 (DWR 2014c), 11 species were determined to have moderate or high potential to occur within the Proposed Project site. These species are discussed in further detail below.

Table 3.4-2. Special-status Plant Species with the Potential to Occur in the Proposed Project Vicinity

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Ferris' milk-vetch *Astragalus tener* var. *ferrisiae*	CNPS, CNDDB	– /– /1B.1	April– May	7–246	Vernally mesic soils in meadows and seeps and subalkaline flats in valley and foothill grassland	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
alkali milk-vetch *Astragalus tener* var. *tener*	CNPS, CNDDB	– /– /1B.2	March– June	3–197	Playas, adobe clay in valley and foothill grassland, and alkaline vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
heartscale *Atriplex cordulata* var. *cordulata*	CNPS, CNDDB	– /– /1B.2	April– October	0–1,837	Saline or alkaline soils in chenopod scrub, meadows and seeps, and sandy soils in valley and foothill grassland	**Low;** valley and foothill grassland habitat may be present but is highly disturbed	No	**Low;** valley and foothill grassland habitat would continue to be present but it would continue to be highly disturbed

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
crownscale *Atriplex coronata* var. *coronata*	CNPS	– /– /4.2	March–October	3–1,936	Alkaline, often clay soils in chenopod scrub, valley and foothill grassland, and vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
brittlescale *Atriplex depressa*	CNPS, CNDDB	– /– /1B.2	April–October	3–1,050	Alkaline or clay soils in chenopod scrub, meadows and seeps, playas, valley and foothill grassland	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
San Joaquin spearscale *Atriplex joaquinana*	CNPS, CNDDB	– /– /1B.2	April–October	3–2,740	Alkaline soils in chenopod scrub, meadows and seeps, playas, valley and foothill grassland	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
vernal pool smallscale *Atriplex persistens*	CNPS, CNDDB	– /– /1B.2	June–October	33–377	Alkaline soils in vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
big tarplant *Blepharizonia plumosa*	CNPS, CNDDB	– /– /1B.1	July–October	98–1,657	Valley and foothill grassland, usually in clay soils	**None;** outside of the elevation range	No	**None;** outside of the elevation range
watershield *Brasenia schreberi*	CNPS, CNDDB	– /– /2B.3	June–September	98–7,218	Freshwater marshes and swamps	**None;** outside of the elevation range	No	**None;** outside of the elevation range
round-leaved filaree *California macrophylla*	CNPS, CNDDB	– /– /1B.1	March– May	49–3,937	Clay soils in cismontane woodland and valley and foothill grassland	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
bristly sedge *Carex comosa*	CNPS, CNDDB	– /– /2B.1	May–September	0–2,051	Coastal prairie, lake margins, marshes and swamps, and valley and foothill grassland	**Moderate;** marshes present; valley and foothill grassland habitat may be present but is highly disturbed	Yes, tidal influence introduced	**Moderate;** potential habitat would still be available. Hydrologic connectivity may increase colonization potential within the Proposed Project site
pappose tarplant *Centromadia parryi* subsp. *parryi*	CNPS, CNDDB	– /– /1B.2	May–November	0–1,378	Often alkaline soils in chaparral, coastal prairie, meadows and seeps, coastal salt marshes and swamps, and vernally mesic valley and foothill grassland	**None;** suitable habitat not present	No, the tidal influence would not be enough to create coastal salt marsh habitat	**None;** suitable habitat would not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Parry's rough tarplant *Centromadia parryi* subsp. *rudis*	CNPS	– /– /4.2	May–October	0–328	Alkaline, vernally mesic soils in, seeps, sometimes roadsides, valley and foothill grassland and vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
soft bird's-beak *Chloropyron molle* subsp. *molle* [*Cordylanthus mollis* subsp. *mollis*]	CNPS, CNDDB, USFWS	FE/CR/1B.2	July–November	0–10	Coastal salt marshes and swamps	**None;** suitable habitat not present	No, the tidal salinities would be too low to create tidal salt marsh habitat	**None;** suitable habitat would not be created
Bolander's water-hemlock *Cicuta maculata* var. *bolanderi*	CNPS, CNDDB	– /– /2B.1	July–September	0–656	Coastal, fresh or brackish water marshes and swamps	**Moderate;** freshwater marshes present	Yes, tidal influence introduced	**Moderate;** freshwater marshes present

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Hoover's cryptantha *Cryptantha hooveri*	CNPS, CNDDB	– /– /1A	April–May	30–492	Inland dunes, valley and foothill grassland in sandy soils	**Low;** slightly outside of the elevation range	No	**Low;** slightly outside of the elevation range
dwarf downingia *Downingia pusilla*	CNPS, CNDDB	– /– /2B.2	March– May	3–1,460	Mesic soils in valley and foothill grassland and vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
Antioch Dunes buckwheat *Eriogonum nudum* var. *psychicola*	CNPS, CNDDB	– /– /1B.1	July– October	0–66	Inland dunes	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
Mt. Diablo buckwheat *Eriogonum truncatum*	CNPS, CNDDB	– /– /1B.1	April– September (November), (December),	10–1,148	Sandy soils in chaparral, coastal scrub, and valley and foothill grassland	**Low;** valley and foothill grassland habitat may be present is but highly disturbed	No	**Low;** valley and foothill grassland habitat would continue to be present but would continue to be highly disturbed

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Contra Costa wallflower *Erysimum capitatum* var. *angustatum*	CNPS, CNDDB, USFWS	FE/CE/1B.1	March–July	10–66	Inland dunes	**None;** suitable habitat not present and critical habitat outside of the Proposed Project site	No	**None;** suitable habitat would not be created
diamond-petaled California poppy *Eschscholzia rhombipetala*	CNPS, CNDDB	– /– /1B.1	March–April	0–3,199	Alkaline, clay soils in valley and foothill grassland	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
fragrant fritillary *Fritillaria liliacea*	CNPS, CNDDB	– /– /1B.2	February–April	10–1,345	Often serpentinite soils in cismontane woodland, coastal prairie, coastal scrub, and valley and foothill grassland	**Low;** valley and foothill grassland habitat may be present on non-serpentine soils but is highly disturbed	No	**Low;** valley and foothill grassland habitat would continue to be present but it would continue to be highly disturbed

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
adobe-lily *Fritillaria pluriflora*	CNDDB	– /– /1B.2	February–April	60–705	Often adobe soils in chaparral, cismontane woodland, and valley and foothill grassland	**None;** outside of the elevation range	No	**None;** outside of elevation range
Boggs Lake hedge-hyssop *Gratiola heterosepala*	CNPS, CNDDB	– /CE/1B.2	April–August	33–7,792	Clay soils in marshes and swamps, lake margins and vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
woolly rose-mallow *Hibiscus lasiocarpos* var. *occidentalis*	CNPS, CNDDB	– /– /1B.2	June–September	0–394	Freshwater marshes and swamps	**Moderate;** habitat present	Yes, tidal influence introduced	**High;** Hydrologic connectivity may increase colonization potential within the Proposed Project site
Carquinez goldenbush *Isocoma arguta*	CNPS, CNDDB	– /– /1B.1	August–December	3–66	Alkaline soils in valley and foothill grassland	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Northern California black walnut *Juglans hindsii*	CNPS, CNDDB	– /– /1B.1	April–May	0–1,444	Riparian forest and riparian woodland	**None;** habitat present however the CNDDB documented occurrence in the Proposed Project region was extirpated and any other black walnuts in the area are likely of hybrid origin and thus not protected	No	**None;** habitat present however recruits are unlikely given hybridization issues
Contra Costa goldfields *Lasthenia conjugens*	CNPS, CNDDB, USFWS	FE/– /1B.1	March–June	0–1,542	Mesic soils in cismontane woodland, alkaline playas, valley and foothill grassland, and vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	CNPS, CNDDB	– /– /1B.2	May– July (September)	0–13	Freshwater and brackish marshes and swamps	**High;** one occurrence is documented on the neighboring Ryer Island; 40 additional occurrences are documented in the Proposed Project region (CNDDB)	Yes, tidal influence introduced	**High;** species documented adjacent to the Proposed Project site and hydrologic connectivity may increase colonization potential within the Proposed Project site
legenere *Legenere limosa*	CNPS, CNDDB	– /– /1B.1	April–June	3–2,887	Vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
Heckard's pepper-grass *Lepidium latipes* var. *heckardii*	CNPS, CNDDB	– /– /1B.2	March–May	7–656	Alkaline flats in valley and foothill grasslands	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Mason's Lilaeopsis *Lilaeopsis masonii*	CNPS, CNDDB	– /CR/1B.1	April–November	0–33	Brackish or freshwater marshes and swamps and riparian scrub	**High;** two occurrences are documented in the Proposed Project site; 102 additional occurrences are documented in the Proposed Project region (CNDDB)	Yes, tidal influence introduced	**High;** species already documented in the Project site and hydrologic connectivity may increase colonization potential within the Proposed Project site
Delta Mudwort *Limosella australis*	CNPS, CNDDB	– /– /2B.1	May–August	0–10	Usually mud banks of freshwater or brackish marshes and swamps, and riparian scrub	**Moderate;** one occurrence is documented near the Proposed Project site; 37 additional occurrences are documented in the Proposed Project region (CNDDB)	Yes, tidal influence introduced	**High;** hydrologic connectivity may increase colonization potential within the Proposed Project site
showy golden madia *Madia radiata*	CNPS	– /– /1B.1	March– ay	82–3,986	Cismontane woodland and valley and foothill grassland	**None;** outside of the elevation range	No	**None;** outside of the elevation range

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
little mousetail *Myosurus minimus* subsp. *apus*	CNPS	– /– /3.1	March–June	66–2,100	Alkaline soils in valley and foothill grassland and vernal pools	**None;** outside of the elevation range	No	**None;** outside of the elevation range
Baker's navarretia *Navarretia leucocephala* subsp. *bakeri*	CNPS, CNDDB	– /– /1B.1	April–July	16–5,709	Mesic soils in cismontane woodland, lower montane coniferous forest, meadows and seeps, valley and foothill grassland, vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
Colusa grass *Neostapfia colusana*	CNPS, CNDDB, USFWS	FT/CE/1B.1	May–August	16–656	Adobe soils in large vernal pools	**None;** suitable habitat not present and critical habitat outside of the Proposed Project site	No	**None;** suitable habitat would not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Antioch Dunes evening-primrose *Oenothera deltoides* subsp. *howellii*	CNPS, CNDDB, USFWS and critical habitat	FE/CE/1B.1	March–September	0–98	Inland dunes	**None;** suitable habitat not present and critical habitat outside of the Proposed Project site	No	**None;** suitable habitat would not be created
bearded popcorn-flower *Plagiobothrys hystriculus*	CNPS, CNDDB	– /– /1B.1	April–May	0–899	Mesic soils in valley and foothill grassland, vernal pool margins and often vernal swales	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created
eel-grass pondweed *Potamogeton zosteriformis*	CNPS, CNDDB	– /– /2B.2	June–July	0–6,102	Assorted freshwater marshes and swamps	**Moderate;** habitat present	Yes, tidal influence introduced	**Moderate;** although additional habitat would be present, there is only one occurrence 10 mi to the south of the Proposed Project

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Sanford's Arrowhead *Sagittaria sanfordii*	CNPS, CNDDB	– /– /1B.2	May–October	0–2,133	Assorted shallow freshwater marshes and swamps	**Moderate;** four occurrences are documented near the Proposed Project site (CNDDB; DWR, unpubl. data); seven additional occurrences are documented in the Proposed Project region (CNDDB)	Yes,tidal influence introduced	**High;** hydrologic connectivity may increase colonization potential within the Proposed Project site
marsh skullcap *Scutellaria galericulata*	CNPS, CNDDB	– /– /2B.2	June–September	0–6,890	Lower montane coniferous forest, mesic meadows and seeps, and marshes and swamps	**Moderate;** marshes present	Yes, tidal influence introduced	**Moderate;** hydrologic connectivity may increase colonization potential within the Proposed Project site; nearest occurrence is 7 mi to the east/northeast (J. Witzman, pers. comm., January 2014)

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
side-flowering skullcap *Scutellaria lateriflora*	CNPS, CNDDB	– /– /2B.2	July– September	0–1,640	Mesic meadows and seeps, and marshes and swamps	**Moderate;** marshes present	Yes, tidal influence introduced	**Moderate;** hydrologic connectivity may increase colonization potential within the Proposed Project; site nearest occurrences are 7 mi to the east/southeast
Keck's checkerbloom *Sidalcea keckii*	CNPS, CNDDB, USFWS	FE/– /1B.1	April– May (June)	246–2,133	Serpentinite and clay soils in cismontane woodland, and valley and foothill grassland	**None;** outside the elevation range	No	**None;** outside the elevation range

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Suisun Marsh aster *Symphyotrichum lentum*	CNPS, CNDDB	– /– /1B.2	May–November	0–10	Brackish and freshwater marshes and swamps	**High;** four occurrences are documented in the Proposed Project site (CNDDB); 94 additional occurrences are documented in the Proposed Project region	Yes, tidal influence introduced	**High;** species already documented in the Project site and hydrologic connectivity may increase colonization potential within the Proposed Project site
saline clover *Trifolium hydrophilum*	CNPS, CNDDB	– /– /1B.2	April–June	0–984	Marshes and swamps (specifically saltmarsh according to Baldwin et al.[4]), mesic, alkaline soils in valley and foothill grassland, and vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created

Common name Scientific name	Query sources	Status[1]: Federal/ State/ CRPR	Blooming period	Elevation range (ft)	Suitable habitat type	Likelihood of occurrence in the Proposed Project site under existing conditions[2]	Enhanced conditions post restoration? (preliminary assessment)	Likelihood of occurrence in the Proposed Project site under post-restoration conditions[3]
Crampton's tuctoria or Solano grass *Tuctoria mucronata*	CNPS, CNDDB, USFWS	FE/CE/1B.1	April–August	16–33	Mesic soils in valley and foothill grassland and vernal pools	**None;** suitable habitat not present	No	**None;** suitable habitat would not be created

[1] Status:

–	=	None
Federal		
FE	=	Endangered under the ESA
FT	=	Threatened under the ESA
State		
CE	=	Endangered under the CESA
CR	=	Rare under the Commission on National Parks and Protected Areas
CRPR (California		Rare Plant Ranks)
1A	=	Plants presumed extirpated in California and either are or extinct elsewhere
1B	=	Plants rare, threatened, or endangered in California and elsewhere
2B	=	Plants rare, threatened, or endangered in California, but more common elsewhere
3	=	Plants for which more information is need –a review list
4	=	Plants of limited distribution –a watch list
0.1	=	Seriously threatened in California
0.2	=	Moderaely threatened in California
0.3	=	Not very threatened in California

[2] Likelihood for a special-status species to occur in the Proposed Project site under existing conditions is defined as follows:

- None: the species' required habitat (i.e., plant community types and elevation range) is lacking from the Proposed Project site.
- Low: the species' required habitat occurs in the Proposed Project site but it is of very low quality.
- Moderate: the species' required habitat occurs in the Proposed Project site.
- High: the species has been documented in the Proposed Project site.

[3] Likelihood for a special-status species to occur in the Proposed Project site under post-restoration conditions is defined as follows:

- None: the species' required habitat is lacking from the Project site and restoration would not create this habitat.

Bristly Sedge (*Carex comosa*) is a California Rare Plant Ranks (CRPR) List 2.1 herbaceous perennial that flowers between May and September. Bristly sedge occurs along lake margins and waterside edges in freshwater wetlands and wetland-riparian habitats. Appropriate habitat exists within the Proposed Project site in the non-tidal freshwater perennial emergent wetland vegetation communities on the interior of the island, and on the tidally influenced exterior of the island within tidal perennial emergent wetland and valley/foothill riparian natural communities. The closest recorded occurrences of bristly sedge are approximately 7.5 mi east at Delta Meadows State Park. A second occurrence is located farther east at Delta Meadows State Park.

Bolander's Water Hemlock (*Cicuta maculata var. bolanderi*) is a CRPR List 2.1 herbaceous perennial that flowers between July and September. Bolander's water hemlock occurs in salt marsh and wetland-riparian habitats, and appropriate habitat exists within the Proposed Project site on the island's tidally influenced exterior within tidal perennial emergent wetland and valley/foothill riparian natural communities. The closest recorded occurrences of Bolander's water hemlock are approximately 6 mi west of Prospect Island in Lindsey Slough.

Woolly Rose-Mallow (*Hibiscus lasiocarpos var. occidentalis*) is a CRPR 1B.2 herbaceous perennial that flowers from June to September. The plant occurs in freshwater wetland and riparian habitats. Appropriate habitat exists within the Proposed Project site in non-tidal freshwater perennial emergent wetland natural communities on the interior of the island, and on the tidally influenced exterior of the island within tidal perennial emergent wetland and valley/foothill riparian natural communities. The closest recorded occurrence of woolly rose mallow is located approximately 4 mi west of Prospect Island in Steamboat Slough. Other nearby occurrences have been recorded in Lindsey Slough and Hass Slough to the west.

Delta Tule Pea (*Lathyrus jepsonii* var. *jepsonii*) is a CRPR 1B.2 herbaceous perennial that flowers between May and July. This plant occurs in freshwater and brackish marsh and riparian habitats, although it is usually restricted to areas with tidal influence. Suitable habitat for delta tule pea exists within the Proposed Project site in the non-tidal freshwater perennial emergent wetland natural community on the interior of the island, and in tidal perennial emergent wetland and valley/foothill riparian natural communities on the tidally influenced exterior of the island. The closest occurrence of delta tule pea is located on Ryer Island, just across Miner Slough from the southern tip of Prospect Island. Other nearby occurrences are located to the west on Lindsey Slough and Cache Slough.

Mason's Lilaeopsis (*Lilaeopsis masonii*) is listed by the state of California as rare, and is a CRPR 1B.1 herbaceous perennial that flowers between April and November. The plant occurs in riparian, freshwater marsh and brackish marsh habitats, and is usually restricted to areas with tidal influence. Appropriate habitat exists within the tidal perennial emergent wetland and valley/foothill riparian natural communities on the exterior of Propect Island. Mason's Lilaeopsis was found on the Proposed Project site in the spur channel. The next closest recorded occurrence of Mason's Lilaeopsis is located at the southern tip of Prospect Island, with additional occurrences in the DWSC, and in Hass, Cache, and Lindsey Sloughs on the west side of the island.

Delta Mudwort (*Limosella australis*) is a CRPR 2B.1 perennial stoloniferous herb that flowers between May and August. The plant usually occurs on mud banks in freshwater or brackish marshes or swamps, or riparian scrub, and is usually restricted to areas with tidal influence. Suitable habitat exists within the tidal perennial emergent wetland and valley/foothill riparian natural communities on the exterior of Prospect Island. The closest recorded occurrence of delta mudwort is located at the southern tip of Prospect Island, with additional nearby occurrences along Lindsey Slough to the west and the Sacramento River to the south.

Eelgrass Pondweed (*Potamogeton zosteriformis*) is a CRPR 2.2 herbaceous aquatic annual that flowers between June and July. This plant occurs in wetlands and wetland-riparian natural communities. Appropriate habitat exists within the Proposed Project site in non-tidal perennial aquatic and non-tidal freshwater perennial emergent wetland natural communities on the interior of the island, and on the tidally influenced exterior of the island within tidal perennial aquatic and tidal perennial emergent wetland natural communities. The closest recorded occurrence of eelgrass pondweed was observed in 1949 near Webb Tract, located approximately10 mi south of Prospect Island.

Sanford's Arrowhead (*Sagittaria sanfordii*) is a CRPR 1B.2 rhizomatous perennial herb that flowers from May through October. This plant occurs in freshwater wetlands and wetland-riparian natural communities. Appropriate habitat exists within the Proposed Project site in non-tidal freshwater perennial emergent wetland natural communities on the interior of the island, and on the tidally influenced exterior of the island within tidal perennial emergent wetland and valley/foothill riparian natural communities. There are several recorded occurrences of **Sanford's Arrowhead** located in Miner Slough which borders

Prospect Island on its eastern side. Other nearby occurrences are located on the Sacramento River to the south, and Steamboat Slough to the east.

Marsh Skullcap (*Scutellaria galericulata*) is a CRPR 2.2 rhizomatous perennial herb that flowers from June through September. This plant occurs in meadows and freshwater marsh in yellow pine forest, freshwater wetlands and wetland-riparian habitats. Appropriate habitat exists within the Proposed Project site in non-tidal freshwater perennial emergent wetland communities on the interior of the island, and on the tidally influenced exterior of the island within tidal perennial emergent wetland and valley/foothill riparian natural communities. The closest recorded occurrences are located over 8.5 mi west of Prospect Island at Delta Meadows State Park, and to the south near Staten Island and at Franks Tract State Recreation Area.

Side-flowering Skullcap (*Scutellaria lateriflora*) is a CRPR 2.2 rhizomatous perennial herb that flowers from July through September. This plant occurs in meadows and freshwater marsh in freshwater wetlands and wetland-riparian habitats, and is often found growing on woody debris located in the intertidal zone. Appropriate habitat exists within the Proposed Project site in non-tidal freshwater perennial emergent wetland natural communities on the interior of the island, and on the tidally influenced exterior of the island within tidal perennial emergent wetland and valley/foothill riparian natural communities. The closest recorded occurrences of side-flowering skullcap are located approximately 8.5 mi east of Prospect Island at Delta Meadows State Park, with additional occurrences further south to Bouldin Island

Suisun Marsh Aster (*Symphyotrichum lentum*) is a CRPR 1B.2 rhizomatous perennial herb that flowers from May through November. This plant occurs in freshwater and brackish marshes and wetland-riparian habitats, and is usually restricted to areas with tidal influence. Suitable habitat exists within the tidal perennial emergent wetland and valley/foothill riparian natural communities on the exterior of Prospect Island. Suisun Marsh Aster has been recorded or observed in all waterways surrounding Prospect Island, with an extensive record of additional occurrences throughout the Sacramento-San Joaquin Delta, stretching from San Pablo Bay inland toward the city of Stockton.

Special-status Wildlife Species

Special-status wildlife species were identified as having low, moderate, or high potential to occur at the Proposed Project site (Table 3.4-3). The likelihood of these species occurring at the site was determined by: (1) surveys conducted by

California Department of Water Resources (DWR) between 2009 and 2011; (2) presence and extent of potential habitat; and/or (3) proximity to known occurrences, such as from CNDDB (CDFW 2014c) or the eBird online portal used to report bird sightings (eBird 2013). This review and analysis resulted in the following categories potential for a special-status species to occur:

- None: the Proposed Project site is outside the species' known range and/or the species' required habitat is lacking from the Proposed Project site.
- Low: the species' known range overlaps with the Proposed Project vicinity but not the Proposed Project site, and/or the species' required habitat is of very low quality or quantity in the Proposed Project site; documented sightings of the species in the Proposed Project vicinity are rare, if any.
- Moderate: The species' known distribution or elevation range overlaps with the Proposed Project site and the species' required habitat occurs in the Proposed Project site; there is also a reasonable chance for the species to occur based on frequency of documented sightings in the Proposed Project vicinity.
- High: The species has been documented on the Proposed Project site and/or its required habitat occurs on the Proposed Project site and is of high quality.

Seven special-status species have a high potential to occur or are known to occur at the site: western pond turtle, Northern Harrier, Swainson's Hawk, Yellow Warbler, Yellow-breasted Chat, Song Sparrow ("Modesto" population), and western red bat. Any potential impacts to these and other special-status species whose critical habitat is on the Proposed Project site are discussed in this section.

Table 3.4-3. Special-status Wildlife Species in the Proposed Project Vicinity

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
INVERTEBRATES							
Conservancy Fairy Shrimp *Branchinecta conservatio*	USFWS, CNDDB, DWR et al.	FE/–	Disjunct occurrences in Tehama, Glenn, Butte, Yolo, Solano, Stanislaus, Merced, and Ventura counties	Large, deep vernal pools in annual grasslands	**None**; there is no vernal pool habitat at the Proposed Project site	No	**None**; no vernal pool habitat would be created
Longhorn Fairy Shrimp *Branchinecta longiantenna*	DWR et al.	FE/–	Four known populations in San Luis Obispo, Merced, Alameda, and Contra Costa counties	Vernal pools; also found in sandstone rock outcrop pools, grass-bottomed pools, and claypan pools	**None**; the Proposed Project site is outside of the species' known range	No	**None**; the Proposed Project site is outside of the species' known range
Vernal Pool Fairy Shrimp *Branchinecta lynchi*	USFWS, CNDDB, DWR et al.	FT/– Critical habitat (Designated)	Central Valley, central and south Coast Ranges from Tehama County to Santa Barbara County; isolated populations also in Riverside County	Vernal pools; also found in sandstone rock outcrop pools	**None**; there is no vernal pool habitat at the Proposed Project site	No	**None**; no vernal pool habitat would be created
Vernal Pool Tadpole Shrimp *Lepidurus packardi*	USFWS, CNDDB, DWR et al.	FE/– Critical habitat (Designated)	Shasta County south to Merced County	Vernal pools and ephemeral stock ponds	**None**; there is no vernal pool habitat at the Proposed Project site	No	**None**; no vernal pool habitat would be created

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus*	USFWS, CNDDB, DWR et al.	FT/–	Streamside habitats throughout the Central Valley	Riparian and oak savanna habitats below 3,000 ft with host plant *Sambucus nigra* ssp. *caerulea* (blue elderberry)	**Low**; the Proposed Project site is likely outside of the species' known range; elderberry plants were observed during surveys in December 2013, and no exit holes were observed (J. Downs, CDFW, pers. comm. 2014)	No	**Low**; the Proposed Project site is likely outside of the species' known range
Delta Green Ground Beetle *Elaphrus viridus*	USFWS, CNDDB, DWR et al.	FT/– Critical habitat (Designated)	Only known to occur in Solano County	Grassland habitat interspersed with vernal pools	**None**; there is no vernal pool habitat at the Proposed Project site	No	**None**; no vernal pool habitat would be created
Lange's Metalmark Butterfly *Apodemia mormo langei*	USFWS, CNDDB	FE/–	Antioch Sand Dunes in Contra Costa County	Dunes; larval food plant is nakedstem buckwheat (*Eriogonum nudum* ssp. *auriculatum*); adult nectar plants include buckwheat, butterweed (*Senecio douglasii*), and snakeweed (*Gutierrezia divergens*)	**None**; the Proposed Project site is outside of the species' known range	No	**None**; the Proposed Project site is outside of the species' known range

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
AMPHIBIANS							
California Red-legged Frog *Rana draytonii*	USFWS	FT/SSC Critical habitat (Designated)	Largely restricted to coastal drainages on the central coast from Mendocino County to Baja California; in the Sierra Nevada foothills south to Tulare and possibly Kern counties	Breeds in still or slow-moving water with emergent and overhanging vegetation, including wetlands, wet meadows, ponds, lakes, and low-gradient, slow-moving stream reaches with permanent pools; uses adjacent uplands for dispersal and summer retreat	**None**; the Proposed Project site is outside of the species' known range	No	**None**; the Proposed Project site is outside of the species' known range
California Tiger Salamander *Ambystoma californiense*	USFWS, CNDDB, DWR et al.	FT/ST Critical habitat (Designated)	Very fragmented; along the coast from Sonoma County to Santa Barbara County, in the Central Valley and Sierra foothills from Sacramento County to Tulare County	Grassland, oak savannah, or edges of woodland that provide subterranean refuge (typically mammal burrows); breeds in nearby temporary ponds, vernal pools, or slow-moving parts of streams	**None**; there is no suitable upland habitat at the Proposed Project site	No	**None**; no suitable upland habitat would be created

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
REPTILES							
Western Pond Turtle *Actinemys marmorata*	CNDDB, DWR et al.	–/SSC	From the Oregon border along the coast ranges to the Mexican border, and west of the crest of the Cascades and Sierras	Permanent, slow-moving fresh or brackish water with available basking sites and adjacent open habitats or forest for nesting	**High**; there is suitable non-tidal perennial aquatic habitat present at the Proposed Project site; nesting habitat present on dry levees and uplands; commonly sighted in the Delta	Yes, marshes enhanced	**High**; suitable marsh habitat present and would be enhanced
California Legless Lizard *Anniella pulchra*	CNDDB	–/SSC	Northern Contra Costa County south to northwestern Baja California; scattered occurrences in San Joaquin Valley, along the southern Sierra Nevada mountains, and in the western Mojave Desert	Sparsely vegetated areas of beach dunes, chaparral, pine-oak woodlands, desert scrub, sandy washes, and stream terraces; warm, moist, loose soil for burrowing	**None**; the Proposed Project site is outside of the species' known range and there is no suitable habitat at the Proposed Project site	No	**None**; the Proposed Project site is outside of the species' known range

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Giant Garter Snake *Thamnophis gigas*	USFWS, CNDDB, DWR et al.	FT/ST	Central Valley from the vicinity of Burrel in Fresno County north to near Chico in Butte County; has been extirpated from areas south of Fresno	Sloughs, canals, low-gradient streams and freshwater marsh habitats where there is a prey base of small fish and amphibians; also found in irrigation ditches and rice fields; requires grassy banks and emergent vegetation for basking and areas of high ground protected from flooding during winter	**Low**; this species was not detected during trapping surveys in 2009, though there is suitable habitat present; emergent marsh provides foraging habitat and levees provide winter upland retreat from flooding	No	**Low**; habitat condition suitable, within historic range, few individuals have been detected within the Delta
BIRDS							
Redhead *Aythya americana*	DWR et al.	–/SSC (nesting)	Summer resident; breeds in northeastern California, Central Valley, southern coasts, and southern desert	Freshwater emergent wetlands with dense stands of cattails (*Typha* spp.) and bulrush (*Schoenoplectus* spp.) interspersed with areas of deep, open-water; forage and rest on large, deep bodies of water	**Low**; permanent freshwater emergent wetland at the Proposed Project site may provide suitable breeding habitat; rarely documented in Central Valley, and prefer larger lakes for nesting	No	**Low**; habitat would not be enhanced; this species is rarely documented in the Central Valley

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Least Bittern *Ixobrychus exilis*	DWR et al.	–/SSC (nesting)	Primarily a summer resident; breeds in northeastern California, Central Coast, Central Valley, southern coasts, and southern deserts	Freshwater and brackish marshes with dense aquatic or semiaquatic vegetation interspersed with clumps of woody vegetation and open-water	**Low**; permanent freshwater emergent wetland at the Proposed Project site may provide suitable breeding habitat, though species is rare in the Delta	No	**Low**; while habitat present, this species is rarely detected in the Delta
White-tailed Kite *Elanus leucurus*	CNDDB, DWR et al.	–/SFP (nesting)	Year-round resident; found in nearly all lowlands of California west of the Sierra Nevada mountains and the southeast deserts	Lowland grasslands and wetlands with open areas; nests in trees near open foraging area	**Moderate**; may nest in large riparian trees at the Proposed Project site, and use emergent marsh and grasslands for foraging	No	**Moderate**; riparian forest nesting habitat present but would be reduced in area.
Northern Harrier *Circus cyaneus*	CNDDB, DWR et al.	–/SSC (nesting)	Year-round resident; scattered throughout California.	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields	**High**; documented nesting and foraging at the Project site	No	**High**; suitable nesting and foraging habitat present but reduced in area
Swainson's Hawk *Buteo swainsoni*	CNDDB, DWR et al.	–/ST (nesting)	Summer resident; breeds in lower Sacramento and San Joaquin valleys, the Klamath Basin, and Butte Valley.	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields	**High**; nesting documented in riparian forest habitats at the Proposed Project site	No	**High**; suitable riparian forest nesting habitat present.

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Golden Eagle *Aquila chrysaetos*	DWR et al.	BGEPA/SFP (nesting and wintering)	Uncommon permanent resident and migrant throughout California, except center of Central Valley	Open woodlands and oak savannahs, grasslands, chaparral, sagebrush flats; nests on steep cliffs or large trees	**None**; no suitable nesting habitat on or near Proposed Project site	No	**None;** no suitable nesting habitat would be created
California Black Rail *Laterallus jamaicenis coturniculus*	CNDDB, DWR et al.	–/ST, SFP	Marshes of San Francisco Bay (primarily San Pablo and Suisun Bay), Sacramento-San Joaquin Delta, Sierra Nevada foothills, few in central coast and southeastern California	Primarily large tidal saline to brackish wetlands with dense vegetative cover and sufficient elevation for high tide refugia; in the Delta: in-channel islands with mixed emergent wetland (Schoenoplectus sp.) and riparian scrub-shrub (Salix sp., Cornus sp.), managed marsh, or irrigated pasture with emergent wetland vegetation	**Low**; No black rails were encountered during 2014 surveys; water levels in the Proposed Project site are too deep to support black rail	No	**Low**; a majority of the tidal marsh would remain too deep and would not have appropriate elevation to support nesting.
Ridgway's Rail *Rallus obsoletus*	USFWS, DWR et al.	FE/SE, SFP	Predominantly in marshes in San Francisco Bay, and sporadically in Suisun Marsh east to Browns Island	Salt and brackish water marshes, typically dominated by pickleweed (*Sarcocornia pacifica*) and Pacific cordgrass (*Spartina foliosa*)	**None**; outside the species' known range	No	**None**; outside the species' known range

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Greater Sandhill Crane *Grus canadensis tabida*	DWR et al.	–/ST, SFP (nesting and wintering)	Winter visitor and migrant; scattered locations in the Central Valley; breeds in extreme northeastern California	Forages in harvested rice fields, corn stubble, barley, and newly planted grain fields; occasionally in managed freshwater marshes	**Low** (wintering/foraging only); the Proposed Project site is on the edge of the species' known range; low potential to forage in freshwater emergent wetland habitats	No	**Low**; the Proposed Project site is on the edge of the species' known range; tidal habitat does not provide suitable roosting habitat for the species
Mountain Plover *Charadrius montanus*	CNDDB, DWR et al.	FPT/SSC (wintering)	Winter visitor; found in the Central Valley south of Yuba County and parts of Central and South Coast and Southeastern California	Occupies open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grain fields	**None**; no suitable habitat at the Proposed Project site	No	**None**; no suitable grassland habitat would be created
California Least Tern *Sternula antillarum browni*	USFWS, DWR et al.	FE/SE, SFP (nesting colony)	Pacific coast from San Francisco to Baja California	Sparsely vegetated coastal beaches and estuaries near shallow waters, above high tide line	**None**; no suitable habitat at the Proposed Project site	No	**None**; no suitable estuarine habitat would be created

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Western Yellow-billed Cuckoo *Coccyzus americanus*	CNDDB, DWR et al.	FC/SE (nesting)	Breeds in limited portions of the Sacramento River and the South Fork Kern River; small populations may nest in Butte, Yuba, Sutter, San Bernardino, Riverside, Inyo, Los Angeles, and Imperial counties	Summer resident of valley/foothill and desert riparian habitats; nests in open woodland with clearings and low, dense, scrubby vegetation	**Low**; rare in the Proposed Project vicinity; low probability of nesting	No	**Low**; while habitat present, this species is rare in the Proposed Project vicinity
Western Burrowing Owl *Athene cunicularia hypugaea*	CNDDB, DWR et al.	–/SSC (burrow sites and some wintering sites)	Year-round resident throughout much of the state; Central Valley, northeastern plateau, southeastern deserts, and coastal areas; rare along south coast	Level, open, dry, heavily grazed or low- stature grassland or desert vegetation with available burrows	**Low;** limited availability of suitable nesting or foraging habitat in grasslands at western perimeter of Proposed Project site along dry levees and uplands	No	**Low**; grassland habitat would continue to be present in the Proposed Project site but extent would still be limited

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Short-eared Owl *Asio flammeus*	DWR et al.	–/SSC (nesting)	Year-round resident in certain areas; breeding in California episodic and a widespread winter migrant, found primarily in the Central Valley, in the western Sierra Nevada foothills, and along the coastline	Irrigated alfalfa or grain fields, ungrazed grasslands, old pastures, and salt or freshwater marshlands	**Moderate**; Not documented during 2009 or 2014 surveys; may forage in permanent freshwater emergent marsh and upland habitats, primarily in winter; very low potential for nesting at the Proposed Project site due to limited upland breeding sites or suitable dry nest sites in wetlands.	No	**Moderate;** suitable nesting and foraging habitat present but reduced in area
Loggerhead Shrike *Lanius ludovicianus*	DWR et al.	–/SSC (nesting)	Year-round resident in most of California except for the forested coastal slope and the high elevations of the Sierra Nevada, southern Cascade, and Transverse Ranges	Open shrubland or woodlands with short vegetation and and/or bare ground for hunting; some tall shrubs, trees, fences, or power lines for perching; typically nest in isolated trees or large shrubs	**Low**; Not documented during 2009 or 2014 surveys; may nest in isolated shrubs at the Proposed Project site, though suitability of foraging habitat is marginal	No	**Low**; limited suitable nesting or foraging habitat

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Least Bell's Vireo *Vireo bellii pusillus*	DWR et al.	FE/SE (nesting)	Summer resident; breeds in scattered locations around southern California. There is some evidence that the species may be recovering in the Central Valley	Nests in dense vegetative cover of riparian areas; often nests in willow or mulefat; forages in dense, stratified canopy	**Low**; while this species is a rare migrant in the Proposed Project vicinity, there is evidence that the species could be increasing in the Central Valley; one recent nesting record in restored habitat at San Joaquin River National Wildlife Refuge, and recent documented singing males in Yolo Bypass Wildlife Area	No	**Low**; suitable habitat present but would be reduced in area; the species is rare in the Proposed Project vicinity

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Bank Swallow *Riparia riparia*	CNDDB, DWR et al.	–/ST (nesting)	Summer resident; occurs along the Sacramento River from Tehama County to Sacramento County, along the Feather and lower American rivers; and in the plains east of the Cascade Range in Modoc, Lassen, and northern Siskiyou counties; small populations near the coast from San Francisco County to Monterey County	Nests in vertical bluffs or banks, usually adjacent to water, where the soil consists of sand or sandy loam	**None**; no suitable vertical bank habitat at the Proposed Project site	No	**None**; no suitable vertical bank habitat would be created

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Yellow Warbler *Dendroica petechia*	DWR et al.	–/SSC (nesting)	Summer resident; nests in most of California, except most of the Central Valley, high Sierras, and Mojave and Colorado deserts	Open-canopy, deciduous riparian woodland close to water, along streams or wet meadows	**Moderate to High**; documented during summer in riparian scrub-shrub at the Proposed Project site (breeding status unknown); the Proposed Project site is outside of what is considered the species' current breeding range (Heath 2008)	No	**Moderate to High**; riparian forest nesting habitat present but would be reduced in area
Saltmarsh Common Yellowthroat *Geothlypis trichas sinuosa*	CNDDB, DWR et al.	–/SSC	San Francisco Bay region	Brackish marsh, riparian woodland/swamp, freshwater marsh, and salt marsh often near upland habitats	**None**; outside the species' known breeding range	No	**None**; outside the species' known breeding range

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Yellow-breasted Chat *Icteria virens*	DWR et al.	–/SSC (nesting)	Uncommon summer resident and migrant in coastal California and in foothills of the Sierra Nevada	Early-successional riparian habitats with a dense shrub layer and an open canopy	**High**; although the Delta is considered outside the species' breeding range (Comrack 2008), observations during breeding season at the Proposed Project site and the Delta indicate the species likely nests in the region (National Audubon Society 2013)	No	**High**; riparian forest habitat present but would be reduced in area
Grasshopper Sparrow *Ammodramus savannarum*	CNDDB, DWR et al.	–/SSC (nesting)	Summer resident; nests in Mendocino, Trinity, and Tehama counties south, west of the Cascade–Sierra Nevada axis and southeastern deserts, to San Diego County	Typically found in moderately open grasslands with scattered shrubs	**Low**; grassland habitats at the Proposed Project site are limited and of marginal quality.	No	**Low**; grassland habitat would continue to be present in the Proposed Project site but extent would still be limited
Song Sparrow ("Modesto" population) *Melospiza melodia*	DWR et al.	–/SSC	Year-round resident; north-central portion of the Central Valley	Emergent freshwater marshes, riparian willow thickets, and riparian forests	**High**; sightings common throughout the Proposed Project site during 2009 and 2014 surveys, including nesting	No	**High**; marsh nesting and foraging habitat present but would be reduced in area

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Suisun Song Sparrow *Melospiza melodia maxillaris*	CNDDB	–/SSC	Resident of Suisun Bay	Brackish-water marshes	**None**; outside the species' known range	No	**None**; outside the species' known range
Tricolored Blackbird *Agelaius tricolor*	CNDDB, DWR et al.	–/SSC (nesting colony)	Permanent resident, but makes extensive migrations both in breeding season and winter; common locally throughout Central Valley and in coastal areas from Sonoma County south	Feeds in grasslands and agriculture fields; nesting habitat components include open accessible water, a protected nesting substrate (including flooded or thorny vegetation), and a suitable nearby foraging space with adequate insect prey	**Low**; while permanent freshwater emergent wetland at the Proposed Project site may provide suitable breeding habitat, breeding colonies are uncommon in the Proposed Project vicinity.	No	**Low**; while habitat present, this species is uncommon in the Proposed Project vicinity

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Yellow-headed Blackbird *Xanthocephalus xanthocephalus*	CNDDB, DWR et al.	–/SSC (nesting)	Primarily a migrant and summer resident, though small numbers remain in winter; Central Valley, northeastern California, central and southern coasts, and southern deserts	Breeds almost entirely in open marshes with relatively deep water and tall emergent vegetation, such as bulrush (*Schoenoplectus* spp.) or cattails (*Typha* spp.); nests are typically in moderately dense vegetation; forage within wetlands and surrounding grasslands and croplands	**Low;** while permanent freshwater emergent wetland at the Proposed Project site may provide suitable breeding habitat, breeding is uncommon in the Proposed Project vicinity; emergent marsh provides foraging habitat	No	**Low;** while habitat present and would be enhanced, this species is uncommon in the Proposed Project vicinity
MAMMALS							
Salt marsh harvest mouse *Reithrodontomys raviventris*	USFWS, CNDDB	FE/SE, SFP	San Pablo, Suisun, and San Francisco bays in Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, and San Mateo counties	Tidal salt marshes; depend on dense cover, preferring pickleweed (*Salicornia pacifica*) and saltgrass	**None**; outside the species' known range	No	**None**; outside the species' known range

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
Western Red Bat *Lasiurus blossevillii*	CNDDB, DWR et al.	–/SSC	Near the Pacific Coast, Central Valley, and the Sierra Nevada	Riparian forests, woodlands near streams, fields and orchards	**High**; species detected during acoustic monitoring in 2009; roosting habitat throughout riparian forest at the Proposed Project site, including maternity roosts	Yes	**High**; riparian forest roosting habitat present
San Joaquin Kit Fox *Vulpes macrotis mutica*	USFWS	FE/ST/BLMS	San Joaquin Valley floor and surrounding foothills of the coastal ranges, Sierra Nevada, and Tehachapi mountains	Annual grasslands or open areas dominated by scattered brush, shrubs, and scrub	**None**; no suitable habitat at the Proposed Project site	No	**None**; no suitable grassland habitat would be created
American Badger *Taxidea taxus*	CNDDB	–/SSC	Throughout the state except in the humid coastal forests of Del Norte County and the northwest portion of Humboldt County	Shrubland, open grasslands, fields, and alpine meadows with friable soils	**None**; no suitable habitat at the Proposed Project site	No	**None**; no suitable grassland habitat would be created

Common name Scientific name	Query sources	Status[1] Federal/ State	Distribution in California	Habitat association	Likelihood to occur[2] at the Proposed Project site under existing conditions	Restoration enhances conditions for species?	Likelihood to occur in the Proposed Project site under post-restoration conditions
California Ringtail *Bassariscus astutus raptor*	Zeiner et al. 1990a	–/SFP	Widely distributed, though greatest abundance in northern California and Sierra Nevada foothills	Mixture of forest and shrub habitats in association with rocky areas or riparian habitats, low to middle elevations	**Low**; very little is known about this species in this region; may occur in riparian trees at the Proposed Project site, though there is a lack of connectivity to other riparian areas	No	**Low**; the species is uncommon in the Delta; as restoration and habitat connectivity increases, likelihood for occurrence could increase

[1] Status codes:

Federal	State
FE = Listed as endangered under the federal Endangered Species Act	SE = Listed as Endangered under the California Endangered Species Act
FT = Listed as threatened under the federal Endangered Species Act	ST = Listed as Threatened under the California Endangered Species Act
FC = Federal candidate species	SSC = California Species of Special Concern
FSC = Federal Species of Concern	SFP = CDFW Fully Protected species

[2] Sources: Appendix 12A in DWR and USBR (2016); and 2014 bird surveys (SWS 2014). Likelihood for species to occur at the Proposed Project site:

- None: the Proposed Project site is outside the species' known range and/or the species' required habitat is lacking from the Proposed Project site.
- Low: the species' known range overlaps with the Proposed Project region but not the Proposed Project site, and/or the species' required habitat is of very low quality or quantity in the Proposed Project site; documented sightings of the species in the Proposed Project region are rare, if any.
- Moderate: The species' known distribution or elevation range overlaps with the Proposed Project site and the species' required habitat occurs in the Proposed Project site; there is also a reasonable chance for the species to occur based on frequency of documented sightings in the Proposed Project region.
- High: The species has been documented in the Proposed Project site and/or its required habitat occurs in the Proposed Project site, is of high quality, and documented sightings of the species in the Proposed Project region are common.

Special-status invertebrates

Several special-status invertebrate species are known to occur within the study area; however, all but one of the species require vernal pool, alkali seasonal wetland, or sand dune habitats that are absent from the project site. Due to lack of suitable habitat on the Proposed Project site, these species have no potential to occur and are not further addressed in this document: Conservancy fairy shrimp (*Branchinecta conservatio*), Longhorn fairy shrimp (*Branchinecta longiantenna*), Vernal pool fairy shrimp (*Branchinecta lynchi*), Vernal pool tadpole shrimp (*Lepidurus packardi*), Delta green ground beetle (*Elaphrus viridis*), and Lange's metalmark butterfly (*Apodemia mormo langei)*.

Valley elderberry long horn beetle

The valley elderberry long horn beetle, a federally listed threatened species, is completely dependent on its host plant, elderberry (*Sambucus* spp.), a common shrub of riparian forests and adjacent upland habitats in the Central Valley. The host plant for this species occurs on-site in several locations; however, the project site is believed to be outside the range of this species. The two closest occurrences of this species are located 13.6 mi from the project site: a 1991 occurrence along Dudley Creek, just east of Pedrick Road, 0.1 mi north of Dixon Ave, just east of Dixon, and a 1987 occurrence 2.25 mi east of Franklin Field along the Cosumnes River (CDFW 2014c). Within the primary zone of the Sacramento-San Joaquin River Delta (Delta), there is one known occurrence from 1984 along Wing Levee Road between Howard and Undine Roads on Union Island near Middle River, approximately 30 mi southwest of the Proposed Project site.

A protocol level survey on April 16 and 24, 2014, conducted in accordance with the *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (USFWS 1999a) identified seven elderberry shrubs on-site. The shrubs were of sufficient size to provide habitat for the beetle but no indicators of extant presence (recently created exit holes) were detected. Argentine ants, known to prey upon beetle larvae, were observed on several of the shrubs on-site (J. Downs, pers. comm, 2014). The Proposed Project site is over 13 mi from the nearest known population of the beetle. The lack of recorded occurrences in the vicinity of the Proposed Project site and the relative abundance of the host plant in the delta indicate that the elderberry shrubs on-site are unlikely to be potential habitat for the beetle.

Special-status reptiles

Habitat for two special-status reptile species occurs on the Proposed Project site: giant garter snake (*Thamnophis gigas*), a federal and state listed threatened species; and western pond turtle (*Actinemys marmorata*), a California Species of Special Concern. Habitats for other amphibian or reptile species are known to occur in Solano, Yolo, or Sacramento counties, but do not exist on the Proposed Project site and therefore are not considered further in this document. These species include: California tiger salamander (*Ambystoma californiense*), California red-legged frog (*Rana draytonii*), and California legless lizard (*Anniella pulchra*).

Giant garter snake

The giant garter snake resides in marshes, ponds, sloughs, small lakes, low-gradient streams, and other waterways, and in agricultural wetlands, including irrigation and drainage canals, rice fields, and adjacent uplands (USFWS 1993a). Primary habitat requirements of the giant garter snake include the following: (1) adequate water during the snake's active season (early-spring through mid-fall) to provide food and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, accompanied by vegetated banks for escape cover and foraging habitat during the active season; (3) basking habitat of grassy banks and openings in waterside vegetation; and (4) higher elevation uplands for cover and refuge from flood waters during the snake's winter dormant season (Hansen and Brode 1980, Hansen 1986, USFWS 2012). In some rice-growing areas, giant garter snakes have adapted well to vegetated, artificial waterways and associated rice fields (Hansen and Brode 1993). Throughout its winter dormancy period, the giant garter snake resides in small mammal burrows and soil crevices located above prevailing flood elevations (USFWS 2012). Burrows are typically located in sunny exposures along south- and west-facing slopes (USFWS 1993a).

Occurrence records indicate that giant garter snakes are currently distributed in 13 unique population clusters coinciding with historical flood basins, marshes, wetlands, and tributary streams of the Central Valley (Hansen and Brode 1980; Brode and Hansen 1992; USFWS 1999b). These populations are isolated, without protected dispersal corridors to other adjacent populations, and are threatened by land use practices and other human activities, including development of wetland and suitable agricultural habitats. The Proposed Project site is within the Mid-Valley Recovery Unit identified in the draft recovery plan and near the Yolo-Liberty Farms population cluster (USFWS 1999b). Hansen (1988) reported that although the major permanent waterways of the Delta are

apparently unsuitable for the giant garter snake, small backwater sloughs and toe drains support suitable habitat for, and thus could potentially support, small numbers of giant garter snakes.

The U.S. Geological Survey (USGS) conducted surveys for giant garter snake in 2004 and 2005 in the southern portion of the Yolo Basin near Cache Slough between Liberty Island and Lower Ulatis Creek in Solano County (Wylie and Martin 2005). Surveys were conducted in areas that supported habitat similar to known occupied sites and in areas where several historical occurrences were apparently reported. No giant garter snakes were found during these surveys (Wylie and Martin 2005).

While suitable habitat continues to persist along natural streams and artificial channels throughout much of the Delta, historical and recent occurrence records based on a substantial survey effort suggest two primary geographic areas that retain extant populations and probably a greater likelihood of potential occurrence and re-establishment of populations. These include the Yolo Bypass Floodway (Yolo Bypass) and vicinity west of the DWSC and the eastern Delta fringe from approximately the Stone Lakes area south to Stockton and generally east of the Mokelumne River (Figure 12-15a in DWR and USBR 2016).

There are five CNDDB occurrences for giant garter snake within a 10 mi radius of the Proposed Project site (CDFW 2014c), the closest being less than 5 mi to the northwest. While a few other isolated records also occur within the Sacramento-San Joaquin Delta, surveys conducted since the mid-1980s suggest that much of the Delta is unoccupied or supports few giant garter snakes. Giant garter snakes may have occupied this region at one time, but longstanding reclamation of wetlands for intense agricultural applications has eliminated most suitable habitat (Hansen 1986) and prohibited the reestablishment of viable giant garter snake breeding populations.

Larger areas of suitable habitat for giant garter snake developed at Prospect Island as a result of the latest levee breach in 2006, when pumping water off-site was discontinued. Currently, Prospect Island exhibits the primary components of suitable aquatic and upland habitat for giant garter snake, including non-tidal perennial emergent wetlands, shallow open-water areas, riparian scrub wetland, and upland habitats in the form of grassland and valley foothill riparian communities on levees and berms. These existing habitats provide potential basking and brumation (i.e., a hibernation-like state that cold-blooded animals utilize during very cold weather) sites for giant garter snake.

In 2009, limited surveys were conducted for giant garter snake on Prospect Island as part of the Bay Delta Conservation Plan Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) surveys (Appendix 12C in DWR and USBR 2016). During this limited survey effort no giant garter snakes were observed or captured. Other snake species were observed during the survey efforts, including two unidentified garter snakes, one common garter snake, one gopher snake, and one yellow-bellied racer. While the survey effort resulted in a lack of evidence that giant garter snake occurs on-site, the surveys confirmed the presence of other snake species, some of which utilize similar habitat as giant garter snake.

Despite exhibiting the primary components of suitable habitat, Prospect Island appears to provide habitat of marginal quality for giant garter snake, which is likely due to a combination of factors: periodic large flood events, the presence of non-native marsh plant species, and high densities of predatory fish. As stated previously, the marsh habitat currently present on Prospect Island was created by a levee breach in 2006, which was itself one in a series of flood and drain occurrences at the Proposed Project site since the mid-1990s. As part of the Yolo Bypass Flood Control Project, the Proposed Project site is surrounded by restricted height levees that are designed to overtop in high flood conditions. Repeated breaching and intensive flooding of Prospect Island is not desirable for the giant garter snake or the habitats it utilizes because flooding can impact giant garter snake individuals that may be overwintering in upland habitat and typically drowns the emergent marsh the species uses for foraging and cover.

Additionally, non-native invasive plants are found throughout the Proposed Project site; there are currently 75–100 ac of verified *Ludwigia spp.* stands and many more acres of potential mixed stands (Figure 3.4-1) (SWS and WWR 2013) that do not provide ideal habitat for the species. The thick stands may provide edge habitat for the species but the interior of those stands may be avoided by giant garter snake. Lastly, perennial aquatic areas of the Proposed Project site are occupied by high densities of predatory fish in all surveyed areas of the site (CDFW, unpubl. data 2013 to present). While predatory fish do not directly threaten adult giant garter snakes, they can prey upon juvenile snakes, threatening the overall recruitment of the species, should adults attempt to reproduce on the site. Combined, these factors may explain why the recent (2009) survey effort resulted in a lack of evidence that giant garter snake occurs at Prospect Island.

Western pond turtle

The western pond turtle is usually found in still or slow-moving freshwater habitats and sometimes in brackish habitats. Primarily found in natural aquatic habitats, the species also inhabits impoundments, irrigation ditches, and other artificial water bodies with suitable basking sites, underwater cover, and riparian vegetation (Zeiner et al. 1988a).

Historically, western pond turtles inhabited most water bodies throughout their range, but the series of warm, shallow lakes and extensive slough systems that formerly covered most of the floor of the Central Valley represented their optimal habitat (Jennings et al. 1992). Western pond turtles are common throughout many parts of the Delta, including island interiors, particularly main irrigation and drainage canals or ditches, including toe drains. The species has the potential to occur along most of the slower-moving sloughs and other water bodies in the Proposed Project site where essential habitat elements (streamside cover, logs, and other debris for basking, and adjacent upland habitats) are present.

Upland habitats are also important to western pond turtles for nesting, overwintering, and overland dispersal (Holland 1994). Nesting sites may be 1,320 ft from aquatic habitat, although the distance is generally around 650 ft (Jennings and Hayes 1994). The turtle can move up to 1.25 mi from aquatic habitat and can tolerate at least seven days without water if local aquatic habitat changes or disappears (Jennings and Hayes 1994). Dispersal habitat is similar to upland nesting habitat but also includes agricultural land. Grasslands and riparian areas provide western pond turtle upland nesting and overwintering habitat.

Western pond turtle is known to occur within the Proposed Project Site. During Bay Delta Conservation Plan EIR/EIS surveys on the Proposed Project site, there were incidental observations of western pond turtles while conducting surveys for listed vernal pool invertebrate species and giant garter snake, but exact locations were not given (Appendix 12C in DWR and USBR 2016). Western pond turtles were observed in the remnant slough channel between Hall's Island and Prospect Island on April 24, 2014 during protocol level valley elderberry longhorn beetle surveys.

Special-status birds

Prospect Island contains a variety of habitats, including riparian and emergent wetland habitats which have experienced declines of up to 90% loss statewide; the Proposed Project site comprises one of the larger contiguous emergent

wetlands in the Proposed Project vicinity (approximately 1,100 ac, see Table 2.2-2), as well as 145 ac of valley/foothill riparian habitat that hosts a diverse bird community. Surveys conducted at Prospect Island revealed 87 bird species associated with the habitats at the site (SWS 2014). Resident species such as Northern Harrier (*Circus cyaneus*), American Bittern (*Botaurus lentiginosus*), Virginia Rail (*Rallus limicola*), Mallard (*Anas platyrhynchos*), Double-crested Cormorant (*Phalacrocorax auritus*), Pied-billed Grebe (*Podilymbus podiceps*), Song Sparrow (*Melospiza melodia*), Red-winged Blackbird (*Agelaius phoeniceus*), Common Yellowthroat (*Geothlypis trichas*), and Marsh Wren (*Cistothorus palustris*) used freshwater emergent wetland and perennial habitats; Mourning Dove (*Zenaida macroura*), Great Horned Owl (*Bubo virginianus*), American Robin (*Turdus migratorius*), and Nuttall's Woodpecker (*Picoides nuttallii*) used riparian habitats; and Western Meadowlark (*Sturnella neglecta*) and American Goldfinch (*Carduelis tristis*) used ruderal grassland habitats. Several migratory species used Prospect Island during spring and fall migration, including Western Tanager (*Piranga ludoviciana*), Black-bellied Plover (*Pluvialis squatarola*), and Western Sandpiper (*Calidris mauri*). Neotropical migrant species that nested at Prospect Island include Swainson's Hawk (*Buteo swainsoni*), Tree Swallow (*Tachycineta bicolor*), Black-headed Grosbeak (*Pheucticus melanocephalus*), Yellow-breasted Chat (*Icteria virens*), and Wilson's Warbler (*Wilsonia pusilla*). Non-native, invasive species such as Eurasian Collared Dove (*Streptopelia decaocto*), European Starling (*Sturnus vulgaris*), Great-tailed Grackle (*Quiscalus mexicanus*), and Brown-headed Cowbird (*Molothrus ater*) were also recorded at Prospect Island.

Special-status Species with a high or moderate likelihood of occurring at the Proposed Project site under existing conditions and after restoration are discussed in detail below.

Special-status bird species found within the study area that have low to no potential to occur due to lack of suitable habitat at the Proposed Project site are not considered further in this document. These species include: Redhead (*Aythya americana*), Least Bittern (*Ixobrychus exilis*), Golden Eagle (*Aquila chrysaetos*), Ridgway's Rail (*Rallus obsoletus*), Greater Sandhill Crane (*Grus canadensis tabida*), Mountain Plover (*Charadrius montanus*), California Least Tern (*Sterna antillarum browni*), Western Yellow-billed Cuckoo (*Coccyzus americanus*), Western Burrowing Owl (*Athene cunicularia hypugaea*), Loggerhead Shrike (*Lanius ludovicianus*), Bank Swallow (*Riparia riparia*), Saltmarsh Common Yellowthroat (*Geothlypis trichas sinuosa*), Grasshopper

Sparrow (*Ammodramus savannarum*), Suisun Song Sparrow (*Melospiza melodia maxillaris*), and Tricolored Blackbird (*Agelaius tricolor*).

Northern Harrier (*Circus cyaneus*)

Northern Harrier, a California Species of Special Concern (nesting birds), is a marsh-associated ground-nesting bird that is commonly found within the Delta year-round. The breeding population now appears to be restricted to north coastal lowlands, the central coast, the northern Central Valley, Klamath Basin, and Great Basin (MacWhirter and Bildstein 1996, Davis and Niemela 2008). Meadows, marshes, and wetlands are optimal habitat types; other suitable habitats include grasslands, ungrazed or lightly grazed pastures, and grain fields (Davis and Niemela 2008). Northern Harriers nest on the ground in shrubby vegetation, usually along the edge of marshes. Nests are constructed of larger plants (e.g., willows, cattails) at the base with grasses and sedges lining the interior. Northern Harriers feed primarily on voles or other small mammals; birds, frogs, reptiles, and invertebrates make up the rest of their diet (MacWhirter and Bildstein 1996). This highly territorial species breeds from April through September, with peak breeding occurring during June and July (Zeiner et al. 1990a).

Within the Proposed Project site, suitable nesting habitat exists on the dry fringe and higher elevation areas without standing water within the 1,100 ac non-tidal freshwater emergent wetland habitat; foraging habitat exists in non-tidal freshwater emergent and in ruderal grassland habitat (approximately 54 ac, Table 2.2-2). DWR documented four occurrences of Northern Harriers nesting in wetland habitats at the northeastern end of Prospect Island (Appendix 12C in DWR and USBR 2016; SWS 2014). Two more nest sites were documented on fallow agricultural land on adjacent islands just outside of the Proposed Project site, one to the north and one to the east of the Proposed Project site (Appendix 12C in DWR and USBR 2016). Northern Harriers are very common in the Proposed Project vicinity.

Swainson's Hawk (*Buteo swainsoni*)

Swainson's Hawk is a California Threatened species (nesting birds) whose nesting range includes the Central Valley, northeastern California, and the Great Basin, and migrates south during winter. Swainson's Hawks nest primarily in mature riparian trees with relatively dense canopies such as oaks or cottonwoods, also in scattered or isolated trees in rural or residential areas near foraging habitat (Schlorff and Bloom 1984, England et al. 1997). They forage in grasslands and in agricultural lands such as alfalfa, irrigated pasture, and grains.

Prey is dominated by rodents, primarily voles, gophers, and deer mice, but the species also forages opportunistically for reptiles, birds, and insects (CDFG 1994).

Within the Proposed Project site, nesting habitat exists in valley/foothill riparian habitats; suitable foraging habitat in ruderal grassland is limited. There are multiple documented sightings of Swainson's Hawks in riparian habitats on the Proposed Project site by CNDDB and DWR, at least three of which included signs of nesting (Appendix 12C in DWR and USBR 2016; SWS 2014). There is a high density of nesting Swainson's Hawks in the Proposed Project vicinity (Appendix 12C in DWR and USBR 2016).

White-tailed Kite (*Elanus leucurus*)

White-tailed Kite is a State Fully Protected species (nesting birds) distributed throughout the western hemisphere; however, the majority of North American residents occur in California. They inhabit low foothills or valley areas with valley or live oaks, riparian areas, and marshes near open grasslands and agricultural areas for foraging (Dunk 1995). Nesting occurs in trees with dense canopies located near foraging habitat from February to August. Within the Proposed Project site, suitable nesting and foraging habitat exists in valley/foothill riparian and ruderal grassland habitats. The closest CNDDB occurrence of White-tailed Kite is five mi northeast of the Proposed Project site (CDFW 2014c).

Short-eared Owl (*Asio flammeus*)

The Short-eared Owl is a California Species of Special Concern (nesting birds) that breeds throughout the State, including portions of the Sacramento and San Joaquin valleys, and in northeastern and coastal California. The species nests on the ground among herbaceous vegetation such as the dry fringe and higher elevation areas without standing water within freshwater marsh and seasonal wetlands, wet meadows, fallow fields, and alfalfa fields and forages at night in marshes, grasslands, agricultural fields primarily for voles, but also would take small birds as prey (Roberson 2008).

Within the Proposed Project site, suitable nesting and foraging habitat exists in non-tidal freshwater perennial emergent wetland habitats. Surveys conducted by DWR staff did not detect Short-eared Owls using the Proposed Project site (Appendix 12C in DWR and USBR 2016; SWS 2014). The closest CNDDB occurrence of Short-eared Owl is 15 mi southwest of the Proposed Project site (CDFW 2014c).

Yellow Warbler (*Dendroica petechia*)

Yellow Warbler, a California Species of Special Concern (nesting birds), is a summer resident that breeds throughout much of California, except the Central Valley, southern Californian deserts, and high Sierra Nevada (Zeiner et al. 1990a; Heath 1998, 2008). The largest concentrations of breeding pairs occur in northeastern California, in Modoc National Forest and Shasta County, as well as in the Cascade Range and Sierra Nevada (Heath 2008). The species has been extirpated from most of the southern Sacramento and San Joaquin valleys. The preferred habitat of Yellow Warbler includes open-canopy or deciduous riparian vegetation, often along streams or wet meadows (Heath 2008). This species frequently nests in small willows and alders, and is also associated with cottonwoods, Oregon ash, and other riparian shrubs and trees, depending upon the geographic region (Zeiner et al. 1990a, Heath 2008). Breeding occurs from mid-April through early August, with peak activity in June (Zeiner et al. 1990a). Birds forage for insects within the shrub and tree canopy, occasionally feeding on the wing or eating fruit (Zeiner et al. 1990a, Lowther et al. 1999).

Within the Proposed Project site, suitable nesting and foraging habitat exists in valley/foothill riparian habitats. DWR documented a Yellow Warbler singing in riparian scrub-shrub on the Proposed Project site along Miner Slough in 2009 (Appendix 12C in DWR and USBR 2016), which may indicate breeding. This species has not commonly been documented in the Proposed Project vicinity (eBird 2013), and the Proposed Project site is considered outside of the species' current breeding range (Heath 2008).

Yellow-breasted Chat (*Icteria virens*)

Yellow-breasted Chat, a California Species of Special Concern (nesting birds), is a summer resident of the Cache-Yolo region. This species breeds in scattered locations around southern California, and there have been recent sightings in Central Valley. Yellow-breasted Chats nest and forage in dense riparian thickets of willows, vines, and brush associated with streams and other wetland habitats (Eckerle et al. 2001). Population density is directly related to shrub density (Crawford et al. 1981), with a preference for blackberry (Kroodsma 1982, Burnett and DeStaebler 2003), although a variety of other shrubs and thickets are considered suitable, including wild grape, willows, and California wild rose (Melhop and Lynch 1986, Annand and Thompson 1997, Ricketts and Kus 2000, Comrack 2008). Some taller overstory trees are also required for song perches (Eckerle et al. 2001), but mature and dense overstory canopies are apparently avoided (Kroodsma 1982, Melhop and Lynch 1986, Annand and Thompson 1997, Comrack 2008).

Within the Proposed Project site, suitable nesting and foraging habitat exists in valley/foothill riparian habitats. Several Yellow-breasted Chats were documented using riparian scrub-shrub at the southern end of Prospect Island in 2009 (Appendix 12C in DWR and USBR 2016). Survey data indicate that the species is found in the Delta in much greater numbers than was previously thought (Appendix 12C in DWR and USBR 2016). Pairs of Yellow-breasted Chat at Liberty Island, Sherman Island, and Piper Slough have also been observed in the central Delta (National Audubon Society 2013).

Song Sparrow (*Melospiza melodia*, "Modesto" population)

The "Modesto" population of Song Sparrow (hereafter referred to as Modesto Song Sparrow), is ubiquitous in the Delta. Modesto Song Sparrow, a California Species of Special Concern, was a valid subspecies until 2001 and may be again after additional taxonomic analysis (Gardali 2008). The population is endemic to the north-central portion of the Central Valley and the Bay-Delta is one of two areas with the highest population densities. The Modesto Song Sparrow occupies wetland, riparian, and scrub habitats, as well as most agricultural habitats along associated drains. Emergent marsh and riparian scrub provide primary nesting habitat (Gardali 2008).

Within the Proposed Project site, suitable nesting and foraging habitat exists in non-tidal freshwater perennial emergent wetland, valley/foothill riparian, and ruderal grassland habitats. Many nesting Song Sparrows, presumed to belong to the "Modesto" population based on location, were documented nesting in riparian scrub-shrub, riparian trees, and marsh habitats along the perimeter of Prospect Island (CDFW 2013, Appendix 12C in DWR and USBR 2016; SWS 2014). This species is commonly documented in the Proposed Project vicinity (eBird 2013).

Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)

Yellow-headed Blackbird is a State Species of Special Concern (nesting birds) that resides year-round in California; it nests in the Central Valley, northeastern California, and portions of southern California, but winters in western and northern Mexico. The species nests colonially in densely vegetated freshwater emergent wetlands with deep water, often along borders of lakes or ponds and forages in agricultural fields and pastures with abundant insect prey (Jaramillo 2008).

Within the Proposed Project site, suitable nesting and foraging habitat exists in non-tidal freshwater perennial emergent wetland habitats, but surveys conducted

by DWR staff did not detect Yellow-headed Blackbird using the Proposed Project site (Appendix 12C in DWR and USBR 2016; SWS 2014). The nearest record of Yellow-headed Blackbird nesting is more than 15 mi north of the Proposed Project site in the Yolo Bypass Wildlife Area (Yolo Natural Heritage Program 2009).

California Black Rail (*Laterallus jamaicensis coturniculus*)

The California Black Rail is a State Threatened and Fully Protected species that resides year-round in northern San Francisco Bay, Suisun Marsh, the Sacramento-San Joaquin Delta, with isolated populations in the Sierra Nevada foothills, Morro Bay, and southeastern California. During winter, the species' range expands to throughout San Francisco Bay and coastal Marin County. The species nest in saline, freshwater, or brackish emergent marshes above the high tide line with adjacent upland refugia, and also use managed emergent marshes or emergent marshes associated with seeps with dense vegetative cover (Eddleman et al. 1994).

Within the Proposed Project site, suitable nesting and foraging habitat exists in non-tidal freshwater perennial emergent wetland habitats, however water levels are too deep for the species throughout much of the site. Black Rail surveys conducted by DWR staff did not detect rails using the Proposed Project site (Appendix 12C in DWR and USBR 2016; SWS 2014). The nearest record of Black Rail is approximately 6 mi west of the Proposed Project site on the Lindsey Slough Habitat Enhancement Project site (S. Estrella, pers. comm., 2014).

Least Bell's Vireo (*Vireo bellii pusillus*)

Least Bell's Vireo is a federal and State Endangered species (nesting birds) that formerly nested throughout the Sacramento and San Joaquin valleys and coastal valleys and foothills of central and southern California. Due to habitat loss, the Least Bell's Vireo has been extirpated from most of this range. Least Bell's Vireos nest in dense thickets of willows and other riparian shrubs near water or intermittent streams and migrates south in the winter (Kus 2004). The species was recently recorded nesting in Kern County, Yolo Wildlife Area in Yolo County, and may re-establish nesting within the Central Valley in the future.

Within the Proposed Project site, suitable nesting and foraging habitat exist in valley/foothill riparian habitats. Surveys conducted by DWR staff did not detect Least Bell's Vireo using the Proposed Project site (Appendix 12C in DWR and USBR 2016; SWS 2014). The nearest record of Least Bell's Vireo is 15.5 mi

north of the Proposed Project site on the Yolo Bypass Wildlife Area (CDFW 2014c).

Other avian species

Species that currently occur at the Proposed Project site that are of management concern but do not have State or Federal protection, as well as species that do not currently occur, but have a high or moderate likelihood of occurring after restoration include:

American Bittern (*Botaurus lentiginosus*) is a USFWS species of management concern and is included on the National Audubon Society's Blue List (USEPA 2003) that resides year-round throughout the Central Valley. American Bittern nests in dense freshwater emergent wetland habitats with open-water and is secretive and difficult to observe. Populations have declined since the 1960s due to habitat loss and degradation (Lowther et al. 2009). Within the Proposed Project site, suitable nesting and foraging habitat exists in non-tidal freshwater emergent wetland habitats. Surveys conducted by DWR staff detected American Bittern using the Proposed Project site (SWS 2014) and the nearby Liberty Island Ecological Reserve.

Double-crested Cormorant (*Phalacrocorax auritus*; California Department of Fish and Wildlife (CDFW) Watch list species for nesting colonies), Great Blue Heron (*Ardea herodias*; California Department of Forestry Sensitive species for nesting colonies), Great Egret (*Ardea alba*; California Department of Forestry Sensitive species for nesting colonies), and Snowy Egret (*Egretta thula*; California Department of Forestry Sensitive species for nesting colonies) all nest in rookeries (colonial nest sites in large trees), often in mixed species groups, and forage in a variety of habitats including open-water, edges of emergent wetlands, agricultural ditches, irrigated pasture, and agricultural fields. Snowy Egret also nests on mats of vegetation in tule-dominated wetlands.

Within the Proposed Project site, suitable nesting habitat exists in riparian trees and snags. Surveys conducted by DWR staff recorded Double-crested Cormorant, Great Blue Heron, Great Egret, and Snowy Egret foraging at the Proposed Project site, but no rookeries were observed (Appendix 12C in DWR and USBR 2016; SWS 2014). The nearest heron or cormorant rookery is approximately 0.25 mi west of the Proposed Project Site at the nearby Liberty Island Ecological Reserve (Appendix 12C in DWR and USBR 2016).

Special-status mammal species

Species with a high or moderate likelihood of occurring at the Proposed Project site under existing conditions and after restoration are discussed in detail below.

Western red bat (*Lasiurus blossevillii*)

The western red bat is listed as a California Species of Special Concern and occur throughout the Central Valley. The western red bat is closely associated with riparian habitat, especially mature stands of cottonwood and sycamore, which provides suitable roosting sites in trees and sometimes shrubs. There is evidence for seasonal movements by western red bats in California, but little evidence for mass migration characteristics (Pierson et al. 2006). The distribution of males and females in California differ seasonally. Males are dispersed throughout the State during maternity season, while females are concentrated in the Central Valley (Peirson et al. 2006). Based on the habitat requirements of western red bats for breeding and the vast majority of breeding records for the species occur in the Central Valley, it is likely that the western red bat uses the Proposed Project site as maternity roosting habitat. The species feeds on a variety of insects, primarily moths, crickets, beetles, and cicadas, often in large groups and over a variety of areas including grasslands, shrublands, open woodlands, and cropland (Zeiner et al. 1990b).

Western red bat was documented on the Proposed Project site during the 2009 Bay Delta Conservation Plan EIR/EIS habitat assessments and acoustic monitoring surveys conducted by DWR (Appendix 12C in DWR and USBR 2016) and habitat was re-verified within the Proposed Project site during a site visit in 2014. Western red bats were detected in each session, indicating that they are present in some numbers the majority of the year, but most likely present in the largest numbers during maternity season (May through August).

Other bat species

Species that currently occur at the Proposed Project site that are of management concern but do not have State or Federal protection, are discussed in briefly below.

Hoary bat (*Lasiurus cinereus*) and silver-haired bat (*Lasionycteris noctivagans*) are Western Bat Working Group Medium Priority species (Western Bat Working Group 2007). Both species use large trees for roosts, with the hoary bat preferring to roost in dense foliage and the silver-haired bat preferring tree hollows and snags. Both species were detected on Prospect Island during 2009 surveys (Appendix 12C in DWR and USBR 2016). Both species feed over open areas including open-water, streams, edge habitats, and open brushy areas. Due

to the similar life history requirements of these species, any impact analysis for western red bat would also be applicable to these species.

Legal and regulatory setting

Federal laws

Multiple federal programs are applicable to the regulation and protection of wetland and terrestrial resources in the Proposed Project site, as discussed below. The CWA and the Rivers and Harbors Act of 1899 are discussed in Section 3.2.2. Unless otherwise noted, the Proposed Project would comply with the following federal laws.

Endangered Species Act

The federal Endangered Species Act (ESA) of 1973, as amended, establishes a national program for conservation (survival and recovery) of species listed as threatened or endangered, and the ecosystems on which they depend. USFWS and NMFS are responsible for implementing this act. Federally-listed plants, wildlife, and non-anadromous fish species are regulated by USFWS, and federally-listed, anadromous fish species and (most) marine mammals are regulated by NMFS.

The federal ESA Section 7 requires that federal agencies consult with USFWS or NMFS if their actions may affect a federally-listed species or destroy or adversely modify critical habitat. This section also prohibits any federal agency from taking actions likely to jeopardize the survival and recovery of listed species. Issuance of a federal permit is one type of action that may trigger the Section 7 consultation. USFWS or NMFS concludes formal Section 7 consultation with the issuance of a BiOp, which may also include an incidental take statement. The statement provides authorization for incidental take (e.g., indirect killing, harm, harassment, injury) of listed fish or wildlife species that is otherwise prohibited by Section 9 of the federal ESA. USFWS and NMFS may also conclude informal consultation with the issuance of a letter of concurrence.

Migratory Bird Treaty Act

The federal Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 USC Section 703–711) provides for the protection of migratory birds by making it illegal to possess, hunt, pursue, or kill any migratory bird, or any transaction pertaining to any wild migratory bird, part, nest, egg or product, manufactured or not, unless specifically authorized by the Secretary of the Interior. Currently, there are roughly 1,007 species on the list of migratory birds.

Executive Orders

Executive Order No. 11990 (Protection of Wetlands) requires federal agencies to provide leadership to protect the natural and beneficial values served by wetlands. Federal agencies are directed to minimize the destruction or degradation of wetlands.

Executive Order No. 13112 (Invasive Species) inaugurated the National Invasive Species Management Plan and National Invasive Species Council policy direction to promote coordination between federal, state, and local agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. Specifically, the Executive Order calls on all Federal agencies to identify actions they take which may affect the status of invasive species and use relevant programs and authorities to prevent introduction, detect and respond rapidly to invasive species, monitor invasive species populations, provide for restoration of native species, and promote public education. In addition, the Executive Order provides:

> "…an agency should not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm would be taken in conjunction with the actions."

State laws and regulations

Multiple state programs are applicable to the regulation and protection of wetland and terrestrial resources in the Proposed Project site. The Porter-Cologne Water Quality Act is discussed in Section 3.2.2. Unless otherwise noted, the Proposed Project would comply with the following state laws and regulations.

California Endangered Species Act

The state counterpart to the federal ESA, California Endagered Species Act (CESA) (CFG Code Section 2050 *et seq.*) has similar, but distinct requirements and goals. CESA requires state agencies to coordinate with the California Department of Fish and Wildlife (CDFW) to ensure that state-authorized or state-funded actions do not jeopardize a state-listed species. The state list of species classified as rare, threatened, or endangered does not necessarily correspond with the federal list of threatened and endangered species.

The state code also includes a less familiar legal status for some species as fully protected. As originally written, prohibitions against take of older fully protected species were more stringent and inflexible than those of CESA, generally prohibiting nearly all take. However, recent California legislation authorizes CDFW to permit the incidental take of 36 fully protected species pursuant to an approved natural community conservation plan (Senate Bill 618 [Wolk]). The legislation, in effect, gives fully protected species the same level of protection as is provided under the Natural Community Conservation Planning Act for endangered and threatened species (CFG Code Section 2835). The legislation also removes a substantial regulatory barrier to the development of regional conservation plans under the Natural Community Conservation Planning Act.

California Fish and Game Code

Under Section 1600–1616 of the California Fish and Game Code, CDFW regulates activities that would alter the flow, bed, channel, or bank of streams and lakes. The limits are as the "… bed, channel or bank of any river, stream, or lake designated by the department in which there is at any time an existing fish or wildlife resource or from which these resources derive benefit ..." (Section 1601). Undertaking stream-altering activities that may adversely affect fish or wildlife would require an applicant to enter into an agreement with CDFW for authorization for up to five years.

Native Plant Protection Act

The Native Plant Protection Act (NPPA) (CFG Code Section 1900 *et seq.*) designates 64 species, subspecies, and varieties of native California plants as rare. NPPA prohibits take of rare native plants, but includes some exceptions for agricultural and nursery operations; emergencies; and after properly notifying CDFW for vegetation removal from canals, roads, and other sites, changes in land use, and in certain other situations.

Delta Reform Act

With the passage of SB 7x-1, the Delta Reform Act established coequal goals of a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem as overarching state policy. Furthermore, the Act established the policy of reducing reliance on the Delta in meeting California's future water supply needs. Federal agencies are also committed to the coequal goals, thus setting a new course for water management in the state. Drawing on information and experiences gained during the CALFED process, the Delta Reform Act created the Delta Stewardship Council (DSC) with the authority and

responsibility to develop the Delta Plan, and to ensure that actions by state and local agencies in the Delta are consistent with the Plan. The DSC was directed to adequately incorporate the best available science and adaptive management principles, to improve decision-making and reduce stakeholder conflict. The DSC also was empowered to coordinate and collaborate across the myriad governmental agencies that have responsibility for some aspect of the Delta (DSC 2013). With over three years of government coordination and public input, the Delta Plan adopted May 2013 relies on a mix of legally enforceable policies and essential recommendations to prioritize actions and strategies for improved water management, ecosystem restoration, and levee maintenance. It also identifies actions that may cause harm, and provides regulatory guidance for all major plans, projects, and programs in the Delta (DSC 2013).

Executive Orders

Executive Order W-59-93 (California Wetlands Conservation Policy) establishes substantive environmental goals to ensure no overall net loss of wetlands; to achieve a long-term net gain in the quantity, quality, and permanence of wetlands in California; and to provide due consideration for private property and stewardship.

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, the following have been considered in the analysis of potential impacts and identification of mitigation, as needed.

Unless otherwise noted, the Proposed Project would comply with the following local ordinances and policies.

Solano County General Plan

The following two strategies for natural resources articulated in the Solano County General Plan (Solano County Board of Supervisors 2008) are relevant to wetland and terrestrial biological resources:

- preserving the county's valued natural, cultural, and scenic resources;
- enhancing and restoring the natural environment and the county's diverse landscapes.

The goals and policies of the General Plan Resources Element are intended to provide a framework for achieving the resource management vision. Goals applicable to wetland and terrestrial biological resources include:

RS.G-1: Manage and preserve the diverse land, water, and air resources of the county for the use and enrichment of the lives of present and future generations.

RS.G-2: Ensure continued presence and viability of the county's various natural resources.

RS.G-3: Repair environmental degradation that has occurred, and seek an optimum balance between the economic and social benefits of the county's natural resources.

RS.G-4: Preserve, conserve, and enhance valuable open space lands that provide wildlife habitat; conserve natural and visual resources; convey cultural identity; and improve public safety.

Applicable policies include:
RS.P-1: Protect and enhance the county's natural habitats and diverse plant and animal communities, particularly occurrences of special-status species, wetlands, sensitive natural communities, and habitat connections.

RS.P-2: Manage the habitat found in natural areas and ensure its ecological health and ability to sustain diverse flora and fauna.

RS.P-3: Focus conservation and protection efforts on high-priority habitat areas depicted in the Solano County General Plan (Solano County Board of Supervisors 2008, Figure RS-1).

RS.P-4: Together with property owners and federal and state agencies, identify feasible and economically viable methods of protecting and enhancing natural habitats and biological resources.

RS.P-5: Protect and enhance wildlife movement corridors to ensure the health and long-term survival of local animal and plant populations. Preserve contiguous habitat areas.

RS.P-7: Preserve and enhance the diversity of habitats in marshes to maintain these unique wildlife resources.

RS.P-8: Protect marsh waterways, managed wetlands, tidal marshes, seasonal marshes, and lowland and grasslands because they are critical habitats for marsh-related wildlife and are essential to the integrity of the marshes.

RS.P-9: Encourage restoration of historic marshes to wetland status, either as tidal marshes or managed wetlands. When managed wetlands are no longer used for waterfowl hunting, restore them as tidal marshes.

P-20: The goals, policies, and provisions of the Land Use and Resource Management Plan for the Primary Zone of the Delta are incorporated by reference. Ensure that all public and private management and development activities within the Primary Zone of the Delta are consistent with the goals, policies and provisions of the Land Use and Resource Management Plan for the Primary Zone of the Delta as adopted and as may be amended by the Delta Protection Commission.

RS.P-21: Preserve and protect the natural resources of the Delta including soils and riparian habitat. Lands managed primarily for wildlife habitat should be managed to provide inter-related habitats.

Prospect Island and the surrounding area are designated as Giant Garter Snake Priority Conservation Area and are within the Delta Primary Zone (Solano County Board of Supervisors 2008). These designations indicate general locations of priority habitat and provide both opportunities and restrictions regarding the use of the underlying properties.

3.4.2 Significance criteria

Potential impacts to wetlands and biological resources would be significant if the Proposed Project would exceed any of the following threshold criteria per Appendix G *Environmental Checklist* of the CEQA Guidelines:

- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the CDFW or USFWS.
- Have a substantial adverse effect on federally-protected wetlands as defined by Section 404 of the CWA (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means.
- Cause an increase in aquatic or terrestrial invasive species.
- Conflict with any local policies or ordinances protecting biological resources (Delta Reform Act-Delta Plan).

- Conflict with provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.
- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW or USFWS.
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native species nursery sites.

3.4.3 Impacts and mitigation

Impact 3.4-1: Short-term impacts to perennial aquatic habitats and wetland communities from site preparation

Prior to construction, site preparation would include dewatering, clearing, and invasive plant species control (Table 2.2-6). Maintenance dewatering and soil drying would continue throughout the construction period. Dewatering is expected to result in temporary losses of up to 340 ac of non-tidal perennial aquatic and up to 1,100 ac of non-tidal freshwater perennial emergent wetland habitat (Table 2.2-2). Due to the planned south property levee repair along Miner Slough, the timing of dewatering may differ between the north and south properties and accordingly the duration of dewatered conditions and the temporal impacts to perennial aquatic habitats and emergent wetland communities may also differ between the north and south properties.

Following initial dewatering, up to approximately 156 ac of existing wetland vegetation would be cleared and grubbed within the construction footprint (i.e., excavated channel network, eastern toe berm and intertidal bench, site access roads/ramps, Miner Slough spur channel dredge placement area). In addition, above ground wetland vegetation would be cleared within 504 ac, including a 100 ft buffer outside of the construction footprint and all areas at moderate subtidal elevations (<0 ft NAVD 88). These cleared materials would be disked in place. To limit habitat suitability for ambush predators within the approximately 496 ac of shallow subtidal (0.0 to 2.1 ft NAVD 88) habitat, a limited number of existing trees at these elevations would be removed. All plant debris not including large wood debris retained for future use (see also Impact 3.4-13) would chipped, transported, and disked within the moderate subtidal areas (Section 2.2.3).

In addition to dewatering and clearing activities, invasive plant species control measures would be undertaken using approved aquatic herbicides applied across 504 ac of moderate subtidal areas (<0 ft NAVD 88) and within the agricultural ditches. Herbicide application for site preparation and invasive aquatic species control would occur in the late summer/early fall (Section 2.2.3).

Overall these impacts would be *significant and unavoidable*.

Impact significance
Significant and unavoidable

Impact 3.4-2: Short-term impacts to tidal aquatic habitats and wetland communities from dredging in the Miner Slough spur channel

Dredging is proposed to ensure that unimpeded tidal exchange occurs through the southern breach to Miner Slough spur channel. The desired increase in channel conveyance capacity would be accomplished by deepening the slough. Dredging would not result in changes in the area of tidal Waters of the U.S., including wetlands, as defined by Section 404 of the CWA within the spur channel. Further, because dredging activities would be conducted within only the navigable portions of the spur channel and no fringing tidal wetland has been documented along the rip-rapped levees of the channel, no impacts to tidal freshwater emergent wetlands would result from this activity.

Impact significance
No impact

Impact 3.4-3: Short-term loss of valley/foothill riparian habitat

Of the approximately 145 ac of existing valley/foothill riparian habitat on the Proposed Project site, clearing activities would result in short-term impacts to approximately 19 ac. Implementation of Mitigation Measure 3.4-3.1 would largely limit riparian clearing activities to scrub shrub and understory species and would reduce this impact to *less than significant*.

Mitigation Measure 3.4-3.1
Potential short-term impacts to individual high value trees for nesting and roosting would be minimized during final design by avoidance and protection measures, as specified in Mitigation Measures 3.4-14.1 and 3.4-17.1. A map of high value trees for nesting to be protected will be made available to on-site construction management.

Impact significance
Less than significant with mitigation

Impact 3.4-4: Short-term construction-related mortality or detrimental effects to sensitive plants

Special-status plant species were not found on the interior of Prospect Island, but several occurrences have been recorded on the Miner Slough levee. Special-status plants with the potential to occur within the Prospect Island Project site are primarily limited to shallow water from 1 ft depth to perennially moist soils. Site preparation and construction activities that may affect this zone such as dewatering, clearing, grading, excavation, levee breaching, and dredging of the Miner Slough spur channel in the Proposed Project would result in the temporary loss of suitable habitat for these species. If these plants are located in the vicinity of levee breach sites or in the Miner Slough spur channel they may be directly removed either through excavation, dredging, or erosion. Drift of herbicides used invasive plant species control following site dewatering could negatively affect sensitive plant species within the Proposed Project site. This could occur via air or water and could be influenced by weather conditions and application methods. Low levels of herbicide drift may not result in direct mortality of plants, but could cause developmental and metabolic problems which could lead to increased susceptibility to disease and reduced vigor. Implementation of Mitigation Measures 3.4-4.1 and 3.2-3.2 would reduce this impact to *less than significant*.

Mitigation Measure 3.4-4.1
Mitigation shall include conducting pre-construction surveys for special-status plants. If special-status plants are found within the affected footprint, preservation methods such as transplantation, salvage, or seed collection and dispersal would be considered and shall be implemented if deemed necessary to avoid a significant impact to the local population through consultation with CDFW. Herbicide application practices shall include following all application recommendations for the herbicide to be applied, and refraining from applying product under wind conditions which would increase the likelihood for drift.

Impact significance
Less than significant with mitigation

Impact 3.4-5: Long-term conversion of perennial aquatic habitats and wetland communities to tidal habitat types

The Proposed Project would permanently convert up to approximately 340 ac of non-tidal perennial aquatic (open-water) habitat and up to approximately 1,100 ac of non-tidal freshwater perennial emergent wetland habitat into 472 ac of perennial aquatic (open-water) habitat and a total of 1,053 ac of tidal (intertidal and shallow subtidal) freshwater emergent wetland types (Table 2.2-2).

Immediately following levee breaching, approximately 1,089 ac of tidal perennial aquatic (open-water) habitat and 348 ac of tidal freshwater emergent wetlands (intertidal) would be created. Within graded portions of the site, including unplanted areas of the eastern intertidal bench and toe berm, approximately 88 ac of tidal mudflat habitat would be established in the short term (Table 2.2-2). Tidal freshwater emergent wetland vegetation is expected to rapidly establish in the tidal mudflats and to expand to shallow sub-tidal elevations (0.1 to 6.5 ft [NAVD 88]) within 10–15 years.

Over the long-term, increased water depths within the Proposed Project site following breaching would result in an increase of approximately 122 ac of open-water (aquatic) habitat and a decrease of approximately 48 ac of wetland habitats (Table 2.2-2).

Jurisdictional Waters of the U.S.

Although increased water depths following breaching would result in an approximate long-term loss of 48 ac of federally-protected wetlands as defined by Section 404 of the CWA, the Proposed Project would result in an approximate overall increase of 73 ac of Waters of the U.S., including wetlands (DWR and CDFW 2014). Consistent with the Proposed Project objectives (Section 1.2), the resulting mosaic of tidal wetland and open-water habitats would provide a number of benefits to the Delta ecosystem within the surrounding Cache Slough region, including but not limited to:

- Increased primary and secondary productivity and food availability for Delta Smelt and other native fishes (Impacts 3.3-2 and 3.3-9).
- Increased quantity and quality of salmonid rearing habitat (Impacts 3.3-2 and 3.3-9).

Overall, the Proposed Project would increase the acreage of Waters of the U.S., provide more frequent tidal inundation to adjacent natural communities, and result in a mosaic of tidal habitats that provide benefits such as resiliency to flooding, increased habitat quality, and functionality relative to existing conditions.

Therefore, the overall increase in tidal Waters of the U.S. more than offsets the loss of non-tidal perennial emergent wetland and the conversion of wetland communities at the Proposed Project site would be a less-than-significant impact.

Impact significance
Less than significant

Impact 3.4-6: Long-term loss of valley/foothill riparian habitat

Breaching of the Miner Slough levees under the Proposed Project would result in the conversion of approximately 90 ac of existing valley/foothill riparian habitat below MHHW (6.5 ft [NAVD 88]) to tidal freshwater emergent wetland habitat. However, as part of Proposed Project construction, the toe berm, staging areas, and other areas at the appropriate elevation shall be planted with a riparian mix containing both canopy and understory trees and shrubs creating complex, high value riparian area (Section 2.2.3). The riparian planting would reduce the long-term loss of valley/foothill riparian habitat to approximately 28 ac (Table 2.2-2). In addition, potential long-term impacts to individual high value trees for nesting and roosting would be minimized through implementation of Mitigation Measure 3.4-3.1.

Impact significance
Less than significant with mitigation

Impact 3.4-7: Reduction in available habitat for special-status plant species adapted to existing conditions

Breaching of the levees would increase the mean water depth within the interior of Prospect Island because high tide levels in Miner Slough exceed the current water level which exists under non-tidal conditions. Loss of shallow water habitat may reduce the amount of appropriate habitat for special-status plant species within the Proposed Project site. Breaching the levee and opening the interior of the island to water from Miner Slough may provide a benefit to special-status plant species which currently exist in Miner Slough and surrounding waterways if hydrologic connectivity allows propagules to reach suitable habitat in the interior of the island. In addition to the construction of an intertidal bench and interior topographic features using materials excavated from the existing agricultural ditches (Section 2 *Proposed Project Description*), increased suitable shallow intertidal habitat for special status plant species is expected to be created at higher elevations following breaching. Furthermore, targeted herbicide application to dewatered areas would reduce invasive plant species compared

with existing conditions, and allow special-status plant species to colonize these previously invaded areas.

Impact significance
Less than significant

Impact 3.4-8: Short-term construction-related impacts to valley elderberry longhorn beetle

Recent protocol level surveys identified seven elderberry shrubs on the Proposed Project site that were of sufficient size to provide habitat for the beetle. No indicators of extant presence (recently created exit holes) were detected. Argentine ants, known to prey upon beetle larvae, were observed on several of the shrubs. Site preparation and construction activities under the Proposed Project would not require the removal of elderberry shrubs and would take place in areas where no elderberry shrubs are present. Lastly, with respect to herbicide application for invasive plant species control, implementation of Mitigation Measures 3.2-3.1 and 3.2-3.2 would reduce potential short-term construction-related impacts of the Proposed Project on valley elderberry longhorn beetle to *less than significant*.

Impact significance
Less than significant with mitigation

Impact 3.4-9: Long-term impacts to valley elderberry longhorn beetle

The Proposed Project would not require the removal of any elderberry shrubs, and there is no evidence of recent beetle use of the shrubs at the Proposed Project site. In the long-term, the Proposed Project could provide a net gain of potential habitat for the species if elderberry is included in the native riparian species mix or if natural colonization is allowed to occur. However, since there is no evidence of beetle presence at the Proposed Project site, overall there would be no long-term impact on habitat for this species.

Impact significance
No impact

Impact 3.4-10: Short-term construction-related injury or mortality and loss of habitat for giant garter snakes

Despite the lack of evidence of giant garter snake presence at the Proposed Project site (Section 3.4.1 *Wetland and Terrestrial Biological Resources – Setting*), potential short-term impacts to this species include construction-related direct injury or mortality as well as a temporary loss of habitat. The following site preparation and construction activities have the potential to cause injury or mortality to individual giant garter snakes:

- Clearing and grubbing
- Creation of temporary ramps and roads
- Creation of temporary staging areas
- Herbicide and mechanical invasive species control
- Dead tree/snag removal
- Excavating constructed channel network
- Blocking and filling agricultural ditches
- Construct interior topographic features
- Construction of eastern toe berm
- Excavation of levee breaches

The aforementioned activities could fill or crush burrows and crevices; obstruct giant garter snake movement; decrease the prey base for foraging; and result in the direct disturbance, displacement, injury and/or mortality of individual giant garter snakes, if present. Implementation of Mitigation Measure 3.4-10.1 would reduce this impact to *less than significant*.

Additionally, during the construction period, potentially suitable giant garter snake habitat may be impacted by the aforementioned construction activities. A temporary loss of approximately 1,100 ac of freshwater emergent wetland would be expected at the Proposed Project site during the construction period due to site preparation and construction activities (Table 2.2-2). Implementation of Mitigation Measure 3.4-10.1 would provide individual giant garter snakes, if present, the opportunity to move out of impacted habitats, reducing the short-term impact to *less than significant*.

In addition to potential mortality or injury due to mechanical disturbance during construction, an accidental chemical and/or petroleum spill during construction could result in the mortality or injury of individual giant garter snakes and/or prey species. Injury or mortality of individual giant garter snakes as a result of an

accidental spill would be significant. Implementation of Mitigation Measure 3.2-1.2 would reduce this potential impact to a *less than significant* level.

As required through the federal and state permitting processes, further minimization and avoidance measures shall be developed in coordination with USFWS through Section 7 of the federal ESA consultation and with CDFW through CESA for the Proposed Project.

Mitigation Measure 3.4-10.1
This mitigation measure includes the following:

1. Require construction personnel to receive USFWS and CDFW-approved worker environmental awareness training to recognize giant garter snake and its habitat.
2. Install exclusion fencing around all staging areas.
3. Survey the site at least 24 hours prior to the initiation of ground-disturbing activities in suitable giant garter snake habitat. This survey shall be conducted by a USFWS and CDFW-approved biologist in suitable giant garter snake habitat. Surveys shall be repeated if a lapse in construction activity of two weeks or greater occurs. If giant garter snake is encountered during ground-disturbing activities, activities at that specific location shall cease until appropriate corrective measures, in concurrence with USFWS and CDFW coordination, have been completed or it has been determined that individual giant garter snakes would not be harmed. Sightings shall be reported to USFWS and CDFW.
4. Implement ground disturbing construction activity within giant garter snake habitat between May 1 and October 1. This is the active period for giant garter snake and direct mortality is lessened, because giant garter snakes are expected to actively move and avoid danger. DWR would contact the USFWS and CDFW to determine if additional measures are necessary to minimize and avoid take for work between October 2 and April 30.
5. Vehicle speeds shall not exceed 15 miles per hour (MPH) to avoid hitting giant garter snakes and other special-status wildlife.
6. Remove temporary fill and construction debris after construction completion, and, wherever feasible, restore disturbed areas to pre-Proposed Project conditions.

Impact significance
Less than significant with mitigation

Impact 3.4-11: Long-term conversion of giant garter snake habitat

The Proposed Project would convert non-tidal perennial aquatic habitat and non-tidal freshwater perennial emergent wetland to tidal perennial aquatic and tidal freshwater emergent wetland habitats (Impact 3.4-5), including a network of tidal channels and interior topographic features above MHHW (Table 2.2-2) that would provide suitable habitat for giant garter snake. Although recent surveys at Prospect Island and other locations in the surrounding Cache Slough Region did not identify or capture giant garter snake, there is potential for marginal habitat at the Proposed Project site (Section 3.4.1 *Wetland and Terrestrial Biological Resources – Setting*). To quantify suitable habitat, the following criteria were applied from the giant garter snake species habitat suitability model (Appendix 12C in DWR and USBR 2016) using associations with existing natural community types at Prospect Island.

> *Upland basking and over-wintering habitat* was considered suitable in upland areas along perimeter levees within 200 ft of perennial aquatic and/or emergent wetland habitat, excluding mapped valley/foothill riparian habitats.
>
> *Aquatic foraging habitat* was considered suitable within freshwater emergent wetland habitat and extending 20 ft into perennial aquatic habitat, excluding dense patches of *Ludwigia spp.* mapped during invasive plant surveys (SWS and WWR 2013).

Based upon the existing mapped natural community types at Prospect Island (Figure 3.4-1), the criteria above result in an estimated 53 ac of upland basking and over-wintering habitat and 941 ac of foraging habitat for giant garter snake on the Proposed Project site. However, the existing available habitat at the Proposed Project site appears to be of marginal quality due to a combination of factors. As stated previously, the Proposed Project site has a history of flooding. The levees on Prospect Island are restricted height to allow the island to flood before neighboring islands. Flooding makes the upland habitat problematic as overwintering habitat due to the possibility the levees would overtop and drown bruminating snakes (Section 3.4.1 *Wetland and Terrestrial Biological Resources – Setting*). In addition, there are 75–100 ac of verified *Ludwigia spp.* stands and many more acres of potential mixed stands (Figure 3.4-1) that do not provide ideal habitat for the giant garter snake. Lastly, perennial aquatic areas of the Proposed Project site are occupied by high densities of predatory fish, which could threaten giant garter snake recruitment (Section 3.4.1 *Wetland and Terrestrial Biological Resources – Setting*).

Based on the above criteria, it is expected that the Proposed Project would provide 1,093 ac of giant garter snake foraging habitat in the long-term, resulting in a decrease of 27 ac of upland basking and over-wintering habitat and an increase of 152 ac of giant garter snake foraging habitat. Under the Proposed Project, breaching of the Miner Slough levee would restore the site hydrology to its historical pre-reclamation tidal regime.

Under the Proposed Project, large sections of upland habitat would no longer be usable after the island is breached. However, consistent with giant garter snake conservation strategy for the Bay Delta Conservation Plan (Chapter 12 in DWR and USBR 2016), the existing perimeter levees would provide relatively low disturbance, higher quality basking and overwintering habitat. In addition, due to the presence of upland habitats adjacent to the Proposed Project area, the marginal quality of the current upland habitat, and the increased value of post-construction upland habitats, the anticipated decrease in upland habitat due to the Proposed Project would be a *less than significant* impact.

Additionally, the Proposed Project includes linear design features that would provide suitable aquatic foraging habitat for giant garter snake, such as small back water sloughs and toe drains (Hansen 1988). This would potentially support small numbers of snakes in a Delta location where large populations of the snake are not currently found (Section 3.4.1 *Wetland and Terrestrial Biological Resources – Setting*). Creation of tidal freshwater emergent wetland (including intertidal bench features) and tidal perennial aquatic habitat (including tidal channels, shallow open-water, and dispersed topographic mounds) as part of the Proposed Project, including linear features that are consistent with giant garter snake conservation strategy for the Bay Delta Conservation Plan (Chapter 12 in DWR and USBR 2016), would support quality forage and escape cover habitats for giant garter snake (Table 2.2-2, DWR and CDFW 2014).

Under the Proposed Project, aquatic invasive plant species would be removed during pre-construction-site preparation activities (Section 2.2.3), allowing for establishment of tidal freshwater emergent wetland habitat potentially suitable for giant garter snake foraging. However, there would be potential for the continued presence of predatory fishes, particularly Striped Bass, Largemouth Bass, and other non-native fishes in the Centrarchidae (e.g., black bass, crappie, and sunfish) and Ictaluridae (i.e., catfish and bullheads) families (see also Section 3.3.4) at the restored site. While predatory fish may still be present on the Proposed Project site, they are expected to be in much lower densities as

compared with existing conditions (see also Impact 3.3-9), and any associated predation pressure on juvenile giant garter snakes would also be lower as a result.

Overall, conversion of marginal non-tidal perennial aquatic habitat and non-tidal freshwater perennial emergent wetland to tidal perennial aquatic and tidal freshwater emergent wetland habitats under the Proposed Project would be offset by the creation of a mosaic of habitats, including linear features that are consistent with the giant garter snake conservation strategy in the Bay Delta Conservation Plan (Chapter 12 in DWR and USBR 2016), and would increase the acreage and value of available aquatic foraging habitats for giant garter snake. This would be a beneficial effect.

As required through the federal and state permitting processes, further minimization and avoidance measures shall be developed in coordination with USFWS through Section 7 of the federal ESA consultation and with CDFW through CESA for the Proposed Project.

Impact significance
Less than significant

Impact 3.4-12: Short-term construction-related habitat loss and injury or mortality of individual western pond turtles

The Proposed Project would result in a temporary loss and disturbance of aquatic and upland western pond turtle habitat during dewatering, site preparation, and construction. Site preparation and construction activities have the potential to obstruct the movement; decrease prey base; and result in the direct disturbance, displacement, injury and/or mortality of western pond turtles present. During construction it is expected that approximately 1,100 ac of freshwater perennial emergent wetland and 340 ac of perennial aquatic habitats would be temporarily lost due to site dewatering activities. Additionally, an accidental chemical and/or petroleum spill during construction could result in the morality or injury of western pond turtles and prey species. Short-term injury or mortality of individual western pond turtles as a result of site preparation and construction activities would be potentially significant. Implementation of Mitigation Measures 3.2-1.2 (relating to spills) and 3.4-12.1 below would reduce this potential impact to a *less than significant* level. Mitigation Measure 3.4-12.1 is consistent with Solano County's General Plan policies RS.P-1 through RS.P-9.

Mitigation Measure 3.4-12.1
Prior to implementing restoration activities and/or scheduled dewatering, a qualified biologist would survey areas in or adjacent to suitable western pond turtle aquatic habitat. Western pond turtles found in harm's way would be moved by a qualified biologist to a safe location outside of the work area in a manner consistent with applicable CDFW regulations. A qualified biologist would conduct periodic monitoring of suitable western pond turtle aquatic habitat until ground-disturbing/dewatering activities have ceased in those areas.

Impact significance
Less than significant with mitigation

Impact 3.4-13: Long-term conversion of western pond turtle habitat

The Proposed Project would, in the long-term, increase aquatic habitat for the western pond turtle from the creation of tidal channels with adjacent basking habitat on exposed during the lower end of the tide cycle. Because western pond turtles are known to occur in the tidally influenced remnant channels of Miner Slough, restoring the site to full tidal would not result in a loss of aquatic habitat for the turtle. In addition to providing suitable habitat for the turtle, existing woody debris (large tree trunk/limbs and root wads) would, to the extent practicable, be relocated to the intertidal edge for turtle basking sites under the Proposed Project (Section 2.2.3). Overall, the long-term effects on western pond turtle habitat would be beneficial. This benefit is consistent with Solano County's General Plan policies RS.P-1 through RS.P-9.

Impact significance
Beneficial

Impact 3.4-14. Short-term, construction-related injury or mortality, take of nests, and loss of nesting and foraging habitat of special-status and migratory birds

The following short-term site preparation and construction activities may cause individual injury or mortality, take of nests, or loss of suitable nesting and foraging habitat for special-status and migratory birds over the construction period:

- Clearing and grubbing
- Creation of temporary ramps and roads
- Creation of temporary staging areas
- Herbicide and mechanical invasive species control

- Dead tree/snag removal
- Excavating constructed channel network
- Blocking and filling agricultural ditches
- Construct interior topographic features
- Construction of eastern toe berm
- Excavation of levee breaches

Construction activity associated with the Proposed Project, including ground disturbance, vegetation removal, presence of personnel, and operation of equipment, may injure or kill individual adults or nestlings, reduce the prey base, or cause abandonment of active nests. The Proposed Project would result in the short-term loss of riparian nesting habitat for several special-status and migratory birds at the Proposed Project site. Removal of valley/foothill riparian habitat during construction of the eastern toe berm and levee breaches would result in short-term impacts to approximately 90 ac of existing valley/foothill riparian habitat that provides suitable habitat for nesting raptors and songbirds (Table 2.2-2). Although approximately 55 ac of riparian nesting habitat would remain undisturbed within the Proposed Project site and additional habitat is available nearby, many species such as Swainson's Hawk, which are known to occur on the Proposed Project site, are territorial, and reduction in available nesting habitat may result in displacement of nesting pairs from the vicinity. Therefore, this would be a significant impact. However, the toe berm sections that would be impacted are located in areas that avoid the most valuable riparian habitat on the Proposed Project site. Further, implementation of Mitigation Measures 3.4-3.1, and 3.4-14.1 would reduce this impact to *less than significant*.

The Proposed Project would also impact foraging habitats of raptors and migratory birds in freshwater emergent wetland. There would be a short-term loss of approximately 1,100 ac of freshwater perennial emergent wetland (Table 2.2-2). This would also result in an overall reduction of marginal foraging habitat for Swainson's Hawks. Construction of the eastern toe berm and eastern intertidal bench, including limited revegetation in open-water edge habitat (Section 2.2.3), would eventually re-establish wetland foraging habitat, but it would take several years for vegetation to become established and mature. However, because additional wetland foraging habitat is located nearby, the short-term loss of this habitat type would be *less than significant*.

Mitigation Measure 3.4-14.1

In order to minimize potential construction related impacts to special-status and migratory birds over the construction period, this mitigation measure includes the following:

1. Site preparation and construction activities should take place outside of nesting season (February 15–August 15) to avoid take via disturbance or destruction of nests or mortality of individuals. If work begins before this period and continues uninterrupted throughout the nesting season, the consistent disturbance may deter birds from nesting at the site and prevent take.
2. If work must take place during March 15 – August 15, a pre-construction survey would be conducted within 14 days prior to the initiation of construction activity by a qualified biologist to identify nesting Swainson's Hawks within 0.5 mi of the construction footprint. If active Swainson's Hawk nests are found, appropriate non-disturbance buffers and avoidance measures would be developed in coordination with CDFW to avoid disturbance of nesting Swainson's Hawks based on individual bird behavior and construction-related disturbance that occurs. Surveys shall be repeated if a lapse in construction of 14 days or greater occurs. Surveys would be repeated annually if work takes place during subsequent nesting seasons.
3. If work must take place during April 1–August 31, a pre-construction survey would be conducted within 14 days prior to the initiation of construction activity to identify nesting raptors within 500 ft, and other nesting birds within 100 ft of the construction footprint. Appropriate non-disturbance buffers would be established until nestlings have fledged. Surveys shall be repeated if a lapse in construction of 14 days or greater occurs during the nesting season. Surveys would be repeated annually if work takes place during subsequent nesting seasons.
4. If work must take place during March 15–August 15 and use of non-disturbance buffers is infeasible, a qualified biologist shall be on-site to monitor active nests. Monitoring requirements would be established in coordination with CDFW. Monitors would have authority to stop work if it appears that Swainson's Hawk nests are disturbed by construction activity, and CDFW would be contacted for further guidance.
5. Remove or trim the minimal number of trees to satisfy the Proposed Project design. Trimming and removal would take place August 15 to February 15, outside of nesting season.

6. If construction activity results in take of individual birds or their nests, appropriate mitigation would be determined in coordination with CDFW.
7. Vehicle speed limits shall not exceed 15 MPH to avoid striking birds.
8. Remove temporary fill and construction debris after construction completion, and, wherever feasible, restore disturbed areas to pre-project conditions.

Impact significance
Less than significant with mitigation

Impact 3.4-15: Long-term conversion of nesting and foraging habitat for special-status and migratory birds

The Proposed Project would result in a long-term loss of nesting and foraging habitat for several special status and migratory birds at the Proposed Project site. Following construction activities, revegetation of the eastern toe berm, staging area, and along the DWSC would offset temporary losses of riparian habitat cleared during site preparation, but it would take several years for vegetation to become established and mature. However, the toe berm has been placed in areas that will avoid the most valuable riparian habitat on the Proposed Project site (Section 2.2.3). The total long-term loss of nesting and foraging habitat would be approximately 18 ac.

The Proposed Project would result in the permanent loss of 48 ac of freshwater emergent wetland (1,053 ac of intertidal + shallow subtidal wetland habitat partially offsetting the loss of 1,100 ac non-tidal wetland habitat; Table 2.2-2), which provides foraging habitat for nesting raptors and nesting and foraging migratory birds. This would also result in an overall reduction of marginal foraging habitat for Swainson's Hawks. Other emergent wetland habitat exists nearby the Proposed Project site for nesting; however, many of these species are territorial and reduction in available habitat may result in the displacement of nesting special-status birds in the vicinity of the Proposed Project site. Implementation of Mitigation Measure 3.4-3.1 would reduce these impacts to *less than significant*.

Impact significance
Less than significant with mitigation

Impact 3.4-16: Post-construction conversion to tidal habitat suitable for foraging migratory birds

The creation of approximately 1,053 ac of intertidal and shallow subtidal freshwater emergent wetland habitat (Table 2.2-2) for foraging birds would be beneficial.

Impact significance

Beneficial

Impact 3.4-17: Short-term, construction-related injury or mortality and loss of roosting and foraging habitat for western red bats

Site preparation and construction activities that may cause individual injury or mortality or loss of suitable roosting and foraging habitat for western red bats over the construction period include:

- Clearing and grubbing
- Creation of temporary ramps and roads
- Creation of temporary staging areas
- Herbicide and mechanical invasive species control
- Dead tree/snag removal
- Excavating constructed channel network
- Blocking and filling agricultural ditches
- Construct interior topographic features
- Construction of eastern toe berm
- Excavation of levee breaches

Construction related activities could cause individual injury or mortality or disturb roosting bats, especially during breeding season. The largest numbers of western red bats are expected to be on the Proposed Project site during the maternity season from May to August. During most of this time young are not able to fly on their own and individuals would be unable to relocate during construction. Construction activities such as vegetation management in the form of trimming, clearing, removal by mechanical or other methods (herbicides) during this period could have a significant impact on individual western red bats. Other bat species could also be impacted by these project activities, especially vegetation removal and structure removal.

The removal of valley/foothill riparian vegetation, in particular mature trees, for site preparation and construction of the eastern toe berm and levee breaches would result in the short-term loss of roosting habitat (Impact 3.4-3). Removal of valley/foothill riparian habitat during construction of the eastern toe berm and levee breaches would result in the loss of 90 ac of suitable roosting habitat for western red bat (Table 2.2-2). This would be a potentially significant impact; however, implementation of Mitigation Measures 3.4-17.1 and 3.4-3.1 would reduce potential impacts to individual bats, roosting, and foraging habitat to *less than significant*.

Site preparation would result in the temporary loss of approximately 1,100 ac of freshwater emergent wetland habitat (Table 2.2-2) used for bat foraging due to its high insect concentrations. This temporary loss of foraging habitat would result in a temporary change in the composition of available prey, which could negatively impact the species. However, because additional wetland foraging habitat is located nearby, the short-term loss of this habitat type would be *less than significant*.

Mitigation Measure 3.4-17.1
In order to minimize potential construction related impacts to western red bats over the construction period, this mitigation measure includes the following:

1. Confine clearing of vegetation to only those areas necessary to facilitate construction activities and no greater.
2. A pre-construction survey shall be conducted by a qualified biologist to identify roosting western red bats during the maternity season (May through August). If roosting bats are present, construction activities that involve the removal of mature riparian trees, snags, and remnant structures suitable for roosting shall be timed to avoid bat maternity season (May through August).
3. Wherever feasible the Proposed Project design and implementation would avoid potential roosting habitat especially large mature trees like cottonwood and sycamore.
4. Coordinate with CDFW on measures to minimize impacts to individuals.

Impact significance
Less than significant with mitigation

Impact 3.4-18: Long-term removal of western red bat roosting and foraging habitat

The Proposed Project would result in a long-term loss of roosting habitat for western red bats at the Proposed Project site. Following construction activities, revegetation of the eastern toe berm, staging area, and along the DWSC would offset temporary losses of riparian habitat cleared during site preparation, but it would take several years for vegetation to become established and mature. While the toe berm has been placed in areas that will avoid the most valuable riparian habitat on the Proposed Project site (Section 2.2.3), there would still be a long-term loss of approximately 28 ac of potential roosting habitat. Implementation of Mitigation Measure 3.4-3.1 would reduce these impacts to *less than significant*.

The Proposed Project would result in the permanent loss of 48 ac of freshwater emergent wetland (1,053 ac of intertidal + shallow subtidal wetland habitat partially offsetting the loss of 1,100 ac non-tidal wetland habitat; Table 2.2-2), which provides foraging habitat for western red bats. However, bats will also forage over open-water areas replacing the emergent marsh and on the emergent marsh fringe. This would be a less than significant impact.

Impact significance
Less than significant with mitigation

3.5 Geology and Soils

This section describes geology and soil conditions in the vicinity of the Proposed Project site, and assesses the geologic and soil impacts, constraints, and hazards on the Proposed Project site. Geology and soil issues addressed herein include seismic (earthquake) hazards, slope stability, soil expansion, settlement, and erosion. This analysis is based on a review of soils and geologic studies and maps prepared by private consultants and resource agencies for the region, Proposed Project site, and adjacent development projects.

This section evaluates potential geologic and soils impacts, including erosion during and/or after construction resulting from proposed levee reconfiguration and breaching, slough channel excavation, or soil placement.

3.5.1 Setting

Environmental setting

Geology

The tectonic setting and geologic history of the Sacramento-San Joaquin River Delta (Delta) occurs within a distinctive geologic province, composed primarily of alluvial sediments that have accumulated within a marine-terrestrial depositional basin since the mid-Mesozoic era. This section builds from the broader understanding of the regional geologic setting and summarizes pertinent information on the tectonics and local surficial sediments (soils) within the Cache Slough Complex (CSC) or Proposed Project region. The Proposed Project site is located along the east side of this region.

Tectonic setting

The Proposed Project region lies within the Great Valley geomorphic province—a deep, sedimentary basin principally fed by surrounding uplands of the Coast Ranges to the west and the Sierra Nevada to the east. The catchment of the Proposed Project site lies to its west, and includes low-order streams draining the Vaca Mountains and Montezuma Hills. These uplands compose part of the central portion of the Coast Range province—a tectonically active zone, composed primarily of right-lateral strike-slip (horizontal sliding motion) faults, separating the Pacific and North American tectonic plates. In contrast, the Great Valley province, which underlies the Proposed Project region, hosts few active faults. The Hayward Fault Zone lies approximately 42 mi to the southwest of the Proposed Project site. On the east side of the Central Valley, the Foothills Fault System (south central reach section [Ione fault]) lies approximately 40 mi to the east of the Proposed Project site. The closest fault[10] designated “active” by the California Geological Survey (CGS) is the Green Valley Fault Zone, located approximately 27 mi to the west-southwest of the Proposed Project site, along Sulfur Spring Mountain (Bryant and Hart 2007). Historical surface displacement (within the past 200 years) has been noted along sections of the Green Valley Fault (CGS 2010a). This fault has an estimated slip rate of about 0.1 inch (in) per year over the past several decades.

The USGS estimates a 6% probability of the fault experiencing an earthquake of magnitude 6.7 or greater before the year 2030 (USGS 1999). Shaking-hazard

[10] An “active fault” is defined by the state as a fault having seismically induced (tectonic) surface displacement within the Holocene epoch, or the past 11,000 years (Bryant and Hart 2007).

risk within the alluvial portion of the Proposed Project region is moderate—with probabilistic peak-ground motion[11] of approximately 30%. This is low in comparison to the higher shaking-hazard level predicted for much of the Coast Range (30–80%), but not as low as that predicted for the middle of the Central Valley (less than 2%) (CGS 2013).

There are other potentially active faults[12] located closer to the Proposed Project site (Figure 3.5-1). Approximately 14 mi west-southwest of the Proposed Project site lie a series of parallel, smaller faults, called the Vaca-Kirby Hills faults, with Late Quaternary activity (i.e., last movement estimated within the past 700,000 years) (CGS 2010a). These faults run along the Vaca Mountains and Montezuma Hills within the headwaters of the Cache Slough drainage The Midland Fault Zone located approximately 2 mi west of the Proposed Project site, bisects the Proposed Project region with a roughly north-south trace closely aligned with the Cache Slough channel. This fault is considered "potentially active" since past displacement is estimated sometime during the Quaternary period (last movement estimated within the past 1.6 million years) (CGS 2010a).

While the Delta is not directly affected by ground-rupture hazards, the Delta islands are susceptible to liquefaction due to shallow groundwater depths and presence of sandy-peaty soils having low cohesive strength (Mount and Twiss 2005). These lands also are susceptible to levee damage caused by seismically induced failure (i.e., mass-failure, liquefaction) or focused wave-energy (i.e., seiches) in the Delta channels (Mount and Twiss 2005, Betchart 2008). Overall, however, the Proposed Project region is estimated to have a low susceptibility to earthquake-induced levee failure, compared with the rest of the Delta (Torres et al. 2000). As described in the Soils section below, the soils of the Proposed Project region are more mineral in nature, than those of the Central Delta, and thus generally have lower liquefaction potential.

[11] Peak ground motion (10% probability of being exceeded in 50 years) is expressed as a percent of the acceleration due to gravity (CGS 2013).

[12] A "potentially active fault" is defined by the state as a fault having surface displacement within the Pleistocene epoch (Bryant and Hart 2007), or between 11,000 years and 2.6 million years before present. The beginning of the Pleistocene epoch (and Quaternary period) was officially changed in 2009 from 1.6 to 2.6 million years before present (Walker and Geissman 2009). The CGS's Special Publications 42 (Bryant and Hart 2007) from which the definitions of "active faults" and "potentially active faults" originate predates this amendment and, therefore, defines the Pleistocene epoch as occurring between 11,000 years and 1.6 million years before present.

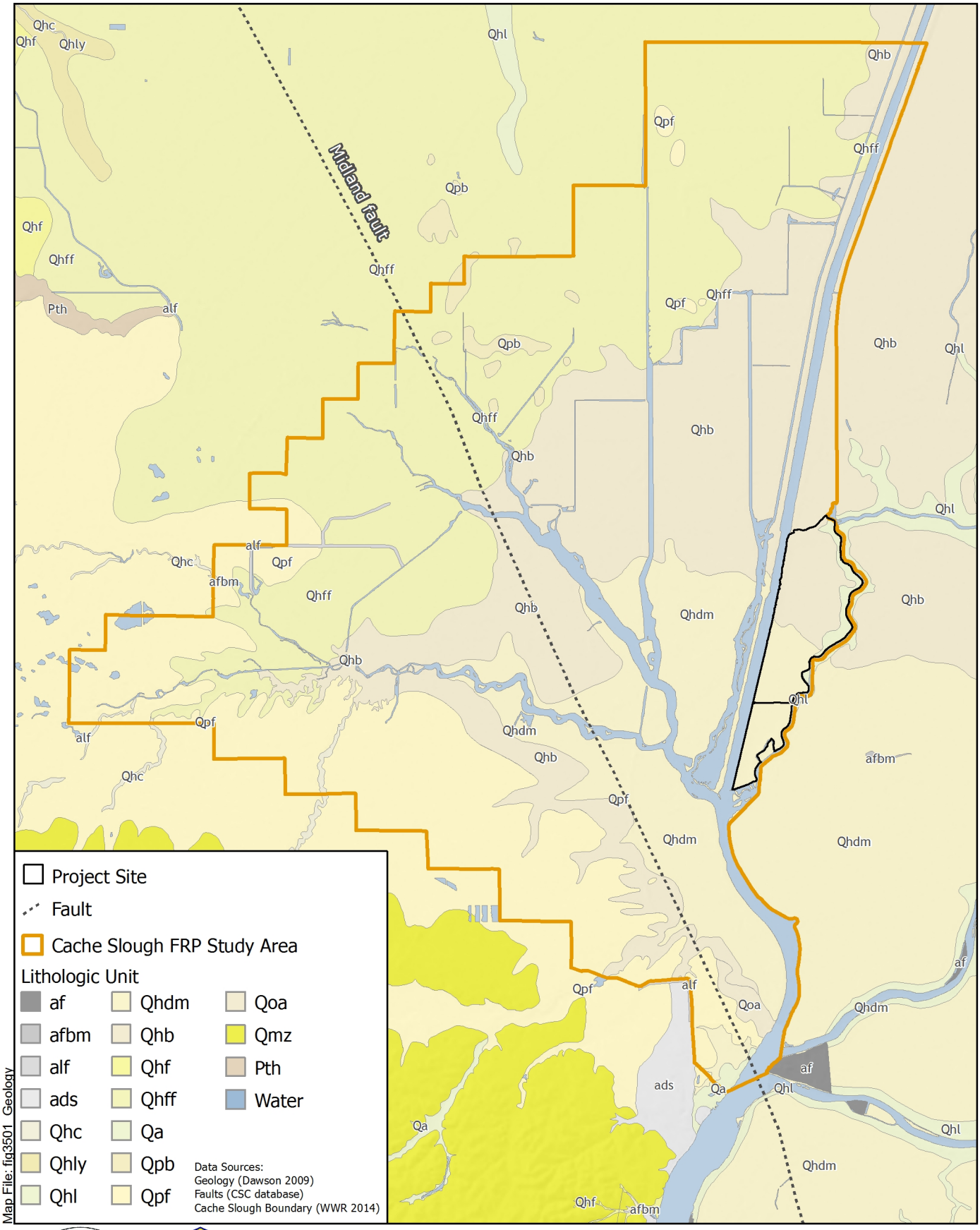


Figure 3.5-1

Geology of the Project Region and Site

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Surficial geology

The valley floor of the Great Valley geomorphic province is composed of unconsolidated to semi-consolidated, continental alluvium that has deposited continuously during the Quaternary Period (last 2.6 million years) (Wagner et al. 1981, Graymer et al. 2006, Dawson 2009, CGS 2010b) (Figure 3.5-1). The vast majority of these sediments were delivered from alluvial processes of the Sacramento River and its major tributaries flowing from the Sierra-Nevada and Coast Ranges. Draining the leeward side of the central Coast Ranges, the upper Cache Slough catchment is underlain by old, marine sedimentary rocks of late Mesozoic and early Tertiary age that compose part of the Great Valley Complex and, together, underlie the younger surficial sediments found in the Delta. These older rock units include mostly well consolidated, inter-mixed sandstones, shales, and conglomerates (and some volcaniclastics) which formed within an ocean (forearc) basin that once lay west of the Mesozoic North American margin, at the edge of the Sierra Nevada (Harden 2004).

The shallow sediments (and soils) found within the Proposed Project region reflect the pre-settlement morphodynamics of this region, when alluvial sediment was regularly deposited within submerged areas of the southern Yolo Basin and tidal marshlands and sloughs of the Delta. The Proposed Project region is underlain primarily by four distinct alluvial units, laterally encircling the Delta as a product of the interplay between fluvial and tidal forces over the past 100,000 years. The units described below follow the naming convention presented by the CGS (Dawson 2009), and are further described with similarly mapped units published by Helley et al. (1979), Atwater (1982), Wagner et al. (1981), and Graymer et al. (2006) (Figure 3.5-1).

- ***Qhdm*** (southeast side, majority of Delta; similar to *Qi* of Wagner et al. [1981]): Intertidal sediments (peaty mud) of late Holocene age deposited at or near sea level in tidal marshes of the Delta (this unit underlies approximately the southern half of the Proposed Project site).
- ***Qhb*** (central area, extending away from the Delta; similar to *Qb* of Wagner et al. [1981]): Fine-grained alluvial flood-basin deposits of late Holocene age with horizontal stratification deposited in topographic lows (this unit underlies approximately the northern half of the Proposed Project site).
- ***Qhff*** (northwestern side, extending even farther away from the Delta; similar to *Q* of Wagner et al. [1981]): Unconsolidated and semi-consolidated fine-grained, moderately- to poorly-sorted, alluvial-fan sediments of Holocene age deposited by upland streams (e.g., Putah Creek) as debris

flows, hyper-concentrated mudflows, or braided stream flows (this unit does not underlie the Proposed Project site).

- ***Qpf*** (southwest side, at base of Montezuma Hills; similar to *Qo* of Wagner et al. [1981]): Older alluvial fan deposits of late Pleistocene age derived from Montezuma Hills composed of moderately- to poorly-sorted and bedded sand, gravel, silt, and clay sediments (this unit does not underlie the Proposed Project site).

It should be noted that a narrow band of unit ***Qhl*** (Holocene fan levee deposits) is present along most of the eastern portion of the Proposed Project site. This unit is related to flood levee deposition from Miner Slough.

Formation of surficial materials in the pre-settlement tidal marshlands of the Delta was driven by deposition of inorganic sediment from the Sacramento and San Joaquin rivers, and by *in situ* accumulation of organic matter (Atwater 1982), with the relative contributions of each process varying through time (Drexler 2011). Peat formation occurred until land reclamation began in the late 1800s, during Euro-American settlement (Mount and Twiss 2005, Whipple et al. 2012). Reclamation, consisting of levee construction around the Delta islands to facilitate agricultural practices, disconnected these lands from the tidal and fluvial flooding that once supported tidal marsh. Resultant oxidation of the drying peat soils has led to soil depletion and subsidence of the diked Delta islands, including those in the Proposed Project region however, subsidence has occurred at lower magnitudes in the Proposed Project region due to thinner peat deposits at the Delta basin edges (Mount and Twiss 2005).

Soils

This section provides a description of the soil units and hydrologic soils groups in the Proposed Project region, followed by a brief discussion of the potential for seepage following restoration.

Mapped soils units

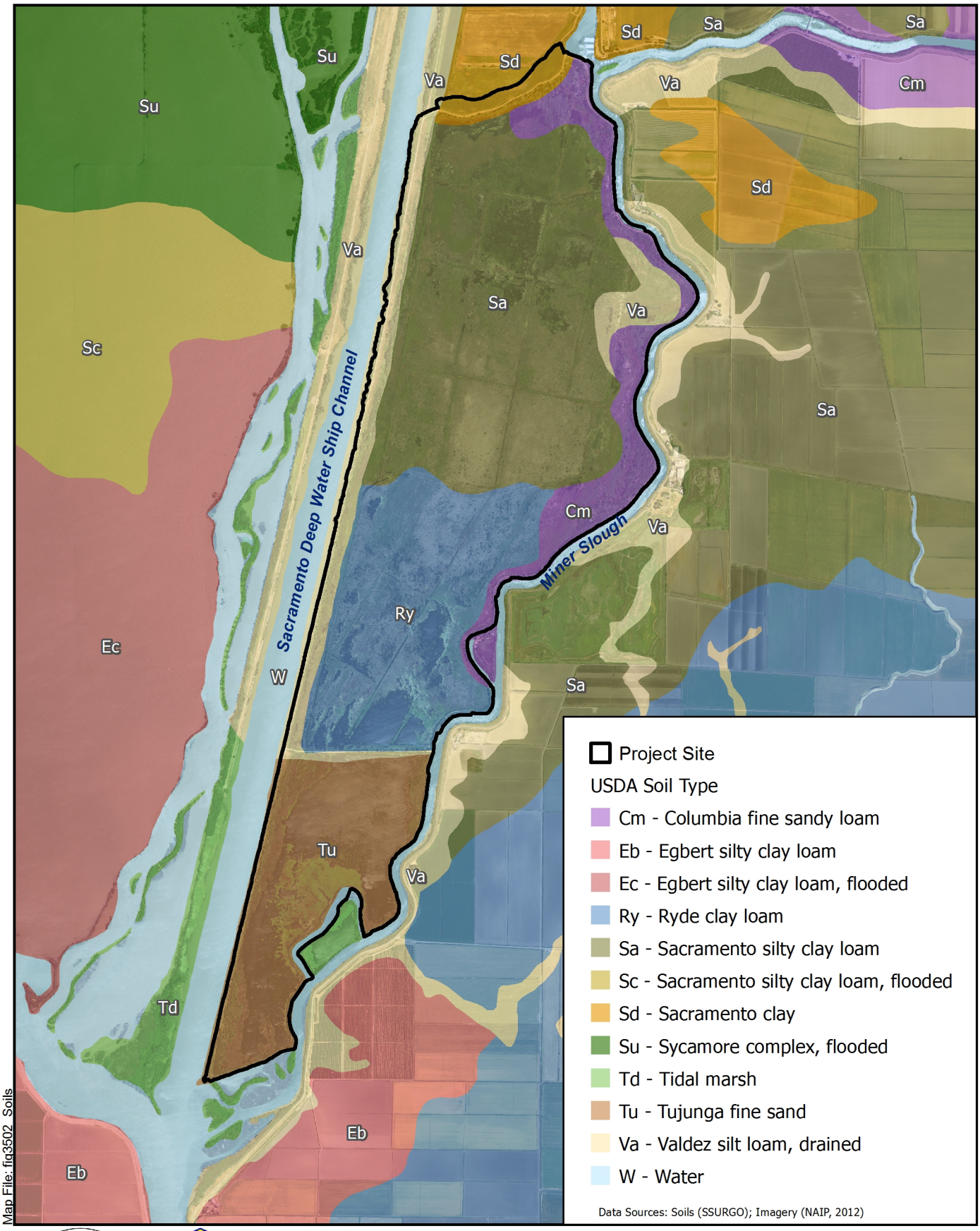
Soils mapped by the Natural Resources Conservation Service (NRCS) in the Proposed Project region reflect the depositional pattern of surface sediments and *in situ* formation of soil materials (NCSS 2012). There are over 34 distinct natural soil units, composing four soil groups: Sacramento-Ryde-Egbert; Stockton-Clear Lake-Capay; Willows-Solano-Pescadero; and San Ysidro-Antioch (Figure 3.5-2). These groups generally coincide with the four mapped surficial geologic units of Wagner et al. (1981) and Dawson (2009). In general, the soils in the Proposed Project region are poorly drained, silty-clayey loams with mostly non-saline to

slightly saline conditions. The slightly to moderately saline soils, accounting for approximately 20% of the diked and tidal lands in the Proposed Project region, have the potential to be detrimental to plant growth for species sensitive to saline conditions. There are also rare occurrences of sandy-gravelly soils with high infiltration potential. The silty-clayey soils have a relatively high potential for shrink-swell behavior, a primary characteristic of expansive soils[13] common to the Delta. This condition generally limits construction of structures without importation of artificial fill or implementation of other significant engineering solutions. Artificial fill is also present in the area, primarily as the dominant material used to construct the levees of the Sacramento Deep Water Ship Channel (DWSC).

Sacramento-Ryde-Egbert soil group

This soil group is situated along the eastern half of the Proposed Project region, and generally coincides with the submerged lands and the geological units *Qhdm* and Qhb (Figure 3.5-1). This soil group underlies the majority of the Proposed Project site (Figure 3.5-2). The 15 distinct soil units that comprise this group are mostly silty clay loams, having high run-off potential, moderately low infiltration rates, non-saline conditions, and moderate to high shrink-swell potential. Two sandy units are present (Columbia fine sandy loam and Tujunga fine sand), which have high infiltration rates and low shrink-swell potential as a function of their larger particle sizes. These units are situated along the east and south sides of the Proposed Project site, respectively, the latter of which is perennially submerged.

[13] Expansive soils are characterized by the ability to undergo significant volume change as a result of varying soil-moisture content. The 2010 California Building Code, Title 24, Part 2, Section 1803.5.3: Geotechnical Investigations defines an expansive soil as meeting the following provisions: (1) plasticity index of $\geq$15; (2) >10% soil particles pass a No. 200 sieve (0.075 mm); (3) >10% soil particles are <0.005 mm; and (4) expansion index of >20.



Map File: fig3502_Soils

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0 0.25 0.5 Mi

0 0.5 1 Km

Figure 3.5-2

Soil Units Underlying the Project Site

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Soil seepage potential with restoration

In addition to classifying soil units by series, as described above, the Natural Resource Conservation Service (NRCS) also classifies soil units within defined hydrologic soils groups, based upon their run-off characteristics. These groupings are based on the following factors:

- intake and transmission of water under the conditions of maximum yearly wetness (thoroughly saturated)
- soil not frozen
- bare soil surface
- maximum swelling of expansive clays

Hydrologic soil group classification for a given soil unit is determined by the water transmitting soil layer with the lowest saturated hydraulic conductivity (Ksat) and depth to any layer that is more or less water impermeable (such as a fragipan or duripan) or depth to a water table (if present) (NRCS 2007).

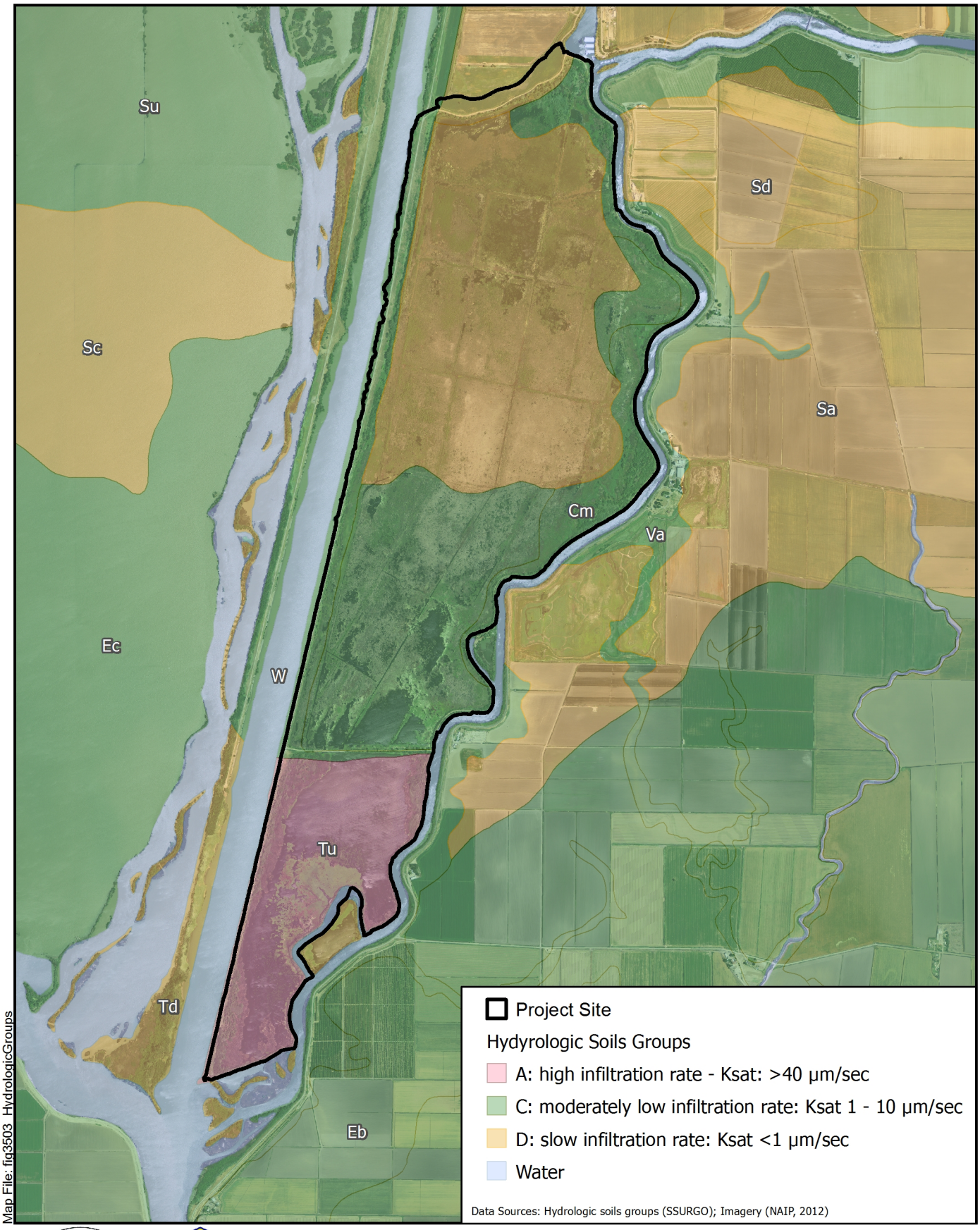
Soil units within in the Proposed Project region fall primarily within two hydrologic soil groups (Figure 3.5-3):

- Group C soils are generally composed of 20 to 40% clays with less than 50% sands or gravels. These soils have “moderately high run-off potential”, Ksat = 1.42 in per hour
- Group D soils are generally composed of greater than 40% clays and less than 50% sands or gravels, and exhibit “high run-off potential”, Ksat $\leq$ .14 in per hour

One exception to this is an area of soils in the southern portion of the Proposed Project site, which falls into hydrologic group A, with low saturated run-off potential, and a very small area along the western boundary of the Proposed Project region, with soils grouped into hydrologic soils group B, with moderate saturated run-off potential (3). Where soils have low run-off characteristics (i.e., high infiltration rates, even under saturated conditions), there may be potential for groundwater seepage into adjacent diked lands.

The data presented in Figure 3.5-3 indicate that much of the eastern extent of the Proposed Project region (including the Proposed Project site) is composed of soil units that generally have low permeability and can, therefore, support restoration projects that should not be significantly affected by potential seepage impacts to surrounding areas. Further evaluation of the hydrogeology of the Proposed

Project site and seepage potential from the Proposed Project site to surrounding areas is covered in Section 3.1 *Hydrology*.



Map File: fig3503_HydrologicGroups

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0 0.25 0.5 Mi

0 0.5 1 Km

Figure 3.5-3

Hydrologic Soils Groups of the Project Site

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Subsidence in the Proposed Project area

Subsidence, triggered by the oxidation of soil organic matter, has been expressed dramatically throughout the Delta since reclamation activities began in the 1800s (Figure 3.5-4) (Deverel and Leighton 2010). Soil type and organic matter content are key factors that determine rates of subsidence. Within the Proposed Project region, mineral surface soils (0 to 10% organic content) generally predominate, whereas in the central, eastern, and southern Delta, the majority of the area is composed of highly organic surface soils (>10% organic content); as would be predicted, these regions have experienced the greatest subsidence rates (Figure 3.5-5) (Deverel and Leighton 2010). Between zero and 10 ft of subsidence has been documented within the Proposed Project region as compared to more than 15 ft in the heart of the central Delta, along the San Joaquin River (Figure 3.5-4). Subsidence within the Proposed Project region has generally been localized in the south-eastern portion, where the soils contain the highest organic content (5 to 10%) (Figure 3.5-5). Based on future subsidence rates estimated by Deverel and Leighton (2010), these areas are projected to subside up to 1.6 ft more by the year 2050.

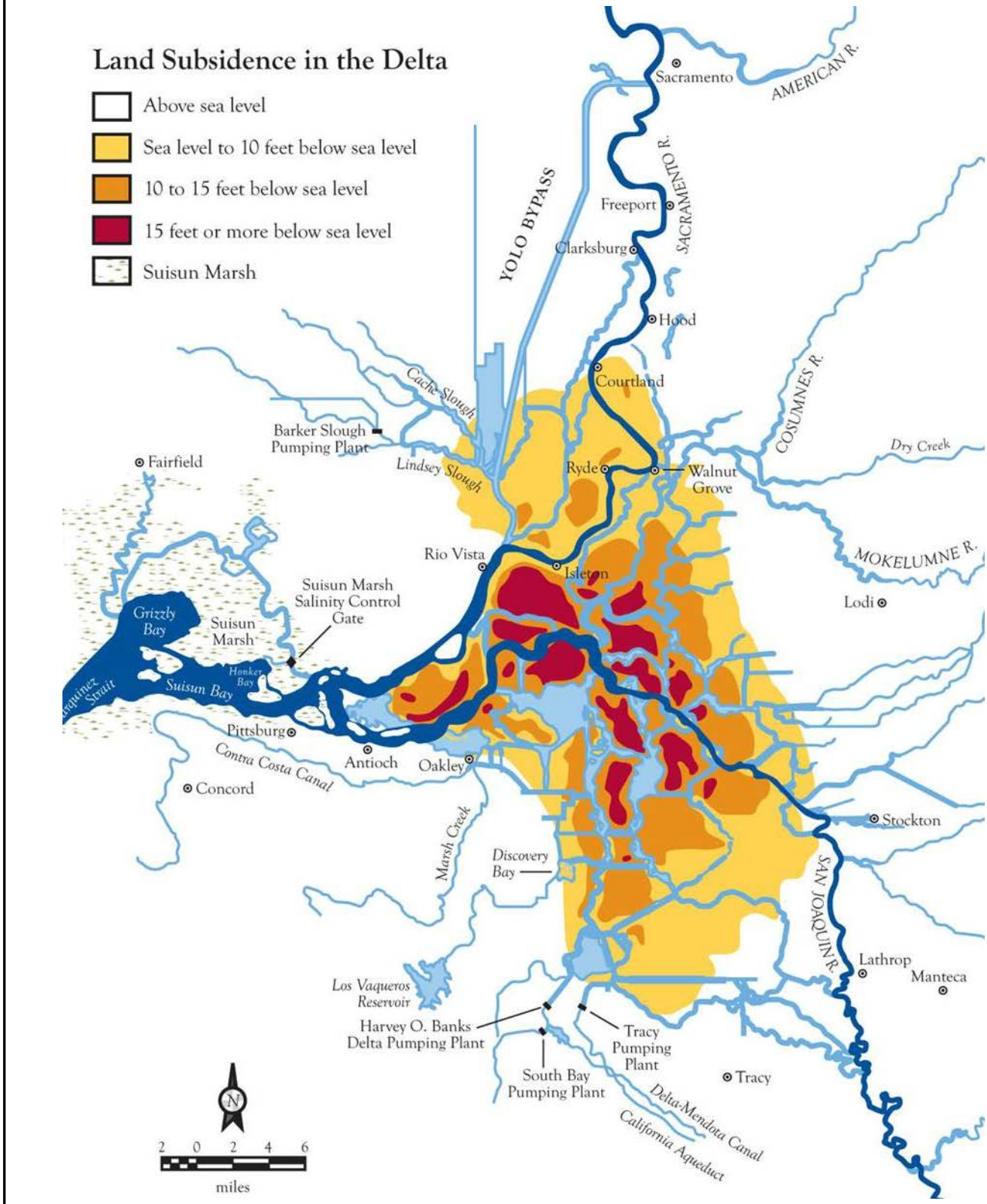


Figure 3.5-4
Land Subsidence throughout the Delta

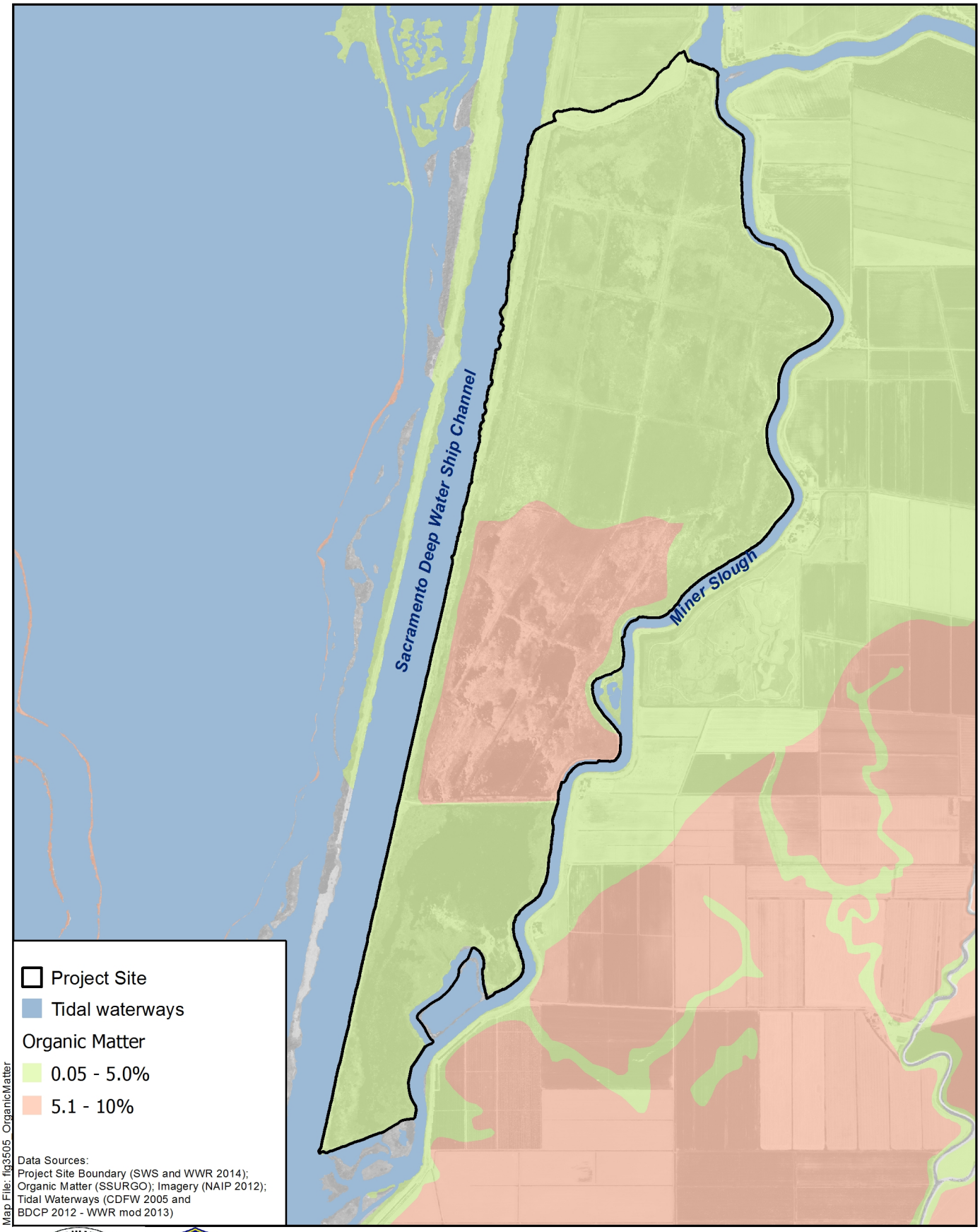


Figure 3.5-5
Percent Soil Organic Matter in the Vicinity of the Project Site

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Legal and regulatory setting

State and local laws and regulations that guide building and construction activities include several acts and plans specifically regulating these activities in geologic hazard areas. In the seismically active San Francisco-Bay Delta estuary, these laws and regulations are particularly relevant and applicable. The following section provides an overview of the principal laws and regulations.

State laws and regulations

Unless otherwise noted, the Proposed Project would comply with the following state laws and regulations.

Delta Plan

The Delta Reform Act requires that the Delta Plan promote effective emergency response and emergency preparedness and promote appropriate land use to attempt to reduce risks to people, property, and state interest in the Delta (Water Code Section 85305). The Delta Reform Act requires the Delta Plan to recommend priorities for state investments in Delta levees. In response, the Delta Plan has adopted policy RR P1, *Prioritization of Statement Investments in Delta Levees and Risk Reduction*.

The hope is that implementation of Policy RR P1 would provide adequate protection to freshwater aqueducts passing through the Delta and the primary freshwater channel pathways through the Delta against floods and other risks of failures as well as prevent water deliveries to East Bay Municipal Utilities District, Contra Costa Water District, the Central Valley Project (CVP) and the State Water Project (SWP) from being interrupted by floods or earthquakes.

Assembly Bill 1200 (Chapter 573, Statutes of 2005)

Assembly Bill 1200 directed California Department of Water Resources (DWR) and California Department of Fish and Wildlife (CDFW) to prepare a report on evaluating the potential effects on water supplies derived from the Delta from a variety of stressors, including continuous land subsidence, earthquakes, floods, and climate change. The bill also requires the studies of possible improvements and options (ranking of possible options) for the water-related issues in the next 50, 100, and 200 years when determining effects on the Delta.

In response to the bill, DWR and CDFW issued a report, Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento/San Joaquin Delta (DWR and CDFG 2008). This report summarizes the potential risks to water supplies in the Sacramento and San Joaquin Delta attributable to future

subsidence, earthquakes, floods and climate change, and identifies improvements to reduce the effects and options to deliver water.

CALFED Delta Risk Management Strategy

A major need for the state is to determine how to make the Delta sustainable in the future. The 2000 CALFED Record of Decision presented its Preferred Program Alternative that described actions, studies, and conditional decisions to help fix the Delta. Included in the Preferred Program Alternative for Stage 1 implementation was the completion of a Delta Risk Management Strategy (DRMS) that would look at sustainability of the Delta, and that would assess major risks to the Delta resources from floods, seepage, subsidence, and earthquakes. DRMS would also evaluate the consequences, and develop recommendations to manage the risk. To implement the Delta risk assessment, legislation requires DWR to evaluate the potential impacts on water supplies derived from the Delta based on 50, 100, and 200-year projections for each of the following possible impacts: subsidence, earthquakes, floods, climate change and sea level rise, or a combination of the above. The DRMS work would provide the majority of this required information. The report to the legislature was submitted in July 2008.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act intends to minimize the hazards posed to people and property during and immediately following earthquakes. First enacted in 1972 (subsequently amended), the Act prohibits the location of developments and structures for human occupancy across the trace of active faults and regulates construction activities in the corridors of earthquake faults zones. The Act prohibits and restricts construction activities and zoning classifications based upon fault activity and fault definition, providing legal definitions for active, sufficiently active, and well-defined and establishes a process for reviewing construction proposals in the vicinity of earthquake fault zones. Trained geologists conduct site-specific investigations to determine the appropriate zoning classification. Regulations are more stringent for areas of greater hazard potential. The Act identifies Earthquake Special Study Zones. The Proposed Project site is not located in a Special Study Zone.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act also intends to provide for a statewide seismic hazard mapping and technical advisory program to assist cities and counties in protecting the public health and safety from the effects of strong ground shaking, liquefaction, landslides, or other ground failure and other seismic

hazards caused by earthquakes. Under the Act, the state is responsible for identifying and mapping seismic hazard zones. Cities and counties are required to utilize these hazard maps in issuing building permits, which provides a mechanism to regulate construction and development accordingly in these zones to ensure that building standards provide for safe development. Prior to issuing permits, the Act requires site-specific geotechnical investigations be conducted and development plans incorporate measures to mitigate potential damage in most developments designed for human occupancy within the Zones of Required Investigation.

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, the following have been considered in the analysis of potential impacts and identification of mitigation, as needed.

Construction and development is also subject to local permitting requirements and site-specific geotechnical investigations. This permitting process may differ somewhat by jurisdiction, but generally involves a multi-stage permit review process. Site-specific geotechnical investigations examine geology, soils, land use history, and relevant factors to ensure building standards provide for safe development.

The State Reclamation Board cooperates with federal and state agencies and local governments in establishing, planning, constructing, operating, and maintaining flood control works.

3.5.2 Significance criteria

Relevant criteria for determining significant impacts are based upon Appendix G *Environmental Checklist* of the CEQA Guidelines and professional judgment. These guidelines state that the Proposed Project would have a significant impact on geology and soils if it would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - Rupture of a known earthquake fault
  - Strong seismic ground shaking
  - Seismic-related ground failure, including liquefaction
  - Landslides
- Result in substantial soil erosion or the loss of topsoil

- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Proposed Project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse

An analysis of potential impacts on levee stability due to wind wave erosion and scour is addressed in Section 3.1 *Hydrology* (Impact 3.1-4) and is not considered further here.

3.5.3 Impacts and mitigation

Impact 3.5-1: Long-term effect on exposure of people and structures to seismic- and landslide-related hazards

The Proposed Project site does not fall within an Alquist-Priolo Earthquake Fault Zone, a Seismic Hazard Mapping Act Zone, or a Landslide Hazard Map Zone, as shown on the California Geological Survey seismic hazard online mapping system (California Department of Conservation 2014). Shaking-hazard risk within the Proposed Project area is moderate—with probabilistic peak-ground motion[14] of approximately 30%. This is low in comparison to the higher shaking-hazard level predicted for much of the Coast Range (30–80%), but not as low as that predicted for the middle of the Central Valley (less than 2%) (CGS 2013).

Overall, the Proposed Project area is estimated to have a low susceptibility to earthquake-induced levee failure, compared with the rest of the Delta (Torres et al. 2000). Additionally, the soils of the Proposed Project region and site are more mineral in nature than those of the Central Delta, and should have lower liquefaction potential. Therefore, there is a low likelihood of earthquake-induced levee failure due to seismic-related ground failure shaking, including liquefaction.

South property levee repairs will improve levee integrity (see Section 2.2.3 *Description of Proposed Project components and construction activities – South property levee repairs*). The Proposed Project itself would not adversely affect levee integrity, and further, inclusion of the levee toe berm in the Proposed Project design would enhance overall levee integrity. This would be a beneficial effect.

Impact significance

Beneficial

[14] Peak ground motion (10% probability of being exceeded in 50 years) is expressed as a percent of the acceleration due to gravity (CGS 2013).

Impact 3.5-2: Long-term effect on sediment deposition and erosion in Prospect Island

Soils on the Proposed Project site are mostly fine-grained (silt and clay) with some areas of silty sand. Phase 2 modeling results included an evaluation of the potential effects of the Prospect Island Tidal Habitat Restoration Project on sediment transport and turbidity in the Proposed Project vicinity (Appendix C in WWR and SWS 2014). The three-dimensional UnTRIM model, which solves Navier Stokes equations in the horizontal plane, was used for hydrodynamic modeling to understand water level, discharge, salinity, sediment advection, sediment settling, and sediment mixing (Appendix C in WWR and SWS 2014). Use of the UnTRIM model was coupled with the SediMorph model to additionally understand erosion and deposition of sediment, seabed morphologic change, and sedimentological properties within the seabed, as well as the SWAN model for wave properties. In order to bracket seasonal ranges of scour and deposition at the site, the modeling period (October 1, 2012 to December 31, 2012) selected for simulation included both low-flow conditions associated with seasonal turbidity minimums, as well as high-flow conditions in Sacramento River associated with annual maximums (i.e., “first flush”) (Appendix C in WWR and SWS 2014). The simulation was only intended to represent suspended sediment dynamics under existing and near-term conditions following Proposed Project implementation.

Annual sediment loads in Miner Slough are large, and dominated by Sacramento River sources during winter (Wright and Schoellhamer 2005). Prospect Island acts as a sediment sink, with little sediment resuspension within the Island (Appendix C in WWR and SWS 2014). Under the Proposed Project (i.e., Alternative 26 of the Phase 2 modeling), monthly-averaged turbidity under low-flow conditions in Sacramento River would typically be less than 10 Nephelometric Turbidity Units (NTU) within Prospect Island, and is predicted to be 1-5 NTU (5–15%) lower than baseline turbidity conditions in Cache Slough and the DWSC (Appendix C in WWR and SWS 2014). The predicted maximum sediment deposition within Prospect Island during the simulation period was on the order of 0.7 ft, with an uneven distribution of sediment deposits throughout the Proposed Project site. Maximum values occurred near the breaches and in the deeper central portion of Prospect Island. During high outflow conditions, monthly-averaged turbidity is predicted to increase by more than 25 NTU within the northern portion of Prospect Island under the Proposed Project, and equivalently decrease in Miner Slough, because turbid water enters Prospect Island from the northern breach in Miner Slough. Turbidity in Miner Slough

downstream of the northern breach, in Cache Slough and the DWSC are predicted to decrease by 5-25 NTU (15 to > 35%), as much of the sediment would be deposited within Prospect Island (Appendix C in WWR and SWS 2014). The Proposed Project is one of three alternatives modeled with the greatest predicted increase of turbidity within Prospect Island, and greatest decrease of turbidity in Cache Slough and the DWSC, under high outflow conditions (common in December) (Appendix C in WWR and SWS 2014). Sediment accretion within Prospect Island under the Proposed Project is predicted to reach maximum annual amounts on the order of tens of centimeters (approximately 0.3 ft), and is a beneficial effect because this may help to reverse existing land subsidence, offset future subsidence, and promote sediment resiliency.

All of the design alternatives modeled are predicted to decrease turbidity at the Cache Slough, DWSC, and Liberty Island monitoring stations. During high outflow conditions, all alternatives are predicted to decrease turbidity in Miner Slough from the confluence with Cache Slough upstream to the farthest considered breach location (Appendix C in WWR and SWS 2014). The baseline seasonal turbidity pattern is also preserved under all alternatives, with higher turbidity in Cache Slough and the DWSC comparative to Miner Slough during October and November, and the reverse in December (Appendix C in WWR and SWS 2014). The presence or absence of a weir in the design configuration only results in minor changes to predicted sediment deposition (Appendix C in WWR and SWS 2014).

Impact significance

Beneficial

3.6 Hazards and Hazardous Materials

3.6.1 Setting

This section describes the potential presence of hazards and hazardous materials in proximity to the Proposed Project site and assesses the impacts of hazardous materials associated with the Proposed Project. The hazards analysis is based on existing information and review of applicable plans and policies.

Environmental setting

Historic site uses

Agricultural crops such as corn, wheat and safflower were grown on the north property from 1963 to 1994; it is likely that insecticides, herbicides and fungicides

were used at the site during that time. The north property has not been farmed since 1994 (USACE and DWR 2001). Prior to 1963, the Port of Sacramento used the south property for placement of dredge spoils. Between 1963 and 1986, the south property may have been used for agriculture. Natural gas wells were constructed on the property from 1946 through 2002. The wells have since been abandoned and sealed.

Existing site hazards and hazardous materials

Background

The lands and waters of Prospect Island may contain hazardous substances associated with past agricultural, residential, and gas-extraction uses. Petroleum products and pesticides may have been stored or released into the surrounding environment. Older gas wells and underground storage tanks may have developed leaks, contaminating local soils and groundwater.

Hazardous materials may have been incorporated into levee construction, repair, and maintenance. In addition to the soil, rock, and concrete materials typically used for bank protection, the surrounding levees may include asphalt, fiberglass, automobile bodies and tires, asbestos-containing materials, and metals. The composition of the levee materials is not known throughout the island. Potential sources of contamination of levee surfaces may include trash and debris from litter and illegal dumping, contaminant-laden sediments transported in adjacent waterways and deposited on the levees, and surficial application of herbicides commonly used for weed control along the levees.

There are 20 groundwater-monitoring wells on Prospect Island. Most of the wells are located on the crown of the levee (Figure 3.1-7).

Environmental Site Assessment

A Phase I/Phase II Environmental Site Assessment was conducted in 2008 for the north property (USBR 2008) to identify the potential for hazardous materials at the site. A tank and metal cart were discovered near the entrance to the north property during the Phase I site reconnaissance. Since the tank appeared to be a fuel tank, a Phase II Assessment was conducted, which included collection of soil samples in the vicinity of the fuel tank and laboratory analysis for diesel, PCBs, lead, and pesticides. No concentrations were found to be above state regulatory limits. Soils were also screened for hydrocarbons in association with a rusted steel drum found next to the levee road along Miner Slough. Results were well below screening levels. Overall, the Phase I/Phase II Environmental Site Assessment did not indicate the presence of hazardous wastes and recommended no additional studies on the north property (USBR 2008).

A Phase I Environmental Site Assessment radial records search was conducted in 2014 for the south property (DWR 2014d) to identify the potential for hazardous materials within a mile radius of the center point of the site. The records search reviewed over 50 state, federal, local environmental data bases for recorded environmental hazards. The Phase I Environmental Site Assessment did not identify any recorded issues of concern for the south property. Four incidents were identified in the radial record search for Prospect Island. The incidents were not located on Prospect Island, but were within the radial search parameters used; three of the incidents were minor petroleum leaks from the Ryer Island Ferry on SR-84 and the J-Mack Ferry, while the fourth incident involved a boat taking on water. Further, a query of the California Department of Toxic Substances Control's (DTSC's) database for Prospect Island identified no known sites within or immediately surrounding Prospect Island that would impact the site (DTSC 2015).

An aerial photograph from June 6, 1993, shows two structures later identified as part of "the Prospect Island houses" (P-48-000417[15]) (see also Section 3.14 *Land Use and Planning/Population and Housing*) on the east side of the north property. During a 2014 California Department of Water Resources (DWR) site visit, it was noted that these structures no longer exist (Google Earth 2014). Outbuildings associated with the Prospect Island houses that can also be seen in the 1993 aerial photograph include a pump platform on the south-east corner of Prospect Island; the wood of the platform appeared to consist of creosote treated logs.

Two structures appear in the 1993 aerial photograph on the east side of the south property, directly south of the Hall property. During the 2014 DWR site visit, only one of the buildings (P-48-000956[15]) remains or is visible due to the overgrown shrubbery on the levee. This structure, designated as the Parus -1H-12 house, is separated from its foundation and has partially collapsed. This structure may contain asbestos and lead base paint.

Gas wells

Based on a review of the Department of Conservation Division of Oil, Gas, and Geothermal Resources website (DOGGR 2014), there are six exploratory gas wells on the northwest side of Prospect Island (Figure 3.9-1):

[15] Structure numbers are assigned by Northwest Information Center of the California Historical Resources Information System.

- Well 09520101, Union Oil Company of California, plugged and abandoned in 1969;
- Well 09500374, Chevron USA, plugged and abandoned in 1946;
- Well 09500474, Arcady Oil Company, plugged and abandoned in 1954;
- Well 09521156 Rosetta Resources Operating LLP, plugged and abandoned in 2002;
- Well 09500473, Arcady Oil Company, plugged and abandoned in 1955;
- Well 09500103, Arcady Oil Company, plugged and abandoned in 1965

These wells have been plugged and abandoned (DOGGR 2011).

Biological vectors

Biological vectors are mosquitoes, ticks, and those wildlife species (e.g., rats and other rodents) that serve as hosts to transmitted viruses, parasites, and diseases affecting humans. In Solano County, major public health concerns include mosquito transmission of West Nile virus, encephalitis viruses, and malaria parasites. In 2013, Solano County had its first and only confirmed case of West Nile virus (Solano County 2015).

The spreading of Lyme disease by ticks and of diseases transmitted by animal-hosts, such as bubonic plague and rabies, is not considered a substantial risk to public health in the Sacramento-San Joaquin River Delta (Delta) (CDPH 2011) and is thus not considered further in this Environmental Impact Report (EIR).

Water that becomes stagnant in excess of five days can serve as a breeding ground for mosquitoes. Immature mosquitoes develop and mature in stagnant habitats. Restoration projects that remove obstacles, such as dikes or enlarge tidal connections (culverts) and create channels where water can flow, have a positive impact (Rochlin et al. 2012). The Solano County Mosquito Abatement District currently manages 10 species of mosquito (Table 3.6-1).

Depending on seasonal and environmental conditions and the particular mosquito species involved, it generally takes from 3 to 12 days for a mosquito to complete its life from developed egg to early adult stage. In general, as temperature increases, the number of days from hatching to adult emergence decreases. The potentially rapid life cycle of mosquitoes can result in rapid, eruptive mosquito populations related to relatively short-term variations in flooding and emergence, or seasonal tidal cycles.

Table 3.6-1. Solano County Mosquito Abatement District: Mosquito Breeding Habitats

California Salt Marsh Mosquito (*Ochlerotatus squamiger*)	Breeds exclusively in the salt and brackish marshes along the California coast
Cool Weather Mosquito (*Culiseta incidens*)	This species seldom breeds during the summer except in coastal areas.
Encephalitis Mosquito (*Culex tarsalis*)	Permanent water with fixed depth rarely supports abundant populations unless intermittently perturbated.
Foul Water Mosquito *(Culex stigmatosoma*)	Commonly referred to as a "foul water" mosquito because of its association with polluted water.
House Mosquito (*Culex pipiens pipiens, Culex pipiens quinquefasciatus*)	House mosquitoes are common in urban and suburban communities as well as on rural premises. Members of the complex readily breed in storm sewer catch basins, clean and polluted ground pools, ditches, animal waste lagoons, effluent from sewage treatment plants and other sites that are slightly to very eutrophic or polluted with organic wastes.
Oc. Melanimon	The female Oc. melanimon deposits its eggs singly (up to 150) on damp soil or at the base of grasses that would be inundated at a later date. Suitable habitat for this species includes irrigated pastures, alfalfa fields, duck clubs and other seasonal waterfowl areas.
Pale Marsh Mosquito (*Oc. dorsalis*)	Dorsalis can produce continuous broods through the spring and summer having 8-12 generations per year.
Pasture Mosquito (*Oc. nigromaculis*)	Referred to as the "pasture mosquito" in California because of its prevalence in irrigated pastures. It is a medium sized mosquito having blackish to brown coloration. Individual mosquitoes usually have a white band near the middle of the proboscis (beak). It is also found in alfalfa, rice fields, row crops, irrigation seepage and associated drainage ditches with changing water levels. Breeding has been found from sea level to an elevation of 6,000 ft
Western Tree Hole Mosquito (*Oc. sierrensis*)	Brackish marshes during the fall and late winter months
Winter Mosquito (*Culiseta inornata*)	Larvae are found in a wide variety of aquatic habitats from fresh water to salt marshes

Although no residential or urban areas occur in the vicinity of Prospect Island, there are ranch residences nearby. Currently, no mosquito abatement or control is being undertaken on Prospect Island (C. Hagen, CDFW, pers. comm., March 2015).

Legal and regulatory setting

Numerous laws and regulations at the federal, state, and local levels regulate how hazardous materials and wastes are identified, handled, treated, transported, and disposed. The U.S. Environmental Protection Agency (USEPA),

the DTSC, and the Department of Transportation regulate how material is handled and transported.

Federal laws

The USEPA is the lead federal agency responsible for the enforcement of federal regulations associated with hazardous materials. The primary legislation governing hazardous materials are the Comprehensive Environmental Response, Compensation, and Liability Act; the Resource Conservation and Recovery Act; and the Superfund Amendments and Reauthorization Act. Unless otherwise noted, the Proposed Project would comply with the following federal laws.

Comprehensive Environmental Response, Compensation and Liability Act, as amended

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 United States Code [USC] Section 9601 et seq. 1980) provides federal funds to clean up uncontrolled or abandoned hazardous waste sites, accidents, spills, discharges, and other emergency releases of pollutants and contaminants into the environment. Through CERCLA, USEPA was given authority to seek out those parties responsible for any hazardous release and assure their cooperation in the cleanup.

Resource Conservation and Recovery Act, as amended

The Resource Conservation and Recovery Act (RCRA) (42 USC Section 6901 et seq. 1976) provides USEPA with the authority to control hazardous waste from cradle-to-grave. This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. The 1984 federal Hazardous and Solid Waste Amendments to RCRA focus on waste minimization and phasing out land disposal of hazardous waste, as well as corrective actions for releases. Other mandates of this law include increased enforcement authority for USEPA, more stringent hazardous waste management standards, and a comprehensive Underground Storage Tank program. The 1986 RCRA amendments enabled USEPA to address environmental problems from underground tanks storing petroleum and other hazardous substances. RCRA also sets forth a framework for the management of non-hazardous solid wastes. RCRA Section 3006 allows USEPA with to authorize state hazardous waste programs. Once authorized, the state program operates in lieu of the federal program, although USEPA retains enforcement authority even after a state program has been authorized.

Toxic Chemical Release Inventory (Section 313) Toxic Substances Control Act
The Toxic Substances Control Act of 1976 (TSCA) (15 USC 2601 et seq. 1976) gives the USEPA authority to establish reporting, recordkeeping and testing requirements, and restrictions relating to chemical substances and/or mixtures. TSCA addresses the production, import, use, and disposal of specific chemicals, including polychlorinated biphenyls (PCB), asbestos, radon, and lead-based paint.

The Clean Water Act
The Clean Water Act (33 USC 1251 et seq.) establishes the institutional structure for USEPA to regulate discharges of pollutants into the waters of the United States, establish water quality standards, conduct planning studies, and provide funding for specific grant projects. The USEPA has provided most states with the authority to administer many of the provisions of the Clean Water Act. In California, the State Water Resources Control Board (SWRCB) has been designated by USEPA to develop and enforce water quality objectives and implementation plans. The SWRCB has delegated these responsibilities to nine Regional Water Control Boards (RWQCBs) throughout California, which in the vicinity of Prospect Island involves the Central Valley Regional Water Quality Control Board (CVRWQCB).

Safe Drinking Water Act
The Safe Drinking Water Act (SDWA) (42 USC 300f et seq. 6939b; 15 USC 1261 et seq.) was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. SDWA authorizes USEPA to set national health-based Maximum Contaminant Levels (MCLs) for drinking water to protect against both naturally occurring and human-made contaminants that may be found in drinking water. USEPA, state regulatory agencies, and water systems managers then work together to ensure these standards are met. The law was amended in 1986 and 1996 and requires many actions to protect drinking water and its sources, including rivers, lakes, reservoirs, springs, and groundwater wells. USEPA protects underground sources of drinking water, and many environmental regulations use the MCLs for environmental clean-up standards.

Occupational Safety and Health Act
The Occupational Safety and Health Administration (OSHA) administers the Occupational Safety and Health Act, (29 USC 15) which requires special training of handlers of hazardous materials, notification to employees who work in the vicinity of hazardous materials, and acquisition from the manufacturer of material

safety data sheets (MSDS). An MSDS describes the proper use of hazardous materials and is intended to provide workers and emergency personnel with procedures for handling or working with that material. The Act also requires the training of employees to remediate any hazardous materials accidental releases.

State laws and regulations

The Porter-Cologne Water Quality Control Act of 1969, promulgated within California Water Code, authorizes the state water quality agencies to implement pertinent federal CWA programs (see Division 7 California Water Code Section 13160). In addition, Porter-Cologne also establishes separate, autonomous state water quality planning, permit, and enforcement programs that may affect the Prospect Island Project (Section 3.2.1 *Water Quality – Setting*). Unless otherwise noted, the Proposed Project would comply with the following state laws and regulations.

California Hazardous Waste Control Law

The California Hazardous Waste Control Law (California Health and Safety Code Chapter 6.5 of Division 20) is the basic hazardous waste statute in California and is administered by DTSC. This law is similar to, but generally more stringent than, RCRA, and applies to a broader range of hazardous wastes, and requires recycling and waste reduction programs. Under this law, DTSC is authorized to administer California's hazardous waste program and implement the federal program in California. Title 22, Division 4.5 contains DTSC's hazardous waste regulations would need to be followed if the structure on the south property is demolished and disposed of off-site and during the work activities if there is an unforeseen incident with hazardous material usage during the Proposed Project.

California Department of Conservation, Division of Oil, Gas, and Geothermal Resources Construction-Site Plan Review Program

The Division of Oil, Gas, and Geothermal Resources (DOGGR) regulates drilling, operation, maintenance, and abandonment of oil, gas, and geothermal wells. Plugging and abandonment of oil and gas wells is to be done according to Title 14 CCR, Division 2, Chapter 4, Subchapter 1, Article 3, Sections 1723–1723.8. As part of DOGGR's responsibilities for implementing Section 3208.1 of the PRC, each of the six DOGGR districts have developed the Construction-Site Plan Review Program to assist local agencies in identifying and reviewing the status of oil or gas wells near proposed development. The program is aimed at addressing potentially dangerous issues associated with development near oil or gas wells. DOGGR serves in an advisory role to make relevant information available to local agencies. As the owner of the north property, DWR is obligated to ensure the

integrity of the abandoned gas wells during construction and operation of the Proposed Project.

California Occupational Safety and Health Act

The California Occupational Safety and Health Administration (Cal-OSHA) regulates worker safety similar to federal OSHA but also requires preparation of an Injury and Illness Prevention Program, an employee safety program of inspections, procedures to correct unsafe conditions, employee training, and occupational safety communication. In addition, Cal-OSHA regulations indirectly protect the general public by requiring construction managers to post warnings signs, limit public access to construction areas, and obtain permits for work considered to present significant risk of injury or to worker health, such as excavations greater than 5 ft.

Typically, applicable requirements found in CCR Titles 19 and 22 are included in construction contacts requiring contractors, among other things, to comply with the proper storage and disposal of substances such as fuel and lubricants. Compliance with applicable requirements for this portion of the law would be implemented once engineering designs are finalized.

Public Resources Code Section 3208.1

PRC Section 3208.1 authorizes the State Oil and Gas Supervisor of the DOGGR to order the re-abandonment of a previously abandoned well if construction of any structure over or in the proximity to a well could result in a hazard. Coordination with DOGGR would be initiated once engineering designs are finalized.

Fire hazard severity zones

In accordance with PRC Sections 4201 to 4204 and Government Code sections 51175 to 51189, the California Department of Forestry and Fire Prevention (CAL FIRE) has mapped areas of significant fire hazards based on fuels, terrain, weather, and other relevant factors. The zones are referred to as Fire Hazard Severity Zones and represent the risks associated with wildland fires. Under CAL FIRE regulations, the Proposed Project is not within high fire hazard severity zones (CAL FIRE 2007).

Certified Unified Program agencies

The Unified Program consolidates, coordinates, and makes consistent the administrative requirements, permits, inspections, and enforcement activities of six environmental and emergency response programs. The California Environmental Protection Agency and other state agencies set the standards for

their programs, and local governments implement the standards. These local implementing agencies are called Certified Unified Program Agencies. For each county, the agencies regulate and oversee the following documents and activities:

- Hazardous materials business plans
- California accidental release prevention plans or federal risk management plans
- Operation of Above Ground and Underground Storage Tanks
- Universal waste and hazardous waste generators and handlers
- Uniform Fire Code implementation
- On-site hazardous waste treatment
- Inspections, permitting, and enforcement
- Proposition 65 reporting
- Emergency response

Local ordinances

Unless otherwise noted, the Proposed Project would comply with the following local ordinances.

Solano County General Plan

The Public Health and Safety Element of the Solano County General Plan (Solano County Board of Supervisors 2008), sets forth goals and policies intended to help protect people and property from natural and human-made hazards, promote public health, and preserve air and water quality. Policies that may be applicable to the Proposed Project are as follows.

HS.P-26: Minimize the risks associated with transporting, storing, and using hazardous materials through methods that include careful land use planning and coordination with appropriate federal, state, or county agencies.

3.6.2 Significance criteria

Potential impacts from hazards and hazardous waste would be significant if the Proposed Project would exceed any of the following threshold criteria per Appendix G *Environmental Checklist* of the CEQA Guidelines:

- Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials.

- Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment.
- Emit hazardous emissions or handle hazardous material, substances, or waste within 0.25 mi of an existing or proposed school.
- Be located on a site which is included on a list of hazardous material sites compiled pursuant to Government Code Section 65962.5 and as a result, would create a significant hazard to the public or the environment.
- Be located within an airport land use plan or, where such a plan has not been adopted, within 2 mi of a public airport or public use airport, which would result in a safety hazard for the public residing or working in the Proposed Project area.
- For a project within the vicinity of a private airstrip, result in a safety hazard for people residing or working in the Proposed Project area.
- Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan.
- Expose people or structures to a significant risk of loss, injury or death involving wild fire, including where wildlands are adjacent to urbanized areas or where residence are intermixed with wildlands.
- Create substantial adverse physical impact associated with the provision of new or physically altered government facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable performance objectives (e.g., use of pesticides for vector control).
- Possess environmental effects that would cause substantial adverse effects on human beings, either directly or indirectly.

Fire, emergency services, and access issues are addressed in the Public Services and Traffic sections of this EIR, and are not addressed further in this section.

The Proposed Project has no components that could affect schools or be affected by airstrips; therefore, those issues are not addressed further.

3.6.3 Impacts and mitigation

Impact 3.6-1: Potential effects from abandoned gas wells

Six plugged and abandoned gas wells have been identified at the Proposed Project site (Section 3.6.1 *Hazards and Hazardous Materials – Setting*),

specifically in areas that would be converted to tidal wetlands or berm area. If an abandoned well is disturbed it could become a pathway for contaminants. During grading activities, heavy equipment could strike the surface plug and/or plate of one or more of the wells, potentially damaging the upper portion of the surface plug and allowing natural gas to be released to the land surface, or into groundwater and/or surface waters. Workers at the Proposed Project site could be exposed to hazardous conditions, including potential explosion and fire, associated with the upset of well plugs and the accidental release of natural gas.

Although possible, construction-related damage to the upper portion of a surface plug is not likely to result in the release of natural gas resources or fluids at the surface, gas reserves are typically located thousands of feet below ground (National Petroleum Council 2011). Furthermore, the placement of cement plugs in the well, overlain by mud placed in the borehole, would likely prevent the release of gas in the event that the upper portion of a surface plug was altered or damaged.

It is possible that other non-mapped natural gas wells may be encountered during Proposed Project construction, thereby posing an additional hazard during construction activities. There is also potential overlap between mapped gas well locations and the currently proposed locations of access ramps and excavated drainage ditches (DWR and CDFW 2014).

In summary, construction activities would create a potentially significant hazard to the public and/or the environment through reasonably foreseeable upset and accident conditions involving the release of natural gas from the abandoned wells. Implementation of Mitigation Measure 3.6-1.1 would reduce these potential impacts to *less than significant*.

Mitigation Measure 3.6-1.1
Final construction plans shall be revised to avoid existing conflicts between grading and excavation areas and well locations. Once site dewatering is complete and prior to construction work, a geophysical survey shall be conducted to confirm locations of all known abandoned gas wells (DOGGR 2014), which shall be marked and avoided during construction. Also prior to construction, DWR shall file an application under the DOGGR Well Review Program and the site would be inspected.

Impact significance
Less than significant with mitigation

Impact 3.6-2: Potential effects from contaminant migration via existing groundwater monitoring wells

No existing monitoring wells are located in the placement area for Miner Slough spur channel dredged sediments. However, 20 groundwater monitoring wells are located along the levees surrounding the north property, including locations designated for breaching. DWR's North Central Regional Office is, and plans to continue, using these wells to monitor groundwater conditions. The wells have the potential to be a direct conduit for vertical movement for point and non-point pollution into the groundwater if the wells are impacted during construction. Implementation of Mitigation Measure 3.6-2.1 would reduce this impact to *less than significant*.

Mitigation Measure 3.6-2.1
The Proposed Project design shall incorporate the groundwater monitoring well locations into the grading and access plans and design any construction at those locations to avoid adversely affecting the wells. If any of the existing groundwater wells are located at planned breach sites, they shall be properly destroyed and capped. Wells shall be avoided or properly destroyed and/or replaced as required by Section 13750 through 13755 (Article 2, Chapter 7, Division 7) of the California Water Code.

Impact significance
Less than significant with mitigation

Impact 3.6-3: Potential mobilization of contaminants from levee breaching and/or sediment dredging and re-use

Levee soils from breach areas and dredged sediments would be re-used within Prospect Island to fortify remaining levees and create the inner-island channels (Section 2 *Proposed Project Description*). There is potential for contaminants to remobilize during construction activities and once tidal action is restored to the site, thereby releasing hazardous materials into the environment. The analysis of potential contaminant mobilization during construction activities is addressed in Impact 3.2-2.

Hazardous waste is defined by specific criteria in CCR Title 22, according to numerical soluble threshold limit concentrations and total threshold limit concentrations. Designated waste is defined in the Water Code as (1) hazardous wastes that have been granted a variance from hazardous waste management

requirements; or (2) nonhazardous waste consisting of or containing soluble pollutants that, under ambient conditions at the location of discharge, could be released in concentrations potentially exceeding water quality objectives or that could reasonably be expected to affect beneficial uses of waters of the state. Inert waste is defined in CCR Title 27 as not meeting any of the above categories.

The 2016 DEIR stated that soil testing would be done at the Proposed Project site and provided a mitigation measure that if soil testing identifies materials as designated or hazardous, then these materials must be removed from the Proposed Project site and properly disposed of at a permitted off-site facility. However, in the period following publication of the 2016 DEIR, DWR completed soil testing as described below. Given the conclusion that there were not hazardous materials, the mitigation measure is no longer necessary.

To assess the potential for release of hazardous materials during short-term construction activities and in the long-term, once tidal action is restored to the site (i.e., due to on-site sediment re-use), sediments were characterized at multiple excavated channel sites, within the adjacent Miner Slough spur channel, and at interior berm and intertidal bench re-use sites (Kinnetic Laboratories 2016a, b). Comparison of contaminant concentrations and toxicity results from the Miner Slough spur channel to those of the south property dredge placement and excavated channel re-use sites indicates generally comparable concentrations, and values that are within the range of background concentrations for sediments in the Delta (Kinnetic Laboratories 2016a, b). While some sediment concentrations in the Miner Slough spur channel composite samples exceeded sediment screening values for adverse biological effects to benthic organisms as well as screening values for terrestrial plants and animals, the sediments were not toxic to benthic organisms, and concentrations in sediments sampled from the southern property placement area and the interior Prospect Island channels, for the most part, exceeded the same objectives (Kinnetic Laboratories 2016a, b). Therefore, there is little evidence that the spur channel dredge sediments and levee soils at the breach locations would degrade soils already present on Prospect Island. Further, Standard Elutriate Test (SET) testing of sediment porewaters in the spur channel samples indicated that while Basin Plan water quality objectives could be exceeded directly at the dredge site with no dilution for aluminum (Al), barium (Ba), and manganese (Mn) at all sampling sites, and for zinc (Zn) at one sample site, a small dilution factor (i.e., 6:1) would bring all concentrations in line with water quality objectives. There was

no evidence of toxicity to Fathead Minnows in the spur channel SET samples (Kinnetic Laboratories 2016b).

Based on the recent sediment testing results, sediments at planned dredging/excavation-sites in the Miner Slough spur channel and/or the levee breach locations would not be classified as either hazardous waste or designated waste and on-site beneficial re-use of inert sediments would result in *less than significant* impacts.

Impact significance
Less than significant

Impact 3.6-4: Hazards associated with the Prospect Island houses on the north property

Remnants of the Prospect Island houses (P-48-000417), including two houses, a bunkhouse, and at least three outbuildings (a pump house, wash/bath house, and a collapsed structure) are located on the north property (Section 3.6.1 *Hazards and Hazardous Materials – Setting*). Only the pump house remains today. In their current state, the buildings present a potentially significant physical safety hazard to the public if accessed. In addition, structures built prior to 1981 are presumed to contain asbestos and lead based paints (OSHA [CalOSHA] 29 CFR19261101, CalOSHA 1529), which could pose a potentially significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of these materials into the environment.

Under the Proposed Project, after site de-watering and vegetation removal have occurred, remnants of the Prospect Island houses (P-48-000417) and the associated outbuildings, including the irrigation pump, would be demolished and removed from the site. All materials would be disposed of at an appropriately permitted facility. Therefore, the Proposed Project would be beneficial compared with existing conditions.

Impact significance
Beneficial

Impact 3.6-5: Potential hazards associated with the abandoned house on the south property

An abandoned and dilapidated house (P-48-000956) is located on the south property Section 3.6.1 *Hazards and Hazardous Materials – Setting*). Historically, the building appears to have been on a raised foundation; however, the floor of the structure has since collapsed. Lead and asbestos may be present as part of the building materials. In its current state, the building presents a potentially significant physical safety hazard to the public if accessed. It also poses a potentially significant hazard to the public or the environment through accidental release of lead and asbestos into the environment.

Under the Proposed Project, after site de-watering and vegetation removal have occurred, structure P-48-000956 would be demolished and removed from the site. Any lead and asbestos associated with this structure would be removed and disposed of at an appropriately permitted facility. In addition, the old refrigerator located just to the south of the structure would be removed and disposed of properly. Therefore, the Proposed Project would be beneficial compared with existing conditions.

Impact significance
Beneficial

Impact 3.6-6: Potential soil or water contamination from on-site equipment storage and fueling

Heavy construction equipment (e.g., bulldozers, excavators, wheel loaders) necessary to move soil and conduct vegetation clearing at the Proposed Project site, as well as small accessory equipment (i.e., chainsaws, generators, water pumps) may need to be refueled or maintained on-site. Equipment refueling and maintenance activities could create a potentially significant hazard to the public and/or the environment due to potential fuel spills during routine transport and refueling, or maintenance of construction equipment. Implementation of Mitigation Measure 3.6-6.1 would reduce this impact to *less than significant*.

Mitigation Measure 3.6-6.1
DWR's standard construction contract Section 01570 requires contractors to conduct fueling and lubrication of equipment in a manner that affords maximum protection against spills and evaporation. Consistent with this standard, the contractor for the Project shall be required to prepare an environmental protection plan, which shall include spill control and contaminant prevention

components. The contractor shall be required to have spill kits on-site and to clean up any spill as soon as reasonably possible.

Impact significance
Less than significant with mitigation

Impact 3.6-7: Potential effects on human health due to the short-term use of aquatic-approved herbicides prior to site construction

Herbicides sold in the United States must be registered with the federal government and in most cases also by state regulatory agencies. They are reviewed and regulated by the USEPA Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA 1974; 7 J.S.C. 135 *et seq*., Public Laws 92-516, 94-140, and 95-356) and recent amendments. Prior to herbicide application, the Proposed Project site would be dewatered to maximize herbicide effectiveness (DWR and CDFW 2014). The Proposed Project may use glyphosate, imazapyr, triclopyr, or similar herbicides. The potential application rates and health impacts of each of these are summarized below.

Glyphosate, if used, would be applied at approximately 7.5 pts/ac (Roundup Custom) for aquatic emergent plant species and 3.3 qts/ac (Roundup ProMax) for terrestrial plant species (Section 2 *Proposed Project Description*, Table 2.2-4). Glyphosate is classified by the USEPA as a Group E, evidence of non-carcinogenicity in humans. The USEPA does not consider glyphosate to be a human carcinogen. The median half-life in soil is between 2 and 197 days and typical field half-life is 47 days (Schuette 1998).

Imazapyr, if used, would be applied at 6 pts/ac (Habitat or Polaris) for aquatic emergent plant species. Imazapyr has a half-life of 14 to 44 days in forest litter/soil. There is no data that Imazapyr causes cancer, deoxyribonucleic acid damage, nerve damage, or birth defects. The USEPA classifies imazapyr as a Class E carcinogen (Oregon State University 2002, USEPA 2006).

Triclopyr (Garlon 4 Ultra), if used, would be applied at 8 qts/ac. There is no known data regarding the toxicity or long-term effects of triclopyr on humans. (NPIC 2002). Triclopyr exhibits a half-life of 1.1 to 90 days. Implementation of Mitigation Measure 3.6-7.1 would reduce this impact to *less than significant*.

Mitigation Measure 3.6-7.1
Herbicides shall be applied under the supervision of a certified pesticide applicator. Certified pesticide applicators are trained to ensure that algaecides

and aquatic herbicides are applied at rates consistent with label requirements and in a manner that avoids potential adverse effects including, effects to human health. Prior to herbicide application, DWR or its contractor will obtain all relevant permits required by the federal, state, and local agencies.

Impact significance

Less than significant with mitigation

Impact 3.6-8: Potential effects on human health due to changes in the extent of mosquito breeding habitat

Currently, the Solano County Mosquito Abatement District does not actively manage the Proposed Project site. Table 3.6-1 identifies 10 varieties of mosquitos that are managed by Solano County Mosquito Abatement District and the habitat necessary for them to breed. Mosquitos can carry diseases such as encephalitis and West Nile virus. Impacts to human health from the Proposed Project would depend on mosquito production (i.e., frequency, type, and abundance) and potential for human exposure to mosquitoes, by either dispersal of mosquitoes from source areas or entry of source areas by humans.

Specific wetland habitat features favorable to mosquito production include:

1. Poorly drained, flat to gently sloping sheltered wetland areas with gradually fluctuating water levels, low turbulence, and rich organic matter from decomposition.
2. Areas of dense wetland vegetation with minimal access to fish predators, strong surface currents, or exposure to wind-generated waves.
3. Areas of gradual seasonal fluctuation in water levels, alternating between wetted and desiccated ground.

Conversely, wetland habitat features that are likely to inhibit mosquito production include strong daily tidal fluctuation and currents, exposure to surface turbulence (wind-waves, currents) of open-water surfaces, and exposure to predators (fish, birds, bats).

Overall, the restored Proposed Project site is not expected to be a major source of mosquito production due to increased tidal flushing and circulation, greater water depths, and more favorable fish habitat relative to existing conditions. Areas of the Proposed Project differ in the extent to which they could contribute to potential increases or decreases in mosquito production relative to existing conditions. Open-water areas (tidal perennial aquatic habitat) and shallow

subtidal emergent wetlands (i.e., bed elevations near mean low water [MLW]) are unlikely to produce mosquitoes because they are too deep (i.e., greater than 2 ft). Based on this, the majority of the restored Proposed Project site (i.e., approximately 1,089 ac; see Table 2.2-2) would not be expected to support high mosquito production. Mosquito production may be supported in intertidal emergent wetland habitat under future conditions (i.e., approximately 428 ac; see Table 2.2-2); however, the area of potential suitable habitat is less than half that of existing non-tidal freshwater perennial emergent wetlands (i.e., 1,100 ac; see Table 2.2-2) present under existing conditions. Constructed channels extending from the breach locations into the intertidal emergent wetlands would increase tidal flushing and exposure to fish predation under the Proposed Project, further reducing the potential for high mosquito production at the restored Proposed Project site.

No urban or major residential areas occur in the vicinity of the Proposed Project; however, the residences on Ryer Island located just over 1 mi to the east, would be subject to mosquitoes produced on the Proposed Project site.

Overall, the Proposed Project would likely reduce levels of mosquito production on the Proposed Project site relative to those of existing conditions, because it would replace non-tidal freshwater perennial emergent wetland habitat (with vegetation and hydrologic characteristics that can promote mosquito production) with perennial aquatic habitats and shallow subtidal emergent wetland habitat which, as described above, are far less suitable for mosquito production. Therefore, the effect on mosquito production would be beneficial.

Impact significance

Beneficial

3.7 Air Quality

This section provides an overview of the regulatory framework, existing air quality conditions for the Proposed Project site and surrounding region, an analysis of potential impacts to air quality that would result from implementation of the Proposed Project, and mitigation measures for any potentially significant impacts.

3.7.1 Setting

Background

Air quality is measured by the level of air pollutants in the ambient air, and it is a function of both local climate/weather and local sources of air pollution. Both National Ambient Air Quality Standards (NAAQS) and California Ambient Air Quality Standards (CAAQS) have established the maximum amount of a pollutant that can be present in outdoor air for several common and widespread air pollutants that can harm human health and the environment, and cause property damage. The standards haven been established for the following air pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (i.e., particles less than 10 microns in diameter [PM_{10}], as well as particles less than 2.5 microns in diameter [$PM_{2.5}$]), and lead (Pb). CAAQS also covers Visibility Reducing Particles, Sulfates, Hydrogen Sulfide (H_2S), and Vinyl Chloride. These standards were established to meet specific public health and welfare criteria; therefore, these pollutants are called “criteria” air pollutants. The physical characteristics and health effects of some of the criteria air pollutants are summarized in Table 3.7-1, and the NAAQS and CAAQS are presented in Table 3.7-2.

Table 3.7-1. Physical Characteristics and Health Effects of Criteria Air Pollutants

Criteria Air Pollutant	Physical Characteristics/Health Effects
Ozone (O_3) Reactive Organic Gases (ROG) and Nitrogen Oxides (NO_x)	O_3 is a respiratory irritant and an oxidant that increases susceptibility to respiratory infections. It can also cause substantial damage to vegetation and other materials. It is not emitted directly into the atmosphere, but is a secondary air pollutant produced through a complex series of photochemical reactions involving ROG and NOx. ROG and NO_x are precursor compounds for O_3 production. Concentrations tend to be higher in the late spring, summer, and fall, when the long sunny days combine with regional air subsidence inversions to create conditions conducive to the formation and accumulation of secondary photochemical compounds, such as O_3.
Carbon Monoxide (CO)	CO is a non-reactive pollutant that is a product of incomplete combustion and is mostly associated with motor vehicle traffic. High CO concentrations develop primarily during winter, when periods of light winds combine with the formation of ground level temperature inversions (typically from the evening through early morning). These conditions result in reduced dispersion of vehicle emissions. In high concentrations, it can cause physiological and pathological changes sometimes resulting in death by interfering with oxygen transport in the blood.
Particulate Matter (PM_{10} and $PM_{2.5}$)	PM represents fractions of small particles that can be inhaled, causing adverse health effects. PM in the atmosphere results from many kinds of dust and fumes producing industrial and agricultural operations, fuel combustion, and atmospheric photochemical reactions. Some sources of PM, such as demolition and construction activities, are more local in nature, while others, such as vehicular traffic, have a more regional effect. Very small particles of certain substances (e.g., sulfates and nitrates) can cause lung damage directly or can contain adsorbed gases (e.g., chlorides or ammonium) that may be injurious to health. PM can also damage materials and reduce visibility.
Sulfur Dioxide (SO_2)	SO_2 is a combustion product of sulfur or sulfur-containing fuels, such as coal. SO_2 also is a precursor to the formation of atmospheric sulfate and PM (both PM_{10} and $PM_{2.5}$) and contributes to potential atmospheric sulfuric acid formation that could precipitate downwind as acid rain.
Lead (Pb)	Pb has a range of adverse neurotoxic health effects, and was historically released into the atmosphere primarily via leaded gasoline. The phasing out of leaded gasoline in California has resulted in decreasing levels of atmospheric lead.

Source: Appendix A of YSAQMD (2007).

Table 3.7-2. National and California Ambient Air Quality Standards 2016

Pollutant	Averaging Time	California Standards[1]	National Standards[2]	
		Concentration[3]	Primary[3,5]	Secondary[3,6]
Ozone (O_3)	1 Hour	0.09 ppm (180 ug/m^3)	—	Same as Primary Standard
	8 Hour	0.070 ppm (137 ug/m^3)	0.070 ppm (137 ug/m^3)	
Respirable Particulate Matter (PM_{10})[8]	24 Hour	50 ug/m^3	150 ug/m^3	Same as Primary Standard
	Annual Arithmetic Mean	20 ug/m^3	—	
Fine Particulate Matter ($PM_{2.5}$)[8]	24 Hour	—	35 ug/m^3	Same as Primary Standard
	Annual Arithmetic Mean	12 ug/m^3	12.0 ug/m^3	15 ug/m^3
Carbon Monoxide (CO)	1 Hour	20 ppm (23 mg/m^3)	35 ppm (40 mg/m^3)	—
	8 Hour	9.0 ppm (10 mg/m^3)	9 ppm (10 mg/m^3)	—
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)	—	—
Nitrogen Dioxide (NO_2)[9]	1 Hour	0.18 ppm (339 ug/m^3)	100 ppb (188 ug/m^3)	—
	Annual Arithmetic Mean	0.030 ppm (57 ug/m^3)	0.053 ppm (100 ug/m^3)	Same as Primary Standard
Sulfur Dioxide (SO_2)[10]	1 Hour	0.25 ppm (655 ug/m3)	75 ppb (196 ug/m^3)	—
	3 Hour	—	—	0.5 ppm (1,300 ug/m3)
	24Hour	0.04 ppm (105 ug/m3)	0.14 ppm (for certain areas)[10]	—
	Annual Arithmetic Mean	—	0.030 ppm (for certain areas)[10]	—
Lead (Pb)[11,12]	30 Day Average	1.5 µg/m^3	—	—
	Calendar Quarter	—	1.5 µg/m^3 (for certain areas)[12]	Same as Primary Standard
	Rolling 3 month Average	—	0.15 µg/m^3	

Pollutant	Averaging Time	California Standards[1]	National Standards[2]	
		Concentration[3]	Primary[3,5]	Secondary[3,6]
Visibility Reducing Particles [13]	8 Hour	See footnote 13	No National Standards	
Sulfates	24 Hour	25 µg/m^3		
Hydrogen Sulfide (H_2S)	1 Hour	0.03 ppm (42 µg/m^3)		
Vinyl Chloride [11]	24 Hour	0.01 ppm (26 µg/m^3)		

Source: CARB (2016).

Note: This table is a summary of NAAQS and CAAQS, with the methods and foot notes omitted. The full version can be found at: https://www.arb.ca.gov/research/aaqs/aaqs2.pdf (accessed 19 September 2018).

Additional air pollutants are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects, even at low concentrations. Those pollutants are called Hazardous Air Pollutants (HAPs) in federal regulations and Toxic Air Contaminants (TACs) in California regulations. Sources producing HAPs and TACs include industrial processes and commercial operations (such as emissions from gasoline stations and dry cleaners), as well as motor vehicle exhaust.

Legal and regulatory setting

The U.S. Environmental Protection Agency (USEPA) and the California Air Resources Board (CARB) manage air quality on the national and state levels, respectively. Air quality management on the regional level is based on air basins, and an air basin is a land area with generally similar meteorological and geographic conditions and thus air pollution patterns throughout. California is divided into 15 air basins regulated by 35 local air districts, determined largely by geographical and meteorological features, while taking political boundaries into consideration. Prospect Island is located in the northeastern portion of Solano County within the Sacramento Valley Air Basin (SVAB). The Yolo-Solano Air Quality Management District (YSAQMD) manages air quality in the portion of SVAB, and their management covers all of Yolo County and the northeastern half of Solano County.

USEPA and CARB regulate direct emissions from motor vehicles, and YSAQMD has authority to regulate stationary, indirect and area sources of air pollution

within its jurisdictional area. The air quality laws and regulations pertaining to the Proposed Project are described below.

Federal laws and regulations

Unless otherwise noted, the Proposed Project would comply with the following federal laws and regulations.

Federal Clean Air Act

The Federal Clean Air Act (FCAA) (42 United States Code Section 7401), which was passed in 1970 and last amended in 1990, is a United States federal law designed to control air pollution on the national level. Basic elements of the Act include NAAQS and state attainment plans for criteria air pollutants, HAP standards, motor vehicle emissions standards, stationary source emissions standards and permits, acid rain control measures, stratospheric ozone protection, and enforcement provisions.

NAAQS for criteria air pollutants

As required by FCAA, USEPA established of NAAQS for six criteria air pollutants and also set deadlines for their attainment. As shown in Table 3.7-2, NAAQS includes both primary and secondary standards. Primary standards set limits to protect public health, including the health of sensitive receptors such as asthmatics, children, and the elderly. Land uses (sites) where sensitive receptors are typically located include: schools, playgrounds and childcare centers; long-term health care facilities; rehabilitation centers; convalescent centers; hospitals; retirement homes; and residences (also see Section 3.7.1 *[Air Quality, Setting, Physical Setting] Sensitive Receptors* below). Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The USEPA classifies air basins (or portions thereof) as “attainment” or “nonattainment” for each criteria air pollutants, based on whether or not the NAAQS had been achieved. The FCAA required each state to prepare an air quality control plan referred to as the State Implementation Plan (SIP). The FCAA 1990 Amendments added requirements for states with nonattainment areas to revise their SIPs in order to incorporate additional control measures to reduce air pollution. The USEPA has responsibility to review all state SIPs to determine if they conform to the mandates of the FCAAA and will achieve air quality goals when implemented.

Hazardous air pollutants

Section 112(b) of the FCAA listed over 180 Hazardous Air Pollutants (HAPs) that need to be controlled, and the HAP list has gone through several revisions and updates. Most HAPs originate from human-made sources, including mobile sources (e.g., cars, trucks, buses) and stationary sources (e.g., factories, refineries, power plants), as well as indoor sources (e.g., building materials and activities such as cleaning). USEPA, working with state and local governments, has reduced the release of HAPs from stationary sources by issuing rules covering over 80 categories of industrial and commercial sources including chemical plants, oil refineries, dry cleaners, and chromium electroplating facilities. Reduction of HAPs from motor vehicle exhaust has been achieved by requiring the use of cleaner fuel, such as reformulated gasoline, and placing limits on tailpipe emissions.

State laws and regulations

California Clean Air Act (CAAQS for Criteria Air Pollutants)

The California Clean Air Act (CCAA), HSC Sections 42302.1, 42311, and 42352 (1988, as amended), was adopted in 1988 to establish a statewide air pollution control program. As required by CCAA, CARB has established more stringent standards for the six criteria pollutants that are covered by NAAQS, and has set standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility reducing particles pollutants.

The CARB also identifies and classifies each air basin in the state on a pollutant-by-pollutant basis, and has designated areas in California as nonattainment based on violations of the CAAQS. CCAA requires all air districts in California to meet the CAAQS by the earliest practical date. Each nonattainment district is required to adopt a plan to achieve a 5% annual reduction, averaged over consecutive 3-year periods, in district-wide emissions of each nonattainment pollutant or its precursors. A Clean Air Plan (CAP) shows how a district would reduce emissions to achieve air quality standards.

California Toxic Air Contaminants Regulations

California state law defines TACs as air pollutants that may cause or contribute to increases in serious illness or death, or that may pose a present or potential hazard to human health. In accordance with AB 2728, all federal HAPs are TACs under California law. A total of 243 substances have been designated as TACs under California law. Diesel particulate Matter (DPM), a common air pollutant generated by diesel-powered equipment from construction projects, is one of the TACs under California law.

California regulates TACs primarily through the Toxic Air Contaminant Identification and Control Act (Part 2, Chapter 3.5, CCAA, 1998; also known as AB 1807) and the Air Toxics "Hot Spots" Information and Assessment Act (Part 6, CCAA, 1998; also known as AB 2588). AB 1807 created California's program to reduce exposure to air toxics. AB 2588 supplements the AB 1807 program, by requiring a statewide air toxics inventory, notification of people exposed to a significant health risk, and facility plans to reduce these risks.

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, the following have been considered in the analysis of potential impacts and identification of mitigation measures, as needed.

Unless otherwise noted, the Proposed Project would comply with the following local ordinances and policies.

Sacramento Regional Ozone Attainment Plan

The SVAB is designated by USEPA as severe nonattainment for 8-hour ozone NAAQS (both 1997 and 2008 standards). The area of nonattainment is referred to as the Sacramento Federal Non-Attainment Area for ozone, and it spans the jurisdictional areas of five air districts, including the YSAQMD, the El Dorado Air Pollution Control District (APCD), the Feather River AQMD, the Placer County APCD, and the Sacramento Metropolitan AQMD. These air districts jointly prepared and adopted the “Sacramento Regional 8-Hour Ozone Attainment and Reasonable Further Progress Plan” (Regional Ozone Plan) in 2009 and revised the plan in 2011 and 2013. This plan is the SIP for the region as required by the FCAA. The Regional Ozone Plan shows that the region is meeting requirements of the FCAA for the 1997 8-hour ozone standard, including meeting minimum emission reduction progress and reaching air quality standard not later than 2018. The plan updates the emissions inventory, provides a review of photochemical modeling results based on changes in the emissions inventories, updates the reasonable further progress and attainment demonstrations, revises adoption dates for control measures, and establishes new motor vehicle emissions budgets for transportation conformity purposes.

Yolo Solano Air Quality Management District Air Quality Management Plan

YSAQMD manages air quality in its jurisdictional area by monitoring air quality, designing programs to attain and maintain state and federal ambient air quality standards, developing and enforcing air quality rules that regulate point source,

area source, and certain mobile source emissions, and establishing permitting requirements for stationary sources.

The YSAQMD adopted its first air quality attainment plan (AQAP) in 1992 and has been updating the AQAP every three years. The most recent, namely the seventh, update to the YSAQMD's AQAP is the 2015 Triennial Assessment and Plan Update (YSAQMD 2016a) and it includes

- Information about emission reductions achieved during the 2009–2011 periods;
- District emission inventory and emission forecasts;
- Air quality data and analysis of air quality trends; and
- Proposed commitments for future periods.

According to the AQAP, the YSAQMD has conducted an "all feasible measure" analysis for ozone control measures as part of the federal planning process, and based on the results of the analysis, YSAQMD committed to adopting several measures to reduce ozone emissions. For the 2012–2016 period, YSAQMD scheduled to adopt amendments to several district rules to achieve additional reductions in the emissions of ozone precursors.

While the YSAQMD is not required to prepare an attainment plan for PM_{10} and $PM_{2.5}$, the YSAQMD continues to work to reduce particulate emissions through rules affecting stationary sources, the construction industry, and the agricultural burning program.

Relevant YSAQMD rules include the following:

- Rule 2.3: Ringelmann Chart. Visible emissions from stationary diesel-powered equipment are not allowed to exceed 40% opacity for more than three minutes in any one hour.
- Rule 2.5: Nuisance. Dust emissions must be prevented from creating a nuisance to surrounding properties.
- Rule 2.11: Particulate Matter. To limit release or discharge into the atmosphere, from any source, particulate matter in excess of 0.3 grains per cubic foot of exhaust volume as calculated at standard atmospheric conditions.

Solano County General Plan (relevant air quality policies and programs)
The Solano County General Plan (Solano County Board of Supervisors 2008) contains various policies and actions that deal with air quality. Table 3.7-3 identifies the policies and programs that Solano County intends to carry out.

Table 3.7-3. Solano County General Plan Policies Related to Air Quality

Policies and Programs	Description
Policy HS.P-43	Support land use, transportation management, infrastructure and environmental planning programs that reduce vehicle emissions and improve air quality.
Policy HS.P-44	Minimize health impacts from sources of toxic air contaminants, both stationary (e.g., refineries, manufacturing plants) as well as mobile sources (e.g., freeways, rail yards, commercial trucking operations).
Program HS.I-54	Require that when development proposals introduce new significant sources of toxic air pollutants, they prepare a health risk assessment as required under the Air Toxics "Hot Spots" Act (AB 2588, 1987) and, based on the results of the assessment, establish appropriate land use buffer zones around those areas posing substantial health risks.
Program HS.I-59	Require the implementation of best management practices to reduce air pollutant emissions associated with the construction of all development and infrastructure projects.
Program HS.I-61	Comply with the CARB and Bay Area or YSAQMD rules, regulations, and recommendations for Solano County facilities and operations. Such operations shall comply with mandated measures to reduce emissions from fuel consumption, energy consumption, surface coating operations, and solvent usage.
Program HS.I-62	Encourage coordination between the Bay Area and YSAQMDs for consistency in air quality planning efforts.
Program HS.I-63	Use the guidelines presented in the CARB's Air Quality and Land Use Handbook: A Community Health Perspective, or the applicable AQMD guidelines and recommendations available at the time, when establishing buffers around sources of toxic air contaminants or odorous emissions.
Program HS.I-64	Assess air quality impacts using the latest version of the CEQA Guidelines and guidelines prepared by the applicable AQMD.

Physical setting

Topography, meteorology, and climate

The SVAB is bounded by the North Coast Ranges on the west and Northern Sierra Nevada Mountains on the east. The intervening terrain is relatively flat.

Hot dry summers and mild rainy winters characterize the Mediterranean climate of the SVAB. During the year the temperature may range from 20 to 115°F, with summer highs usually in the 90s, and winter lows occasionally below freezing. Average annual rainfall is approximately 20 in, and the rainy season generally

occurs from November through March. The prevailing winds are moderate in strength and vary from moist clean breezes from the south to dry land flows from the north.

The mountains surrounding the SVAB create a barrier to airflow, which can trap air pollutants under certain meteorological conditions. The highest frequency of air stagnation occurs in the autumn and early winter when large high-pressure cells collect over the Sacramento Valley. The lack of surface wind during these periods and the reduced vertical flow caused by less surface heating reduces the influx of outside air and allows air pollutants to become concentrated in a stable volume of air. The surface concentrations of pollutants are highest when these conditions are combined with temperature inversions that trap pollutants near the ground.

The ozone season (May through October) in the Sacramento Valley is characterized by stagnant morning air or light winds with the delta sea breeze arriving in the afternoon out of the southwest. Usually the evening breeze transports the airborne pollutants to the north out of the Sacramento Valley. During about half of the days from July to September, however, a phenomenon called the Schultz Eddy prevents this from occurring. Instead of allowing for the prevailing wind patterns to move north carrying the pollutants out, the Schultz Eddy causes the wind pattern to circle back to the south. Essentially, this phenomenon causes the air pollutants to be blown south toward YSAQMD, exacerbating pollution levels in the area and increasing the likelihood of federal or state standards violations. The Shultz Eddy normally dissipates around noon when the delta sea breeze arrives.

Existing air quality conditions and attainment status

CARB and YSAQMD monitor air quality at several locations within their jurisdiction. The monitored pollutants include ozone, CO, PM_{10}, $PM_{2.5}$, and NO_2. Table 3.7-4 summarizes the recent air monitoring data (2011 through 2017) published by CARB for the stations within YSAQMD. The data show a moderate number of violations related to state and federal ozone standards, state and federal PM_{10} standards, and the federal $PM_{2.5}$ standard. The criteria pollutants of most concern in YSAQMD are ozone and particulate matter (PM).

Based on collected monitoring data, the state and federal governments designate the YSAQMD as the following attainment status for the various criteria air pollutants (Table 3.7-5).

Table 3.7-4. Annual Air Quality Monitoring Data 2011–2017

Pollutant	Standard	Site	Number of Days Standards Exceeded						
			2011	2012	2013	2014	2015	2016	2017
$PM_{2.5}$	National 24-Hour Standard	Solano County: Vallejo-304 Tuolumne Street	6.0	1.0	6.0	1.1	3.0	0	9.3
		Yolo County: Woodland-Gibson Road	*	0	0	0	0	0	12.3
PM_{10}	National 24-Hour Standard	Solano County: Vacaville-Merchant Street	0	0	0	0	0	0	6.1
		Yolo County: West Sacramento-15th Street	0	0	0	0	0	0	0
		Yolo County: Woodland-Gibson Road	0	0	0	0	0	0	0
	State 24-Hour Standard	Solano County: Vacaville-Merchant Street	0	0	*	0	*	*	12.7
		Yolo County: West Sacramento-15th Street	12.2	6.5	23.0	0	6.1	0	*
		Yolo County: Woodland-Gibson Road	6.1	6.1	23.3	0	12.2	12.2	18.4

Pollutant	Standard	Site	Number of Days Standards Exceeded						
			2011	2012	2013	2014	2015	2016	2017
Ozone (O_3)	State 1-Hour Standard	Solano County: Fairfield-Chadbourne Road	0	0	0	0	0	0	0
		Solano County: Vacaville-Ulatis Drive	0	0	0	0	0	0	0
		Solano County: Vallejo-304 Tuolumne Street	0	0	0	0	0	1.0	1.0
		Yolo County: Davis-UCD Campus	0	0	0	0	0	0	0
		Yolo County: Woodland-Gibson Road	0	1.0	0	0	0	1.0	0
	State 8-Hour Standard	Solano County: Fairfield-Chadbourne Road	3.0	2.0	1.0	0	1.0	0	0
		Solano County: Vacaville-Ulatis Drive	3.0	3.0	2.0	1.0	1.0	1.0	2.0
		Solano County: Vallejo-304 Tuolumne Street	0	0	0	0	1.0	1.0	2.0
		Yolo County: Davis-UCD Campus	2.0	4.0	0	0	1.0	1.0	1.0
		Yolo County: Woodland-Gibson Road	2.0	9.0	0	1.0	4.0	4.0	2.0
	National 8-Hour Standard	Solano County: Fairfield-Chadbourne Road	1.0	1.0	0	0	1.0	0	0
		Solano County: Vacaville-Ulatis Drive	0	1.0	0	1.0	0	1.0	2.0
		Solano County: Vallejo-304 Tuolumne Street	0	0	0	0	0	1.0	2.0
		Yolo County: Davis-UCD Campus	1.0	1.0	0	0	1.0	1.0	1.0
		Yolo County: Woodland-Gibson Road	0	2.0	0	1.0	3.0	4.0	2.0

Source: CARB (2015) http://www.arb.ca.gov/adam/ (accessed 19 September 2018).

* Insufficient data available.

Table 3.7-5. Federal and State Attainment Status for the YSAQMD 2016b

Criteria Pollutant	Averaging Time	State Standards	National Standards
Ozone (O_3)	1 Hour	Non-attainment	N/A
	8 Hour	Non-attainment	Non-attainment
Carbon Monoxide (CO)	1 Hour	Attainment	Unclassified/Attainment
	8 Hour	Attainment	Unclassified/Attainment
Nitrogen Dioxide (NO_2)	1 Hour	Attainment	N/A
	Annual	N/A	Attainment
Sulfur Dioxide (SO_2)	1 Hour	Attainment	N/A
	24 Hour	Attainment	Attainment
	Annual	N/A	Attainment
Coarse Particulate Matter (PM_{10})	24 Hour	Non-attainment	Unclassified
	Annual average	Non-attainment	N/A
Fine Particulate Matter ($PM_{2.5}$)	24 Hour	N/A	Partial non-attainment
	Annual average	N/A	Attainment
Sulfates	24 Hour	Attainment	N/A
Lead (Pb)	30 Day Average	Attainment	N/A
	Calendar Quarter	N/A	Attainment
Hydrogen Sulfide (H_2S)	1 Hour	Attainment	N/A
Vinyl Chloride	24 Hour	Attainment	N/A
Visibility Reducing Particles	8 Hour	Attainment	N/A

Current attainment statuses can be found at: https://www.ysaqmd.org/plans-data/attainment/ and https://www.arb.ca.gov/desig/changes.htm#summaries.

Sensitive Receptors

Definitions of sensitive receptors variously include or exclude residences:

"Sensitive receptors include, but are not limited to, hospitals, schools, daycare facilities, elderly housing and convalescent facilities. These are areas where the occupants are more susceptible to the adverse effects of exposure to toxic chemicals, pesticides, and other pollutants. Extra care must be taken when dealing with contaminants and pollutants in close proximity to areas recognized as sensitive receptors." [USEPA 2017]

"Sensitive receptors are children, elderly, asmatics and others whose are at a heightened risk of negative health outcomes due to exposure to air pollution. The locations where these sensitive receptors congregate are considered sensitive receptor locations. Sensitive Receptor locations may include hospitals, schools, and day care centers, and such other locations as the air district board or

California Air Resources Board may determine (California Health and Safety Code § 42705.5(a)(5)).” [CARB 2019]

“For CEQA purposes, a sensitive receptor is generically defined as a location where human populations, especially children, seniors, or sick persons are found, and there is reasonable expectation of continuous human exposure according to the averaging period for the AAQS (e.g., 24-hour, 8-hour, 1-hour). Examples of sensitive receptors include residences, hospitals, and schools. Locations of sensitive receptors may or may not correspond with the location of a source’s maximum off-site concentration.” [YSAQMD 2007]

This analysis takes a conservative approach by considering any residence to be a potential sensitive receptor. The nearest residences are live-aboard residences at Arrowhead Harbor Marina, who reside 175 ft from the Proposed Project site, behind Prospect Island’s northeast levee. The next closest residences are on Ryer Island, approximately 500 ft to the east of the site.

Existing conditions in the site vicinity

Prospect Island is a 1,600 ac property located in Solano County, in the northwestern part of the Sacramento-San Joaquin River Delta (Delta). Prospect Island lies between the Sacramento Deep Water Ship Channel (DWSC) on the west and Miner Slough on the east. The Proposed Project would restore Prospect Island to freshwater tidal wetland and open-water (sub-tidal) habitats to benefit native fish and improve aquatic ecosystem functions. Land use at the Proposed Project site and the surrounding properties are primarily open-water and agriculture. Most of the construction activities would occur in a construction zone of approximately 200 ac within the Proposed Project site.

There are no existing stationary sources of air pollutants in the vicinity of the Proposed Project site. Very few sensitive receptors that may be impacted by air pollutant emissions from construction of the Proposed Project have been identified. The most proximal residences are those on Ryer Island, which are located over one mi to the east of the Proposed Project site. No schools, hospitals, or other facilities with a large number of sensitive receptors are present in the immediate vicinity.

3.7.2 Significance criteria

Appendix G *Environmental Checklist* of the CEQA Guidelines, published by the state Office of Planning and Research (OPR), contains a list of effects that may be considered potentially significant:

- Conflict with or obstruct implementation of the applicable air quality plan;
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation;
- Result in a cumulatively considerable net increase of any criteria pollutant for which the Proposed Project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors);
- Expose sensitive receptors to substantial pollutant concentrations; and,
- Create objectionable odors affecting a substantial number of people.

Based on the above, the YSAQMD has developed CEQA significance thresholds for Proposed Project construction and operation to assist lead agencies in determining significant air quality impacts for their projects (see Table 3.7-6). The YSAQMD has published a Handbook that is intended to provide local governments with guidance for analyzing and mitigating project-specific air quality impacts (YSAQMD 2007). Because of the YSAQMD's regulatory role in the vicinity of the Proposed Project, the CEQA significance thresholds, as well as the standards, methodologies and analysis procedures provided in the Handbook are used for the Prospect Island analysis. Cumulative impacts are discussed in Section 3.19.3 *Cumulative Impacts – Summary of cumulative impacts*.

Table 3.7-6. YSAQMD Thresholds of Significance

ID	Threshold	A project would be considered to have a significant air quality impact, if:
1	Criteria Pollutants	It generates criteria pollutants in excess of any of the following thresholds: 80 pounds per day of PM_{10} 10 tons per year of ROG or NOx. Violation of a state ambient air quality standard for CO
2	Plan Consistency	It is inconsistent with any applicable general plans and regional plans such as air quality attainment or maintenance plan or State Implementation Plan [SIP].
3	TACs	It exposes the public to TACs from stationary sources in excess of any of the following thresholds: Probability of contracting cancer for the Maximally Exposed Individual (MEI) equals to 10 in one million or more. Ground-level concentrations of non-carcinogenic toxic air contaminants would result in a Hazard Index equal to one for the MEI or greater.
4	Offensive Odors	It generates odorous emissions in such quantities that: could cause detriment, nuisance, or annoyance to any considerable; number of persons or to the public; may endanger the comfort, repose, health, or safety of any such person or the public; or may cause, or have a natural tendency to cause, injury or damage to business or property.

3.7.3 Impacts and mitigation

Impact 3.7-1: Generation of criteria pollutant emissions that could contribute to air quality violations

Air quality impacts can be divided into those related to the construction of the Proposed Project, which is short-term and temporary nature, and long-term impacts associated with operation of the Proposed Project. Each of these is discussed below.

The construction of the Proposed Project would last approximately 2–3 years (Table 2.2-6). Initial site preparation following dewatering would require aquatic invasive species control in an area of 411 ac using aerial spraying of herbicide by helicopter. As described in Section 2.2.3, the construction period would also involve clearing and grubbing, repair of the Miner Slough levee, and excavation, generating vehicle trips described in Section 3.17.3.

During the construction period, diesel-powered off-road heavy construction vehicles, such as excavators, dozers, loaders, graders, and scrapers would be used for activities such as clearing and grubbing, clearing channels and ditches, excavation and transportation of soil, compacting and grading. Some other types of equipment, such as the pumps for dewatering of the properties, dredgers and the tugs/barges performing in-water work, and aircraft for spraying herbicide, would also be powered by diesel engines. Construction of the Proposed Project would also involve the use of on-road vehicles, such as trucks for material delivery, passenger cars, and trucks for worker commuting; these vehicles would use either diesel or gas as fuel. Diesel-powered or gas-powered off-road construction vehicles as well as on-road vehicles and other equipment would be substantial sources of pollutants.

Construction of the Proposed Project would generate the following pollutants of concern:

- *Nitrogen oxides (NO_x) and reactive organic gases (ROG)* – these pollutants are precursors of ozone and are of regional concern. YSAQMD established 10 ton-per-year YSAQMD thresholds for both NO_x and ROG for attainment and maintenance of the NAAQS and CAAQS in the region.
- *PM_{10} and $PM_{2.5}$* – Emissions of PM have the potential to result in a localized health impact. YSAQMD established an 80 pound-per-day threshold for PM_{10} emissions to minimize local health impacts. PM emissions arise from two major sources: exhaust PM emissions from off-road construction equipment and on-road vehicles, and fugitive dust from the construction-site. PM emissions would be generated from fuel combustion from diesel and gasoline-powered equipment, portable auxiliary equipment, and worker commute vehicles. Fugitive dust, which is often the largest source of PM_{10} emissions, would be generated from loading and unloading of materials, soil disturbance (e.g., soil cut and fill, on-site grading), wind erosion from stockpiles and re-entrainment of settled dust by vehicle and equipment movement. Soil disturbance activities during the construction of the Proposed Project include (1) site preparation activities, such as disking of approximately 411 ac; clearing and grubbing of approximately 156 ac; construction of the staging areas on approximately 32 ac; and construction of access roads and ramps on 17 ac; and (2) construction activities in an area of approximately 200 ac, including excavation of the interior constructed channel network on 63 ac; placement and compaction of dredged material on 12 ac; and filling of agricultural and borrow ditches, construction of interior mounds, construction of the eastern toe berm,

construction of the intertidal bench, and construction of the levee breaches, totaling approximately 115 ac.

- *CO* – Similar to ROG and NOx emissions, CO is mostly generated by off-road construction equipment and on-road vehicles for material delivery and work commute trips. Similar to PM, CO can also result in a localized health impact.

Potential impacts resulting from CO_2 generation under the Proposed Project are addressed in Section 3.8 *Greenhouse Gases*.

The emissions inventory for the above-mentioned criteria pollutants (NO_x, ROG, PM_{10}, $PM_{2.5}$, CO) generated during the approximately 2.5 year construction period is presented in **Appendix G**. Emissions have been estimated based upon information regarding the seasonal timing of each construction task, anticipated operational hours for each type of construction equipment, quantities of imported construction materials, material delivery methods, and worker commute trips. Two options were analyzed based on the delivery methods for importing rip-rap, fill and aggregate base materials: Option A assumed trucks for all import materials, while Option B assumed barging for all import materials. **Appendix G** also describes the emissions methodology, assumptions, and input data. Results from Option A and the corresponding YSAQMD thresholds are summarized in Table 3.7-7. Any variations of the actual equipment used onsite, including additional truck trips, compared with the model outputs in **Appendix G**, would be accounted for by the data collection, calculations, and reporting required by Mitigation Measure 3.7-1.3.

Table 3.7-7. Estimated Construction Emissions for Material Delivery Using Barges or Trucks and Corresponding YSAQMD Significance Thresholds

Pollutants	ROG	CO	NOx	PM_{10}	$PM_{2.5}$	CO_2
Option A: Material Delivery using Trucks						
Year 1 Emissions (tons)	0.8	4.3	8.1	1.9	0.6	1,337
Year 2 Emissions (tons)	2.1	15.0	**20.9**	2.2	1.0	3,534
Year 3 Emissions (tons)	0.5	3.4	4.6	0.5	0.2	917.2
Maximum Annual Emissions (tons)	2.1	15.0	**20.9**	2.2	1.0	3,534
Total Proposed Project Emissions (tons)	3.3	22.7	33.6	4.6	1.9	5,788
YSAQMD Significance Threshold (tons)	10		10			
Significance Determination	No		**Yes**			

Pollutants	ROG	CO	NOx	PM_{10}	$PM_{2.5}$	CO_2
Maximum Daily Emissions (pounds/day)	76.5	229.2	429.6	74.4	24.3	90,187
YSAQMD Significance Threshold (pounds/day)				80		
Significance Determination				No		
Option B: Material Delivery using Barges						
Year 1 Emissions (tons)	1.2	6.5	**13.2**	2.1	0.8	1,889
Year 2 Emissions (tons)	2.1	15.0	**20.9**	2.2	1.0	3,534
Year 3Emissions (tons)	0.5	3.6	5.0	0.5	0.2	963
Maximum Annual Emissions (tons)	2.1	15.0	**20.9**	2.2	1.0	3,534
Total Proposed Project Emissions (tons)	3.8	25.0	39.1	4.7	2.1	6,385
YSAQMD Significance Threshold (tons)	10		10			
Significance Determination	No		**Yes**			
Maximum Daily Emissions (pounds/day)	86.8	285.7	517.9	78.1	29.3	83,372
YSAQMD Significance Threshold (pounds/day)				80		
Significance Determination				No		

NO_x and ROG

Nitrogen oxides and reactive organic gases are precursors of ozone and are of regional concern. YSAQMD established 10 ton-per-year YSAQMD thresholds for both NO_x and ROG for attainment and maintenance of the national and state AAQS in the region. For NO_x and ROG, the proposed habitat restoration is modeled to generate 20.9 tons of NO_x in Year 2 for both the barging and trucking options, which would be more than the YSAQMD threshold (Table 3.7-7). The Year 1 emissions using the barge option are also modeled to exceed 10 tons. This would be a potentially significant impact. Mitigation Measures 3.7-1.1 and 3.7-1.3 are necessary to reduce this impact to *less than significant*. Mitigation Measure 3.7-1.3 has been prepared in consultation with the YSAQMD.

Particulate Matter (PM_{10})

Under the Proposed Project, maximum daily PM_{10} emissions would be 78.1 lbs per day, which is lower than the YSAQMD threshold. PM_{10} emissions are estimated using the same methodology as that of the Roadway Construction Model, which is a simplified approach involving estimates of the maximum area (acreage) of land disturbed on a daily basis. Detailed fugitive dust emission estimates associated with materials-handling operations and/or activity/vehicle types cannot be conducted with the current version of the Roadway Construction Model. Instead, the model uses 10 lbs per day per acre for PM_{10} emissions, an

emission factor accepted by CARB for projects including watering. However, 10 lbs per day per acre is likely to be an overestimate of PM_{10} emissions from the Proposed Project for the following reasons:

- Although maintenance dewatering would be undertaken throughout the construction period, soils at the Proposed Project site would remain relatively moist and some of the construction activities would be carried out in near-saturated soils with no fugitive dust.
- Wherever fugitive dust does arise (e.g., haul roads or other areas of soil disturbance), water trucks would be used.

While the Proposed Project site is located in an agricultural/open space setting, residences do exist within the Proposed Project vicinity. The Hall property on an abandoned island and is not currently occupied, and the Stringer property has been purchased by the California Department of Water Resources (DWR) and is no longer occupied. Therefore, the closest residences are those located at the Arrowhead Harbor Marina (Arrowhead Harbor Marina 2009), which is located along Holland Road. These "live aboard" residences occupy vessels full time at the marina, and are located approximately 175 ft north of the northern edge of the Proposed Project area. A number of residences are located approximately 500 to 1,500 ft east, southeast, and south of the Proposed Project site, across Miner Slough on Ryer Island. The nearest sensitive receptors other than residences (e.g., schools and placed of worship) are located approximately 5 mi southwest within the City of Rio Vista. As few sensitive receptors are present in the immediate vicinity of the Proposed Project site, and concentrations of PM_{10} generated by construction activities would not exceed established thresholds, sensitive receptors would not be exposed to high concentrations as a result of the Proposed Project. Overall, the impacts associated with PM_{10} would be *less than significant*.

However, due to the non-attainment status of the SVAB with respect to PM_{10}, YSAQMD recommends that projects implement feasible best management practices (BMPs) to control fugitive dust regardless of its significance determination, in order to achieve and maintain federal and state air quality standards. Implementation of Mitigation Measures 3.7-1.1 and 3.7-1.2 would reduce the impacts of fugitive dust (PM_{10}) resulting from the Proposed Project.

Carbon Monoxide (CO)

YSAQMD does not provide a quantitative annual or daily emission threshold for CO. Therefore, the Proposed Project would have a significant impact if CO emissions would violate the State and Federal AAQS for CO (Table 3.2-7). Although the Proposed Project site is approximately 1,600 ac, construction activities would occur within a construction zone of approximately 200 ac. It would be unlikely that CO "hot spots" would be formed within the broader 1,600 ac Proposed Project site, where localized CO concentrations exceed the State and Federal CO AAQS. The Proposed Project would not degrade the level of service at intersections where CO "hot spots" could be formed. Therefore, the impacts associated with CO during construction activities would be *less than significant*.

Overall, construction impacts associated with criteria air pollutant emissions (including ROG, PM and CO) under the Proposed Project would be *less than significant*, and the impacts associated with NO_x would be *less than significant with mitigation*.

Lastly, with respect to long-term operational air quality impacts, post-construction-site maintenance, monitoring, and adaptive management activities would generate a low level of criteria air pollutant emissions. Such activities would generate a small number of trips in personal cars and trucks, and possible minor construction vehicle operations for repairs and maintenance. However, the low level of vehicular traffic would result in criteria air pollutant emissions far below the significance thresholds, rendering the operational impacts *less than significant*.

Mitigation Measure 3.7-1.1

The Proposed Project contractors shall implement the techniques listed in Table 3.7-8, below, to reduce impacts of ozone precursors such as NO_x and ROG, and PM_{10} and $PM_{2.5}$ emissions.

Table 3.7-8. Techniques for Reducing Construction Equipment Exhaust

	Technique
1	Minimize idling time either by shutting equipment off when not in use or reducing the time of idling to five minutes [required by California Code of Regulations, Title 13, sections 2449(d)(3) and 2485]. Provide clear signage that posts this requirement for workers at the entrances to the site.
2	Maintain all construction equipment in proper working condition according to manufacturer's specifications. The equipment must be checked by a certified mechanic and determined to be running in proper condition before it is operated.

Mitigation Measure 3.7-1.2

Section 6.1 of the Yolo Solano Air Quality Management District (YSAQMD) CEQA Handbook (YSAQMD 2007) presents a list of feasible measures to control fugitive dust from construction-sites. Common techniques for controlling dust (PM_{10}) focus on minimizing dispersal of earth materials during excavation, transport, and disposal activities. Watering and covering (e.g., tarps, surfactants, and vegetation) are frequently relied on to minimize dust at construction-sites. The Proposed Project contractors shall implement the following techniques for controlling dust (Table 3.7-9). The implementation details of these techniques shall be adjusted based on field conditions.

Table 3.7-9. Techniques for Reducing Fugitive Dust

Technique	Source Category	Effective
Water all active construction-sites (including soil piles, graded areas, unpaved parking areas, staging areas, and access roads) to reduce fugitive dust. Frequency should be based on the type of operation, soil condition, and wind exposure.	Fugitive emissions from active, unpaved construction areas	50%
Haul trucks shall maintain at least 2 ft of freeboard.	Spills from haul trucks	90%
Any haul trucks hauling dirt, sand, or loose materials that would be traveling along freeways or major roadways should be covered.	Spills from haul trucks	90%
Limit vehicle speeds on unpaved roads to 15 mi per hour (MPH).	Unpaved roads	
Apply chemical soil stabilizers on inactive construction areas (disturbed lands within construction projects that are unused for at least four consecutive days).	Wind erosion from storage piles	Up to 80%
Plant vegetative ground cover in disturbed areas as soon as possible.	Wind erosion from storage piles	5–99% (based on planting plan)
Cover inactive storage piles.	Wind erosion from storage piles	Up to 90%
Sweep streets if visible soil material is carried out from the construction-site.	On-road entrained PM_{10}	14%
Treat accesses to a distance of 100 ft from the paved road with a 6 to 12 in layer of wood chips or mulch.	Mud/dirt carryout on-road entrained PM_{10}	27–33%
Treat accesses to a distance of 100 ft from the paved road with a 6 in layer of gravel.	Mud/dirt carryout on-road entrained PM_{10}	42–52%

Note: The effectiveness of two or more mitigation measures that address the same source of emissions would not be the sum of both measures.

Mitigation Measure 3.7-1.3
DWR and/or its contractor shall monitor construction activities throughout the construction period and pay an off-site mitigation fee. Construction activities data will be collected, emissions associated with construction activities will be calculated, and these data will be reported to the Yolo Solano Air Quality Management District (YSAQMD). The specific details of construction monitoring and reporting will be determined in consultation with the YSAQMD. Construction activities data will include, but are not limited to the following items:

- Barges – distance traveled by loaded and unloaded vessels, horsepower, idling time, fuel use and fuel type.
- Construction equipment – type and number, horsepower, hours of operation.
- Haul trucks (heavy-duty trucks) – number of trips, and total trip distance.
- Construction workers—number of construction workers per day.

YSAQMD shall collect the construction activity and emissions reports for record keeping and monitoring purposes. The total offset mitigation fee will be calculated based on actual construction activities. DWR will work in coordination with YSAQMD to assess the specific mechanisms associated with construction monitoring, emission calculations, and payment logistics.

Impact significance
Less than significant with mitigation

Impact 3.7-2: Conflict with or obstruct applicable general plans or regional air quality plans

YSAQMD is designated as a non-attainment district for ozone. In response, YSAQMD and four other air districts in the SVAB jointly prepared and adopted the Regional Ozone Plan. YSAQMD's ten tons-per-year thresholds for the ozone precursors (ROG and NOx) are consistent with this Regional Ozone Plan. As discussed in Impact 3.7-1, the maximum annual NOx emissions would be more than the YSAQMD threshold. Implementation of Mitigation Measures 3.7-1.1 and 3.7-1.3 would reduce and offset construction-related emissions of ozone precursors. This would bring the net emissions into compliance with the Regional Ozone Plan. As a result, there would be no conflict with the Regional Ozone Plan, and the effect of ozone precursor emissions would be *less than significant*.

As PM_{10} and CO thresholds are designed to minimize local impacts, projected PM_{10} and CO emissions would not be in conflict with any regional plans, regardless of the exceedance of these thresholds.

A project is deemed inconsistent with air quality plans if it would result in substantial population and/or employment opportunities that exceed growth estimates included in the applicable local general plans or air quality plan. The Proposed Project would not result in substantial population growth, as it would only restore, enhance, and preserve habitat. Construction of the Proposed Project would involve up to 30 or 40 full-time construction workers during the approximately 2.5-year construction period. During the post-construction phase, a few full-time workers may be required to conduct surveys and other monitoring work. However, not all of these positions would be filled by local residents. For example, the contractor may bring workers from other areas to perform the work. As a result, the impacts to local employment and population growth would be temporary and minimal.

Impact significance
Less than significant with mitigation

Impact 3.7-3: Expose sensitive receptors to air pollutants and cause higher health risks

In considering health risks to sensitive receptors, the Proposed Project would generate criteria air pollutants (NOx, ROG, PM_{10}, $PM_{2.5}$, CO) as well as other pollutants during the 2.5-year construction period (see also Impact 3.7-1). Please refer to Table 2.2-6 for the construction schedule, noting that construction would be generally limited to 8 hours/day during the CVFPB work window (April 16 through October 31) during each construction season. **Appendix G** describes the emissions modeling methodology, assumptions, and input data including types of equipment used during construction. Diesel Particulate Matter (DPM) produced by diesel-powered equipment is considered a Toxic Air Contaminant (TAC) under California law and could lead to indirect effects on sensitive receptors. Although TACs are not classified as criteria air pollutants and no ambient air quality standards have been established for them, a discussion of sources and exposure to potential receptors in the Project vicinity is provided below because of their association with increased lifetime cancer risk.

The Proposed 1,600 ac Project site is situated in a rural, agricultural setting within the Yolo Bypass Floodway (Yolo Bypass), a vast flood control zone which is not densely populated. In examining potentially sensitive off-site receptors,

existing land ownership in the Project vicinity was examined to determine locations where sensitive population groups are likely to be located (see Section 3.7.1 *[Air Quality, Setting, Physical setting] Sensitive Receptors*). Potentially sensitive receptors existing in the immediate vicinity of the Project site would be limited to a small number of residences, including a house that is not permanently occupied (Fonss property), the live-aboard residences occupying vessels at the Arrowhead Harbor Marina, as well as residences located on the adjacent Ryer Island to the east.

There are no existing stationary sources of air pollutants in the vicinity of the Project site and construction would occur within approximately 200 ac located primarily in areas over one mile south of Arrowhead Harbor Marina (Figure 2.2-3), and barges or trucks would haul materials to the site. The proposed northern breach, the nearest construction feature to potentially sensitive receptors, is approximately 500 ft from the nearest residence on Ryer Island and approximately 3,500 ft from Arrowhead Harbor Marina. The predominant wind direction is expected out of the west-southwest, which would carry particulate matter from the Prospect Island construction site towards the southern portion of Ryer Island, which is agricultural land, but not towards Arrowhead Harbor Marina, which is north of Prospect Island. Air pollutant concentrations would decrease with distance from the source due to atmospheric dispersion; therefore, pollutants would be unlikely to form localized DPM hot spots and expose sensitive receptors (described in Section 3.7.1 *[Air Quality, Setting] Sensitive Receptors*) to concentrations that could cause health risks. According to the USEPA, the majority of fugitive dust generally settles out of the atmosphere within 300 ft of the source, with larger particles traveling less distance and smaller particles traveling a longer distance (USEPA 1995). Additionally, concentrations of mobile-source diesel particulate matter emissions are typically reduced by 70% at a distance of approximately 500 ft (CARB 2005).

The location of the haul route has also been considered. If barges are utilized for materials import, the haul route would be distanced from residences and sheltered by the levees and no impacts related of TACs upon sensitive receptors would be expected. If trucks use the DWSC levee route to access the Proposed Project site, the haul route would be approximately 2,800 ft to the west of Arrowhead Harbor Marina, which would provide sufficient distance for dispersion and settling that would also not result in significant impacts. Lastly, because Holland Road is proximal to Arrowhead Marina and terminates on Prospect Island approximately 300 ft west of the marina, use of Holland Road for access may result in short-term DPM exposures to live-aboard residents during

mobilization, materials import, and demobilization. Nevertheless, some dispersion is expected at this distance from Holland Road, and these short-term exposures are not expected to increase lifetime cancer risk >10 in one million individuals. On all transportation routes, watering to prevent fugitive dust would occur, as required, further reducing exposure of both carcinogenic and non-carcinogenic PM during construction. Overall, considering the locations of construction, traffic routes, and residences, as well as the predominant wind direction, and reported settling distances, substantial DPM or other TAC levels would not expose sensitive receptors to substantial pollutant concentrations, or represent a health risk to sensitive receptors during Proposed Project construction.

Impact significance
Less than significant

Impact 3.7-4: Expose sensitive receptors to objectionable odors

The Proposed Project site is situated in a rural, agricultural environment within the Yolo Bypass, a vast flood zone which is not densely populated. Sensitive receptors existing in the immediate vicinity of the Proposed Project site are limited to a small number of residences, including a house that is not permanently occupied, the live-aboard residences occupying vessels at the Arrowhead Harbor Marina, and residences located on the adjacent Ryer Island. A potential short-term source of objectionable odors under the Proposed Project includes emissions from diesel-powered equipment used during the construction period. While the Proposed Project site is approximately 1,600 ac, equipment emissions would occur within a construction zone of approximately 200 ac. The latter is sufficiently large that odor concentrations would be dispersed and, given the low population density of the local area, would not expose a substantial number of people to objectionable concentrations. As a result, short-term construction-related odors under the Proposed Project would be *less than significant*.

With respect to the long-term, the Proposed Project does not involve the development of houses or other facilities that would place sensitive receptors near any existing or planned sources of odor. Thus, in the long-term, there would be no impact of the Proposed Project on sensitive receptors with respect to objectionable odors.

Impact significance
Less than significant

3.8 Greenhouse Gases

This section describes the projected impacts of Proposed Project-related greenhouse gas (GHG) emissions on global climate change. The Proposed Project involves material transportation, site preparation, and construction activities that require the use of emission-generating equipment. GHG emissions analysis is based on the California Department of Water Resources (DWR) Climate Action Plan – Phase 1: Greenhouse Gas Emissions Reduction Plan (GGERP).

3.8.1 Setting

Environmental setting

GHGs in the atmosphere increase the amount of reflected solar radiation that is absorbed, resulting in the increase of global average temperature. Increases in the concentrations of GHGs in the Earth's atmosphere are thought to be the main cause of human-induced climate change (Cubasch et al. 2013). The environmental setting for GHG emissions is global.

Legal and regulatory setting

In May 2012, DWR adopted the DWR Climate Action Plan-Phase 1: GGERP (DWR 2012c), which details DWR's efforts to reduce its GHG emissions consistent with Executive Order S-3-05 and the Global Warming Solutions Act of 2006 (Assembly Bill (AB) 32). DWR also adopted the Initial Study/Negative Declaration prepared for the GGERP in accordance with the CEQA Guidelines review and public process. Both the GGERP and Initial Study/Negative Declaration are incorporated herein by reference and are available at: https://water.ca.gov/Programs/All-Programs/Climate-Change-Program. The GGERP provides estimates of historical (back to 1990), current, and future GHG emissions related to operations, construction, maintenance, and business practices (e.g. building-related energy use). The GGERP specifies aggressive 2020 and 2050 emission reduction goals and identifies a list of GHG emissions reduction measures to achieve these goals.

DWR specifically prepared its GGERP as a "Plan for the Reduction of Greenhouse Gas Emissions" for purposes of CEQA Guidelines Section 15183.5. That section provides that such a document, which must meet certain specified requirements, "may be used in the cumulative impacts analysis of later projects." Because global climate change, by its very nature, is a global cumulative impact, an individual project's compliance with a qualifying GHG Reduction Plan may

suffice to mitigate the project's incremental contribution to that cumulative impact to a level that is not "cumulatively considerable." (CEQA Guidelines Section 15064(h)(3)).

More specifically, "[l]ater project-specific environmental documents may tier from and/or incorporate by reference" the "programmatic review" conducted for the GHG emissions reduction plan. "An environmental document that relies on a greenhouse gas reduction plan for a cumulative impacts analysis must identify those requirements specified in the plan that apply to the project, and, if those requirements are not otherwise binding and enforceable, incorporate those requirements as mitigation measures applicable to the project." (CEQA Guidelines Section 15183.5(b)(2))

Criteria for determining significance are based on Section 12 of the GGERP, which outlines the steps that each DWR project would take to demonstrate consistency with the GGERP. These steps include:

1. Analysis of GHG emissions from construction of the Proposed Project;
2. Determination that the construction emissions from the Proposed Project do not exceed the levels of construction emissions analyzed in the GGERP;
3. Incorporation of DWR's project-level GHG emissions reduction strategies into the design of the Proposed Project;
4. Determination that the Proposed Project does not conflict with DWR's ability to implement any of the "Specific Action" GHG emissions reduction measures identified in the GGERP; and,
5. Determination that the Proposed Project would not add electricity demands to the State Water Project (SWP) system that could alter DWR's emissions reduction trajectory in such a way as to impede its ability to meet its emissions reduction goals.

Consistent with the requirements outlined above, a GGERP Consistency Determination Checklist is attached documenting that the Proposed Project has met each of the required elements (**Appendix H**).

3.8.2 Impacts and mitigation

Impact 3.8-1: Proposed Project-related GHG emissions

Construction-related activities and transport of material on and off-site would generate GHG emissions. An equipment list for the Proposed Project was developed with the assistance of a DWR Division of Engineering Principal

Engineer. The equipment list and emission estimates for each equipment type are included in **Appendix G**, Prospect Island Restoration Project Air Quality Calculation.

The equipment list was then input into models for air quality calculations using the methods described for Air Quality Impact 3.7-1. The CO_2 output from the air quality calculations, summarized in Table 3.7-7, were converted into carbon dioxide equivalents (CO_2e) by dividing the CO_2 output by 99.74%. According to the USEPA's emission factors, CO_2 accounts for 99.74 of CO_2e for medium- and heavy-duty trucks (USEPA 2014).

Operations, maintenance and business activity emissions are identified (inventoried) each year as part of DWR's verified emissions reporting to The Climate Registry done by the DWR State Water Project Power and Risk Office. Therefore, emissions generated by activities of DWR staff and equipment that are accounted for in The Climate Registry inventory need not be accounted for again for CEQA purposes.

Based on the analysis provided in the GGERP and the demonstration that the Proposed Project is consistent with the GGERP (as shown in the attached Consistency Determination Checklist), DWR as the lead agency has determined that the Proposed Project's incremental contribution to the cumulative impact of increasing atmospheric levels of GHGs is less than cumulatively considerable and, therefore, *less than significant*.

Impact significance

Less than significant

3.9 Mineral and Gas Resources

This section describes mineral and natural gas resources at the Proposed Project site and assesses the potential impacts of the Proposed Project on mineral and natural gas rights over, under, or across the Proposed Project site held by third party entities. The analysis is based on readily available information on area gas wells, including published reports, publicly available websites, and applicable plans and policies.

3.9.1 Setting

Environmental setting

Natural gas

There are three known natural gas fields that underlie portions of the Proposed Project site, including Liberty Cut, Liberty Island, and Elkhorn Slough Gas Fields (Figure 3.9-1). The Liberty Cut Gas Field has a maximum confirmed acreage of 690 ac and underlies the northernmost portion of the Proposed Project site. This field was discovered in 1953 and abandoned in 1965 (DOGGR 1992). The Liberty Island Gas Field has a maximum productive area of 690 ac and underlies the southwestern tip of the Proposed Project site. This field was discovered in 1960 and abandoned in 1984. The Elkhorn Slough Gas Field, discovered in the 1990s, underlies the east central portion of the Proposed Project site, and is still in active production (DOGGR 2014). There are six natural gas exploration wells located within the northwestern portion of Prospect Island (DOGGR 2014):

- Well 09500374, Chevron USA, plugged and abandoned in 1946;
- Well 09500474, Arcady Oil Company, plugged and abandoned in 1954;
- Well 09500473, Arcady Oil Company, plugged and abandoned in 1955
- Well 09500103, Arcady Oil Company, plugged and abandoned in 1965
- Well 09520101, Union Oil Company of California, plugged and abandoned in 1969; and
- Well 09521156 Rosetta Resources Operating LLP, plugged and abandoned in 2002.

Five of the wells were dry holes (non-productive) and abandoned shortly after drilling. However, one of the wells (09500103), completed in 1956 in the Liberty Cut Gas Field, was idled from 1956 until 1965, at which time it was abandoned. The most recent exploratory gas drilling on Prospect Island occurred in 2002 and this well (09521156) was found to be a dry hole (non-productive) and was subsequently abandoned.

U.S. Bureau of Reclamation (USBR) holds natural gas rights on the northern portion of the property. Natural gas rights on the southern portion of the property are held by a suite of owners who held property rights prior to the site's condemnation (P. Carlson, DWR, pers. comm., March 2015).

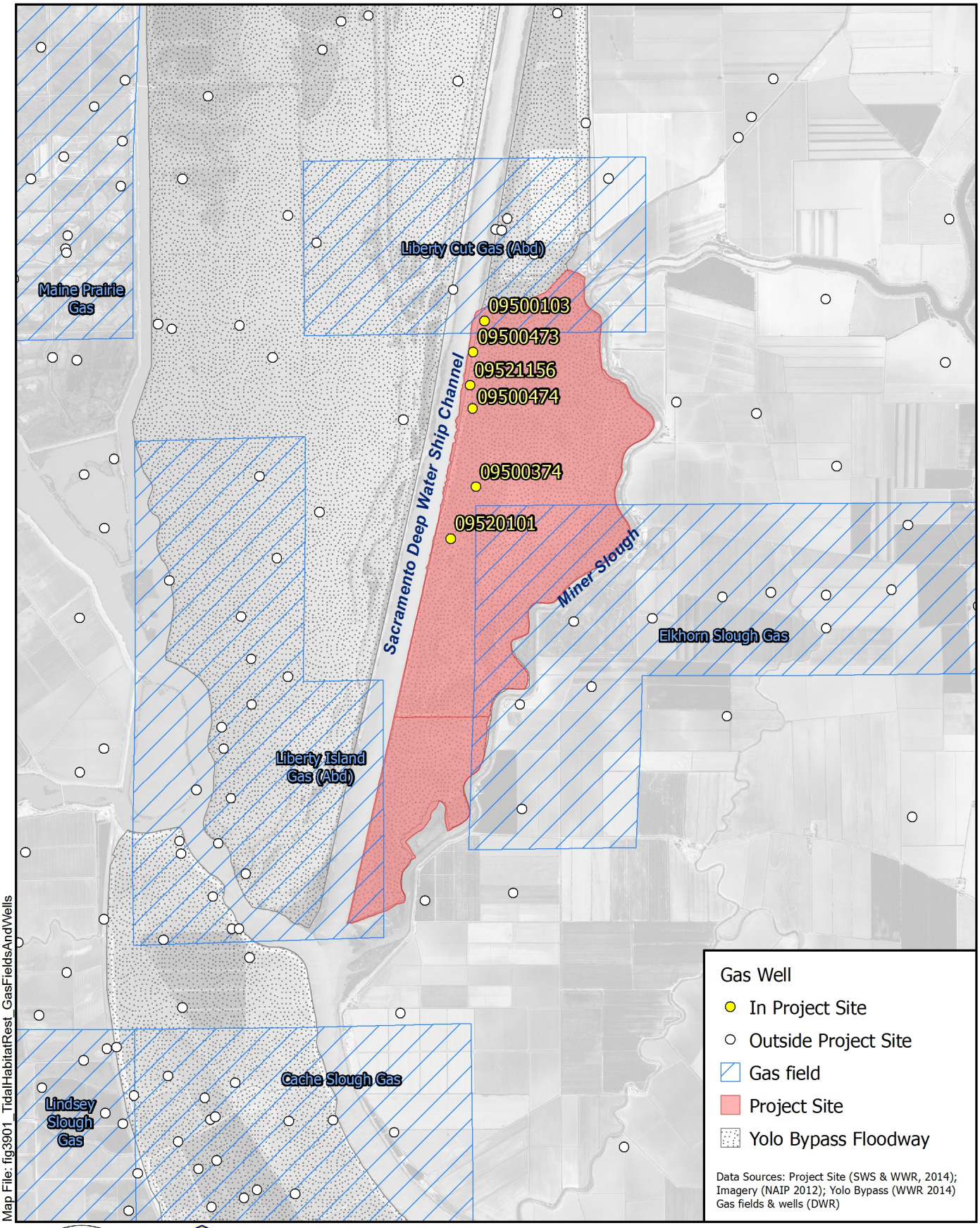


Figure 3.9-1

Gas Fields and Wells in Vicinity of the Project Site

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Non-fuel mineral resources

Non-fuel mineral resources mined or produced within Solano County include mercury, sand, gravel, clay, stone products, calcium, and sulfur (Solano County Board of Supervisors 2008). The California Geological Survey (CGS) and U.S. Geological Survey (USGS) record past or ongoing extraction of some non-fuel mineral resources, including peat, sand, and gravel throughout the Sacramento-San Joaquin River Delta (Delta) (Clinkenbeard 2012, USGS 2013). There are no active mines or mineral processing facilities and no recorded past mine locations within approximately 4 mi of the Proposed Project site. Additionally, the nearest Mineral Resource Zones (MRZs) are within approximately 11 mi of the Proposed Project site.

Legal and regulatory setting

Federal laws

Unless otherwise noted, the Proposed Project would comply with the following federal laws.

Surface Mining Control and Reclamation Act of 1977

The Department of the Interior's Office of Surface Mining regulates the environmental effects of coal mining under the Surface Mining Control and Reclamation Act of 1977 (SMCRA). There are no known coal mines in the study area that would be regulated pursuant to SMCRA.

State laws and regulations

Unless otherwise noted, the Proposed Project would comply with the following state laws and regulations.

California Department of Conservation, Division of Oil, Gas, and Geothermal Resources Construction-site Plan Review Program

The Division of Oil, Gas, and Geothermal Resources (DOGGR) regulates drilling, operation, maintenance, and abandonment of oil, gas, and geothermal wells. As part of DOGGR's responsibilities for implementing PRC Section 3208.1, districts have developed the Construction-site Plan Review Program to assist local agencies in identifying and reviewing the status of oil or gas wells near proposed development. The program is aimed at addressing potentially dangerous issues associated with development near oil or gas wells. DOGGR serves in an advisory role to make relevant information available to local agencies. Section 3208.1 of the PRC states that if any property owner, developer, or local permitting agency either fails to obtain an opinion from DOGGR, or fails to follow the advice of DOGGR when development occurs near an oil or gas well, then the owner of the

property on which the well is located may be responsible for re-abandonment costs should a future problem arise with the well. To use the DOGGR Well Review Program, the developer or property owner submits a completed Well Review Program Application to DOGGR (DOGGR 2007). Before issuing building or grading permits, local permitting agencies review and implement DOGGR's pre-construction well requirements. Interaction between local permitting agencies and DOGGR helps resolve land-use issues and allows for responsible development in oil and gas fields.

Surface Mining and Reclamation Act of 1975

The California law that regulates mining activities is the Surface Mining and Reclamation Act of 1975 (SMARA, PRC Section 2710 et seq.). This law's purpose is to create and maintain an effective and comprehensive surface mining and reclamation policy with regulation of surface mining operations to ensure that adverse environmental effects are prevented or minimized and that mined lands are reclaimed to a usable condition that is readily adaptable for alternative land uses. Production and conservation of minerals are encouraged, and consideration is given to values relating to recreation, wildlife, range and forage, and aesthetic enjoyment, while eliminating residual hazards to public health and safety. These goals are achieved through land use planning by allowing jurisdictions to balance the economic benefits of resource extraction with the need to provide other land uses.

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, the following have been considered in the analysis of potential impacts and identification of mitigation, as needed.

Unless otherwise noted, the Proposed Project would comply with the following local ordinances and policies.

Delta Protection Commission

The Delta Protection Act of 1992 established the Delta Protection Commission and required the Commission to prepare and adopt a Land Use and Resource Management Plan. Section 20050 of the Land Use and Resource Management Plan (LURMP) for the Primary Zone of the Delta (Delta Protection Commission 2010) addresses natural gas wells and pipelines.

Solano County General Plan

Relevant goals and policies of the Solano County General Plan (Solano County Board of Supervisors 2008) are listed below.

Policy RS.P-33: The County shall preserve, for future use, areas with important mineral resources by preventing residential, commercial, and industrial development that would be incompatible with mining practices to the extent feasible.

Policy RS.P-34: Ensure that mineral extraction operations are performed in a manner compatible with land uses on the site and surrounding area and do not adversely affect the environment. At the end of such operations, ensure that the site is restored to conform with SMARA requirements and to a use compatible with surrounding land uses.

Policy RS.P-55: Require responsible extraction, storage, and transportation of natural gas resources that minimize the impact on the natural environment.

Implementation Regulation RS.I-17: Evaluate impacts related to extracting mineral resources from new areas as part of the required permitting process to ensure that remediation occurs after minerals are extracted. Comply with regulations found in SMARA.

Solano County Code

Chapter 29 of the Solano County Code contains requirements for permitting and reclamation of mines in compliance with SMARA.

3.9.2 Significance criteria

Criteria for determining significant impacts are based on the Appendix G *Environmental Checklist* of the CEQA Guidelines and professional judgment. These guidelines state that the Proposed Project would have a significant impact on mineral resources if it would:

- Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state**.**
- Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan**.**

3.9.3 Impacts and mitigation

Impact 3.9-1: Loss of a known mineral resource that would be of value to the region and residents of the state

Prospect Island is currently partially flooded and would remain so under the Proposed Project. The three gas fields underlying portions of the Proposed Project site, including two abandoned gas fields and one active gas field (Elkhorn Slough Gas Field), would still be accessible via directional drilling and thus there would not be a change compared with existing conditions.

There is only one active gas well in the area. It is on Ryer Island, just east of the Proposed Project site. No activities are planned to occur on Ryer Island as part of the Proposed Project. Road construction, dredging, excavation, and grading activities on Prospect Island would not be expected to affect production at the active Ryer Island gas well. Therefore, there would be no impact to known mineral resources due to Proposed Project activities.

Impact significance
No impact

Impact 3.9-2: Loss of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan

As described in Section 3.9 *Mineral Resources – Setting*, there are no active mines or mineral processing facilities and no recorded past mine locations within 4 mi of the Proposed Project site. Additionally, there are no MRZ within 11 mi of the Proposed Project site. Therefore, there would be no impact to known locally important mineral resource recovery sites.

Impact significance
No impact

3.10 Noise

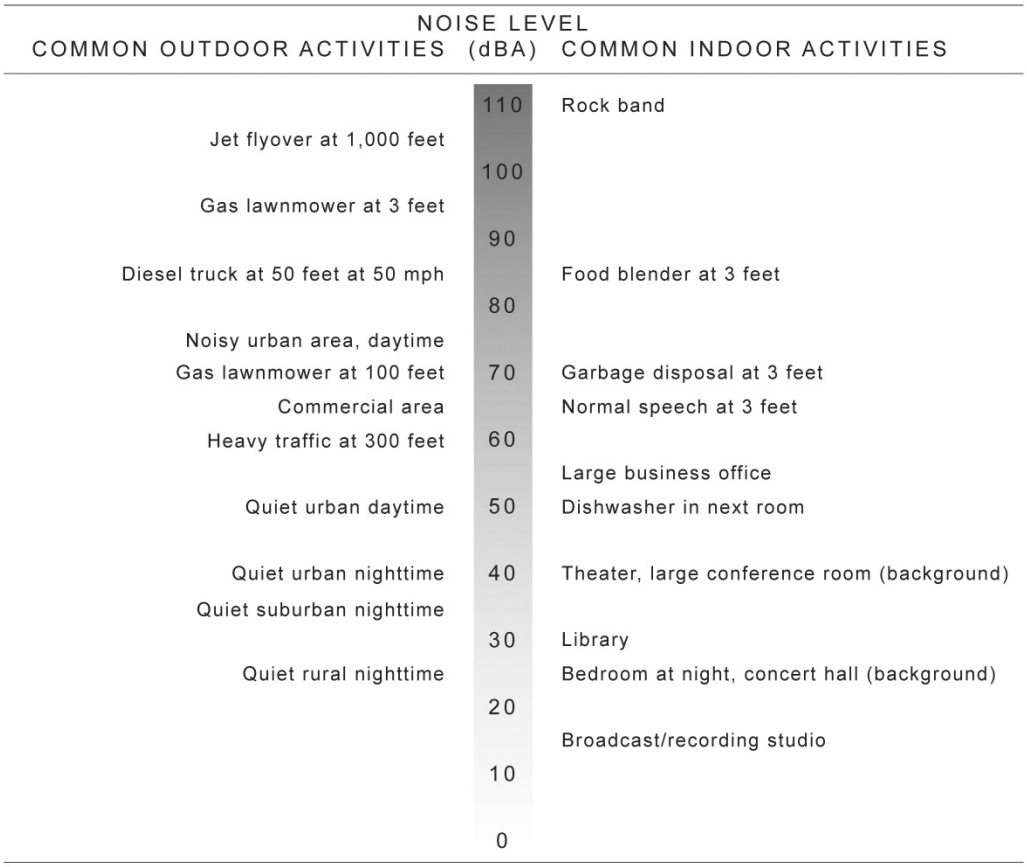
This section discusses noise concepts and characterizes ambient noise in the vicinity of Prospect Island. It then assesses the potential effects of short-term construction-related noise, as well as long-term operation and maintenance activities associated with implementation of the Proposed Project, on sensitive human receptors. Mitigation measures are identified to reduce significant impacts. Noise impacts to wildlife are described in Section 3.4 *Wetland and Terrestrial Resources*.

Noise characteristics

The following terms are used to characterize noise throughout this section:

- *Ambient Noise*: All noise sources audible at a particular location. In many cases, the term "ambient" is used to describe an existing or pre-project condition, such as the setting in an environmental noise study.
- *Attenuation*: The reduction of noise from the source.
- *Decibel (dB)*: A unit of sound energy intensity measured using the logarithmic ratio of the square of the ambient sound pressure level compared to the pressure from the faintest sound detectable by a young person with good auditory acuity.
- *A-Weighting*: A frequency-response adjustment of a sound-level meter that conditions the output signal to approximate human response. (A-weighted decibels are referred to in this Environmental Impact Report [EIR] as "dBA."); Figure 3.10-1 illustrates common noises and their respective dBAs.
- *Community Noise Equivalent Level (CNEL)*: The 24-hour average noise level with noise occurring during evening hours (7–10 p.m.) weighted by a factor of 3 and noise occurring during nighttime hours (10 p.m.–7 a.m.) weighted by a factor of 10 before averaging.
- L_{dn}: Day/night average sound level. Similar to CNEL, but with no evening weighting.
- L_{eq}: Equivalent or energy-averaged sound level.
- L_{Max}: The highest sound level measured over a given period of time.

In an ideal laboratory setting, the human ear can discern a difference in sound level of +/-1 dBA, which consequently is the accuracy of sound level meters and sound propagation computer models. Outside of a laboratory setting, most people cannot discern a change in noise levels that differs by less than 3 dBA between pre-project and post-project exposure if the change occurs under ambient conditions. A change from 3 to 5 dBA may be noticed by some individuals who are extremely sensitive to changes in noise. Typically, a 5-dBA increase is readily noticeable, and the human ear perceives a 10 dBA increase as twice as loud (CalTrans 2009).



Source:CalTrans 2009.

Figure 3.10-1. Noise Levels from Common Activities.

3.10.1 Setting

Environmental setting

The Proposed Project site is characterized by an agricultural/open space setting. Prospect Island is surrounded on three sides by waterways, with the Sacramento River Deep Water Ship Channel on the west, Miner Slough on the east, and a wildlife area at the confluence of the two water bodies to the south.

Typical noise sources in the Proposed Project area are primarily from small boat traffic frequenting the surrounding waterways, and from vehicle traffic on State Route 84 (SR-84) adjacent to Miner Slough to the east. Infrequent noises from ships in the Sacramento Deep Water Ship Channel (DWSC) and airplane flyovers associated with agricultural practices also generate occasional noise sources in the Proposed Project area.

Existing noise levels

An assessment of ambient noise levels near the Proposed Project area was undertaken for the Solano County General Plan EIR (Solano County Board of Supervisors 2008). One of the locations evaluated by the EIR was a community monitoring station located south of Elevator Road and west of Ryer Road, just east of the Proposed Project area. The community noise measurement at this location recorded an average sound level of 46 dBA L_{dn} and a maximum of 59 dBA L_{Max}. The Solano County General Plan EIR also utilized the Federal Highway Administration (FHWA) Highway Traffic Nose Prediction Model to predict the traffic noise levels along SR-84 near the Solano County line (approximately 2 mi from the Proposed Project area) utilizing the data collected from 11 noise-monitoring locations. The FHWA model estimated that the segment along SR-84 measured an average sound level of 61 dBA L_{dn} 100 ft from the centerline of the vehicle pathway. Both the community noise monitoring station located south of Elevator Road and west of Ryer Road, and the modeled noise levels along SR-84 near the Solano County line are representative of the ambient noise levels at the Proposed Project site, as they experience the same typical noise sources and surrounding land uses.

Sensitive receptors

Sensitive receptors for noise impacts are individuals who would experience a substantial increase in ambient noise levels because of project-related activities. These activities could include short-term noise generated by construction and long-term operational noises. Typically, individuals at residences, churches, schools, or hospitals are most sensitive as the ambient noise levels at these locations are quieter than those at businesses, restaurants, or in transportation hubs. As such, any receptor of noise generated by a project activity may be a sensitive receptor; however, whether the noise adversely impacts the receptor is dependent upon how greatly the project-related noise levels vary from ambient noise levels.

While the Proposed Project site is located in an agricultural/open space setting, several sensitive receptors do exist within the Proposed Project vicinity. The Hall property is an abandoned island that is not currently occupied. (Figure 2.1-3). The closest potential sensitive receptors to construction work sites are the residences located at the Arrowhead Harbor Marina (Arrowhead Harbor Marina 2009), which is located along Holland Road. These "live aboard" residences occupy vessels full-time at the marina, and are located 175 ft north of the northern edge of the Proposed Project area. A number of residences are located

approximately 500 ft to 1,500 ft east, southeast, and south of the Proposed Project site, across Miner Slough on Ryer Island. The nearest sensitive receptors other than residences (e.g., schools and places of worship) are located approximately 5 mi southwest within the City of Rio Vista. Additionally, there are agricultural residences located along the haul routes that may be utilized by trucks accessing the site.

Regulatory setting

Federal regulations

Unless otherwise noted, the Proposed Project would comply with the following federal regulations.

Federal vehicle noise limits

Federal regulations establish noise limits for medium and heavy trucks (more than 4.5 tons, gross vehicle weight rating) under CFR, Title 40, Part 205, Subpart B. The federal truck pass-by noise standard is 80 dB at 15 m (approximately 50 ft) from the centerline of the vehicle pathway. These standards are implemented through regulatory controls on truck manufacturers.

State regulations

Unless otherwise noted, the Proposed Project would comply with the following state regulations.

The State of California vehicle noise limits

The State of California establishes noise limits for vehicles licensed to operate on public roads. The pass-by standard for heavy trucks is consistent with the federal limit of 80 dB. The pass-by standard for light trucks and passenger cars (less than 4.5 tons, gross vehicle rating) is also 80 dB at 15 meters from the centerline. These standards are implemented through controls on vehicle manufacturers and by legal sanctions on vehicle operators by state and local law enforcement officials.

The State of California community noise levels

The State of California has established guidelines for acceptable community noise levels based upon the CNEL rating scale to ensure that noise exposure is considered in any development, as shown in Table 3.10-1. CNEL-based standards apply to noise sources whose noise generation is preempted from local control (such as from on-road vehicles, trains, airplanes, etc.) and are used to make land use decisions as to the suitability of a given site for its intended

Table 3.10-1. Solano County General Plan, Land Use Noise Compatibility Guidelines

Land Use Category	Community Noise Exposure (Ldn or CNEL, dBA)			
	Normally Acceptable[1]	**Conditionally Acceptable[2]**	**Normally Unacceptable[3]**	**Clearly Unacceptable[4]**
Residential—Low Density Single Family, Duplex, Mobile Home	<60	55–70	70–75	75+
Residential—Multifamily	<65	60–70	70–75	75+
Transient Lodging—Motel, Hotel	<65	60–70	70–80	80+
Schools, Libraries, Churches, Hospitals, Nursing Homes	<70	60–70	70–80	80+
Auditoriums, Concert Halls, Amphitheaters	-	<70	65+	-
Sports Arena, Outdoor Spectator Sports	-	<75	70+	-
Playgrounds, Neighborhood Parks	<70	-	67.5–75	72.5+
Golf Courses, Riding Stables, Water Recreation, Cemeteries	<75	-	70–80	80+
Office Building, Business Commercial, and Professional	<70	67.5–77.5	75+	-
Industrial, Manufacturing, Utilities, Agriculture	<75	70–80	75+	-

Source: Solano County General Plan (Solano County Board of Supervisors 2008) Table HS-2.

1 Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

2 New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning would normally suffice.

3 New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise insulation features included in the design. Outdoor areas must be shielded.

4 New construction or development should generally not be undertaken.

5 These standards are not applicable for development within the airport compatibility review area. Development in the airport compatibility review areas are subject to standards in the applicable airport land use plan.

use. These CNEL-based standards are provided in the Solano County General Plan under the General Plan Public Health and Safety Chapter.

Local ordinances

Unless otherwise noted, the Proposed Project would comply with the following local regulations.

Solano County General Plan

The Noise Section of the Solano County General Plan Public Health and Safety Chapter provides Land Use Noise Compatibility Guidelines for different land use categories noise exposure levels (Solano County Board of Supervisors 2008). In general, the noise standards specified by the county are designed to prevent annoyance or sleep disruption to sensitive receptors. Table 3.10-1 above shows the acceptable noise levels for various land use categories and is used when determining a project's noise impact. The Proposed Project site falls under the land use designation "Industrial, Manufacturing, Utilities, Agriculture", for which there is no "Clearly Unacceptable" noise exposure limit. However, the General Plan does state that noise levels over 75 dB L_{dn} under normal circumstances would be unacceptable.

3.10.2 Significance criteria

The CEQA Guidelines define significant impacts as those that cause standards to be exceeded where they are currently met. An impact is also considered significant if it "substantially" exacerbates an existing significant impact to the noise environment, or creates an exposure of persons to noise levels exceeding standards established in the local general plan or other applicable regulations.

While "substantially" is not defined by CEQA, typically an increase between 3-5 dBA L_{dn} or greater resulting from the Proposed Project on sensitive land uses would be considered a significant impact.

Adverse impacts to noise would be considered significant if the Proposed Project would:

- Expose persons to, or generate noise levels, in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Result in a substantial temporary or periodic increase in ambient noise levels in the Proposed Project vicinity above levels existing without the Proposed Project.

- Result in a substantial permanent increase in ambient noise levels in the Proposed Project vicinity above levels existing without the Proposed Project.
- Expose persons to excessive ground-borne vibrations.

3.10.3 Impacts and mitigation

Impact 3.10-1: Potential for short-term noise disturbance to nearby residents

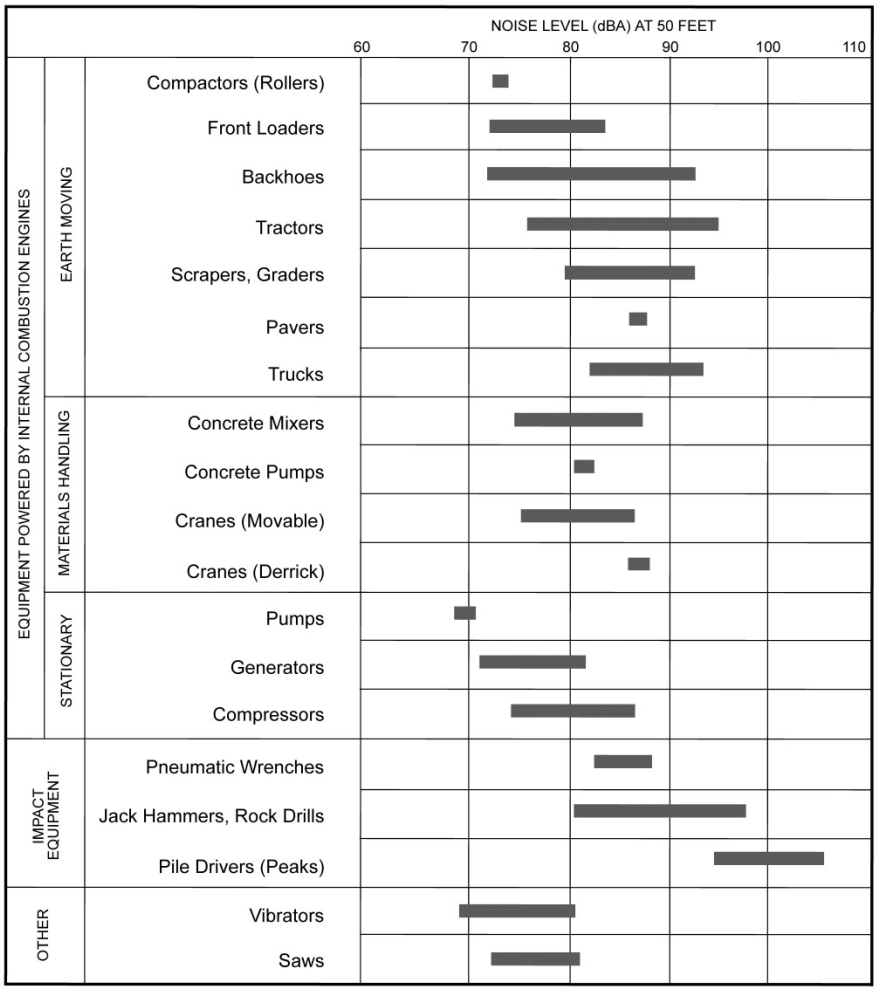
While Solano County does not have a specific ordinance regarding construction-related noise emissions, proposed construction activities would substantially increase short-term noise levels at residences in the Proposed Project vicinity.

Construction generated noise levels in the Proposed Project area would fluctuate depending on the location, and the particular type, number, and duration of equipment used. Figure 3.10-2 shows the typical noise levels associated with different construction stages/phases, and the typical noise levels produced by various types of construction equipment. The range in noise levels in Figure 3.10-2 is intended to illustrate the long-term averaged (L_{dn}) noise levels at the lower end of the range, and the short-term maximum levels at the upper end of the range. Table 3.10-2 lists the anticipated construction equipment for the Proposed Project and its associated L_{eq} noise levels.

Table 3.10-2. Typical Noise Levels from Proposed Construction Equipment

Proposed Construction Equipment	Estimated Duration (Days)	Noise Level (dBA L_{eq} at 50 ft)
Front Loaders and Bulldozers	960	76
Excavators	926	81
Pile Driving Crane	92	101
Graders and Scrapers	920	81
Dewatering Pumps	494	79
Compactor/Roller	185	73
Tractor/Backhoe/Truck	960	76
Dredger	69	75–88

Source: DOT 2006.



Source: USEPA 1971.

Average noise levels correspond to a distance of 50 ft from the noisiest piece of equipment associated with a given phase of construction and 200 ft from the rest of the equipment associated with that phase.

Figure 3.10-2. Noise Produced by Various Pieces of Construction Equipment.

Under the Proposed Project, restoration activities such as vegetation clearing, traffic from workforce transportation, import of materials by barge and/or truck, and operation of dewatering pumps and construction equipment, would result in on-site short-term construction noise that could impact sensitive receptors (describe in Impact 3.7-1 above). Because noise attenuates at 6 dBA per doubling of distance, locations at a distance of approximately 100 ft (just beyond the site) could experience an outside maximum momentary noise level of approximately 90 dBA L_{Max}, and time-averaged outside construction noise levels of approximately 70 dBA L_{dn} while construction is occurring. Both the maximum construction noise level of 90 dBA L_{Max} and the long-term construction noise level of 70 L_{dn} are well above the ambient levels of 59 dBA L_{Max} and 46 L_{dn}

respectively, and above acceptable noise level for residential land uses. The anticipated noise levels described above are for the loudest equipment assumed to be working within 100 ft of any sensitive receptors. The nearest potential sensitive receptor was the intermittently occupied Stringer residence, located approximately 100 ft from the construction site; however, this property has been purchased by California Department of Water Resources (DWR) and is no longer occupied. Nevertheless, to account for any potentially new sensitive receptors within approximately 100 ft at the time of construction, Mitigation Measure 3.10-1.1 is retained to ensure noise impacts at this distance are *less than significant*.

Live-aboard residences at Arrowhead Harbor Marina are located approximately 175 ft from the Proposed Project site and are situated behind Prospect Island's northeast levee (Figure 2.2-3). These residences would be sheltered from the majority of the construction. While ground clearing/grading occurs, residences at Arrowhead Harbor Marina would experience outside noise levels of slightly more than 83 dBA L_{Max} and approximately 76 dBA L_{dn} without the protection of the levee to buffer the noise. As such, these residences would not experience a significant impact from the increase in construction related noise levels.

The nearest residences on Ryer Island are located approximately 500 ft to the east of the Proposed Project site. These residences, like those at Arrowhead Harbor Marina are located behind high levees, and as a result would be buffered from the majority of the noises generated by the Proposed Project construction. Given the distance from the Proposed Project to Ryer Island these residences would experience temporary outside noise levels of approximately 75 dBA L_{Max} and approximately 60 L_{dn} without the levees acting as a sound buffer. As a result, the Proposed Project would not significantly impact these residences.

In addition to on-site construction equipment noise, the Proposed Project also would generate off-site noise from haul trucks, if the truck transport is selected over barge transport. Trucks would utilize existing roads and highways, primarily SR-84, Holland Road, Courtland Road and/or Teal Road, and Road 107 during regular working hours (e.g., Monday–Friday during the daylight hours). These haul trips would create additional noise along these routes, which would be audible to sensitive receptors. Specifically, residences along the access routes (e.g., live-aboard residences at the Arrowhead Harbor Marina) would experience additional noise while trucks are hauling materials to and from the Proposed Project site. Using Courtland Road and/or Teal Road, and Road 107 would avoid the bulk of the construction traffic passing by Arrowhead Harbor Marina, with construction traffic traveling past primarily agricultural properties instead. If

materials import method by truck (Option A) is selected, the Proposed Project is estimated to generate up to 130 one-way trips (65 two-way trips) per day at peak traffic loading (Table 3.10-3). Additionally, construction equipment would be brought to the site on flatbed trucks, requiring trips for each mobilization and de-mobilization event, with an estimated 350/trips per year assuming no equipment will be allowed to remain on-site during winter under the Central Valley Flood Protection Board (CVFPB) permit.

Existing traffic noise at 100 ft was calculated to be 61 dBA CNEL for SR-84 in the Solano County General Plan (2008), and similar noise levels are expected for Courtland Road, Teal Road, Road 107, and Holland Road due to the same traffic types (i.e., agricultural equipment, and vehicles traveling to Arrowhead Harbor Marina). Trucks hauling materials for the Proposed Project are not expected to increase noise more than the 3 dBA threshold considered significant for ambient noise levels between 60 and 65 dBA L_{dn} (Federal Interagency Committee on Noise 1992). Therefore, the impact to residences along those roads would be *less than significant*.

Table 3.10-3. Schedule of Estimated Daily Traffic

Construction Activity	Maximum Trips/Day	Approx. Duration	Total Trips	Estimated Dates
Equipment mobilization and demobilization	7	14 days	94	April and October each construction year
Materials import (Option A - barge)	70	4 weeks	700	Years 1 and/or 2
Materials import (Option B - truck)	130	6 months	7,840	Years 1 and/or 2
Importation of planting materials and removal of sheet pile	11	7 days	29	October Year 3
Work-force transportation	22	2.5 years	14,355	Year 1–Year 3

Notes: Assumes work would occur five days per week for eight hours per day.

Mitigation Measure 3.10-1.1

The following mitigation measure would reduce the noise impact to residences in the Proposed Project area to a less-than-significant level:

1. The construction contractor shall locate stationary noise sources as far from existing residences as possible.
2. The DWR shall identify a disturbance coordinator, and the name and phone number of this person shall be conspicuously be posted at the

Proposed Project site in an area that can be accessed by the general public. If noise complaints are received, the disturbance coordinator shall respond to the complaints and shall take the steps necessary to mitigate the problem.

Impact significance
Less than significant with mitigation

Impact 3.10-2: Potential for long-term increases in ambient noise levels in the Proposed Project vicinity

The Proposed Project may continue to require infrequent operations and maintenance, and monitoring activities within Prospect Island after construction. These activities would only involve temporary actions, many of which occur under existing conditions, such as mowing, DWSC and northern cross-levee road maintenance, and weed abatement. These activities would not involve new long-term stationary noise sources. Therefore, the Proposed Project would not have a significant impact on long-term ambient noise levels in the vicinity.

Impact significance
Less than significant

Impact 3.10-3: Potential for sensitive receptors to be exposed to excessive ground-borne vibrations during construction-related activities

The Proposed Project may involve the construction of a sheet pile cut-off wall for levee repairs at the end of the Miner Slough spur channel (just northwest of the Hall property). Construction of the cut-off wall may generate temporary ground-borne vibrations while the sheet piles are driven into the ground. Sheet piles would most likely be installed out of water using vibratory hammers; however, an impact pile driver within water may be necessary. The nearest sensitive receptor to this activity is a residence located over 1,500 ft to the east on Ryer Island. Assuming the largest type of pile driver would be used (e.g., crane-mounted pile driver) either out of water or in-water, these residences would receive a maximum ground-borne vibration peak-particle velocity (PPV) of less-than 0.001 inch per second (in/sec). As shown in Table 3.10-4 below, vibration levels under 0.035 in/sec PPV are barely perceptible to humans. Thus, the Proposed Project would have no impact on sensitive receptors due to ground-borne vibrations.

Table 3.10-4. Human Response to Transient Vibration

Vibration Level (in/sec PPV)	Human Response
2.0	Severe
0.9	Strongly perceptible
0.24	Distinctly perceptible
0.035	Barely perceptible

Source: CalTrans 2004.

Impact significance

No impact

HUMAN RESOURCES

3.11 Aesthetics

This section describes visual quality of the Proposed Project site and vicinity, and assesses the visual quality impacts of the Proposed Project. The Proposed Project involves breaching portions of the Miner Slough levee and changing portions of the site from open-water, marshes, and uplands to tidal wetland, as well as constructing a levee toe berm, and possible access improvements. Visual quality issues addressed include effects on scenic vistas, other scenic resources, visual character, and light and glare. This analysis is based on a field reconnaissance and review of applicable plans and policies.

3.11.1 Setting

Environmental setting

Agricultural, open space, and recreational landscapes characterize the visual character of Prospect Island and surrounding views. Viewers include recreational users of the area (including boaters, anglers, bird watchers), as well as motorists on nearby roadways with views of the site.

The interior of the Proposed Project site is generally flat and is surrounded by levees obscuring views into the interior of the site from adjacent waterways and low-lying areas. The existing topography of Prospect Island is flat and low-lying, gently sloping up to the north. Site elevations range in the interior of the island from approximately 3 ft below mean tide level (MTL) to 5 ft above MTL (Figure 2.2-2), with the levees rising approximately 10–15 ft above the interior of the island. The topography of the south property is somewhat higher than the

northern part of the Island, reflecting its use for dredged material placement. The south property has had levee breaches that are partially repaired.

Views of the Proposed Project site are mostly limited to the levees surrounding the site, which are vegetated with trees and shrubs, and also include Miner Slough, a developed marina (Arrowhead Harbor Marina), and two barely visible residential properties. Occasional views of the interior of the site are available where the levee dips and/or levee vegetation is sparse. Views of the interior include open-water, freshwater marsh, riparian vegetation, blackberry, and oak and willow trees. The channels, open-water, levees, and marshes on and adjacent to the site also afford views of wildlife and their habitat, which add to the area's visual interest. Representative views of the site are shown in Figure 3.11-1 through Figure 3.11-4.

Public viewpoints of the Prospect Island Tidal Marsh Restoration Project site are primarily from State Route 84 (SR-84), which runs atop the entire length of the Ryer Island levee directly across Miner Slough from Prospect Island (east and south of the Island), as well as from the Arrowhead Harbor Marina (directly north of the Island). Views from this road are primarily of the Prospect Island Miner Slough levee, but, in areas where the levee is lower and/or vegetation sparse, views also include waters of the interior of the island. Boaters have views of the levees surrounding the site from the Marina, Miner Slough (on the east side of the Island), and the Sacramento Deep Water Ship Channel (DWSC) (west of the Island).



Figure 3.11-1. Westerly Views of South End of Prospect Island from State Route 84.



Figure 3.11-2. View of Miner Slough Looking West from Ryer Island Levee.



Figure 3.11-3. View of Miner Slough and Prospect Island from State Route 84 (Including Portion of the Hall Property).



Figure 3.11-4. View of Prospect Island from Arrowhead Harbor Marina.

Legal and regulatory setting

State regulations

Unless otherwise noted, the Proposed Project would comply with the following state regulations.

State Scenic Highway System

SR-84 is the primary highway accessing Prospect Island. This route is part of the California Freeway and Expressway System. SR-84 is eligible for the State Scenic Highway System and is classified as scenic for a section in Alameda County, but it has not been designated as a scenic highway in the Prospect Island vicinity (highway segment that runs from the Sacramento-San Joaquin Delta at Rio Vista to the Yolo County line).

Delta Plan

The Delta Plan notes that state and federal projects (water facilities, ecosystem restoration, or flood management) are not required to secure local agency or Delta Protection Commission approvals, but nevertheless should avoid conflicts with existing and planned land uses when feasible given that these projects can alter scenic views and create other concerns (DSC 2013). Further, Delta Plan Recommendation 14 (R14) to "Enhance Nature-based Recreation" puts forth that the California Department of Fish and Wildlife, in cooperation with other public agencies, should collaborate with nonprofits, private landowners, and business partners to expand wildlife viewing, angling and hunting opportunities (DSC 2013).

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, the following have been considered in the analysis of potential impacts and identification of mitigation, as needed.

Unless otherwise noted, the Proposed Project would comply with the following local ordinances.

The Scenic Resources section of the Solano County General Plan (Solano County Board of Supervisors 2008) focuses on protecting the aesthetic qualities of the county's landscape. Policies and programs contained in the section aim to protect valued landscape features and ensure that new urban or rural development within scenic roadway corridors respects and maintains the integrity of viewsheds. The General Plan includes policies to strengthen the protection of the Tri-City and County Cooperative Plan area, protect ridgelines, reduce light pollution, and encourage the provision of scenic open spaces. The General Plan emphasizes the protection of scenic and natural resources, whether or not they are within view of a designated scenic highway. Prospect Island scenic open spaces would not be significantly altered so the threat to scenic resources as

defined in the Solano County General Plan is negligible. The Solano County General Plan's Scenic Resources policies follow below.

Related plans, programs, and agencies

County area and specific plans contain language aimed at preserving, conserving, and enhancing visual resource values within the target planning area. The plans identify viewsheds or general scenic resources to be protected or improved. Plans that discuss visual resource protection explicitly include the Tri-City and County Cooperative Plan for Agriculture and Open Space Preservation. One of the primary objectives of the Tri-City and County Cooperative Plan is to conserve and enhance visual resources within the plan area.

Scenic resource policies

RS.P-35: Protect the unique scenic features of Solano County, particularly hills, ridgelines, wetlands, and water bodies.

RS.P-36: Support and encourage practices that reduce light pollution and preserve views of the night sky.

RS.P-37: Protect the visual character of designated scenic roadways. (Solano County Board of Supervisors 2008)

3.11.2 Significance criteria

Criteria for determining significant impacts are based upon Appendix G *Environmental Checklist* of the CEQA Guidelines and professional judgment. These guidelines state that the Proposed Project would have a significant impact on visual quality if it would:

- Have a substantial adverse effect on a scenic vista
- Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway
- Substantially degrade the existing visual character or quality of the site and its surroundings, or
- Create a new source of substantial light or glare, which would adversely affect day or nighttime views in the area.

3.11.3 Impacts and mitigation

Impact 3.11-1: Temporary change in views during construction

Views from SR-84, Arrowhead Harbor Marina, and nearby waterways may be affected as a result of construction activities. The site would look different during construction due to the site being dewatered and earth-moving activities. During the construction period, visual character of the interior of the site would change from open-water and marshes to bare earth with construction activities and equipment. However, most views of the interior of the site would continue to be buffered by the vegetated levees. Construction would occur during daytime hours without the need for artificial lighting and would be completed over a several year period. Given that the construction activities would be temporary and not prominent from most viewpoints, this impact would be *less than significant*.

Impact significance
Less than significant

Impact 3.11-2: Long-term change in views from State Route 84

Prospect Island Tidal Marsh area is visible to drivers on SR-84. The primary aesthetic change from the Proposed Project would be expanded views of open-water through the breaches, and the loss of views of the vegetated levee at the breach locations. Views of the interior of the Island also would change with tide stages. At high tide, views from the highway would show primarily open-water in the center of the island or in the levee. At low tide, these viewers may see more marshy areas. However, most views of the interior of the site would continue to be mostly blocked by the vegetated levees.

Impact significance
Less than significant

Impact 3.11-3: Long-term change in views from Arrowhead Harbor Marina

Portions of Prospect Island also are visible from the Arrowhead Harbor Marina, by boaters/visitors and staff. Depending on its final location, the northern breach may be visible from the Marina. This breach would remove some of the existing riparian vegetation in views from the Marina and replace that view with open views onto the interior of the Island. The aesthetic impact of the Proposed Project would not be adverse because the only change for these viewers would be vistas with more open-water and marsh vegetation through the breaches.

Impact significance
Less than significant

Impact 3.11-4: Long-term change in views from boats in Miner Slough

Prospect Island Tidal Marsh area is also visible by boaters in the Miner Slough. The only aesthetic change resulting from the Proposed Project for these viewers would be a view of slightly more open-water and more expansive views of the interior of the Island through the breaches. At high tide, the Proposed Project would provide boaters with views through the breaches of slightly more open-water. At low tide, boaters' views may include more marshy areas. The impact from the Proposed Project would not be adverse because these aesthetic changes would be only marginally different from current views.

Impact significance
Less than significant

Impact 3.11-5: Long-term change in views from boats in the Deep Water Ship Channel

Prospect Island is also visible by boaters in the DWSC. Because no breaching of the ship channel levee would occur, and because most boaters would not be able to see the interior of the Island from their craft (except for large ships, which would afford views elevated over the levee), there would be no change in views for most viewers in the channel. The impact would be minimal and not adverse.

Impact significance
Less than significant

Impact 3.11-6: Long-term change in views from nearby residences

With the Proposed Project, the only aesthetic change would be elimination of portions of the vegetated levee from the breaches. Views of the interior of the Island may include more variation from open-water to tidal wetlands, compared to the primarily open-water views currently experienced. Views from nearby residences, including those on Ryer Island, would not be affected by the Proposed Project. Thus, the impact on the residents of Prospect Island would not be adverse.

Impact significance
Less than significant

Impact 3.11-7: Long-term light and glare

The Proposed Project would not create a new source of substantial light or glare in the area because no lighting is proposed during or after construction and the major water areas would remain similar to existing conditions.

Impact significance

No impact

3.12 Agricultural Resources

This section describes agricultural resources on and near the Proposed Project site, and assesses the impacts of the Proposed Project on any such resources. Agricultural resource issues addressed include conversion of agricultural lands to other uses, impacts to Williamson Act properties, and other possible effects to agricultural resources on or off the site. Forestry resources are not evaluated because there are no forest resources on the site. Loss of mature trees on the levees is evaluated from a biological perspective in the Wetland and Terrestrial Biological Resources (Section 3.4 *Wetland and Terrestrial Biological Resources*). This analysis is based on a December 2013 field reconnaissance and a review of applicable plans and policies.

3.12.1 Setting

Agricultural lands on and near the Proposed Project site

The current land use at the Proposed Project site is open space/wildlife habitat. Surrounding land uses are agriculture and wildlife habitat.

Prior to 1995, Prospect Island was in agricultural use. In 1994, approximately 380 ac of wheat, 586 ac of field corn, and 184 ac of safflower were grown on the site. About the same proportions of these crops were rotated annually, but may have included approximately 100 ac of sugar beets in some years. Processing tomatoes and Sudan grass were also grown in some years. A small portion of land at the site was used for machinery paths and irrigation ditches. An unscreened diversion withdrew several thousand acre-feet of water to support the crops (USACE and DWR 2001).

The Proposed Project site flooded in March 1995 due to breaks in the south Miner Slough levee and the cross-levee separating it from the Port's property.

The breaches in the cross-levee and the Miner Slough levee were repaired, and the California Department of Water Resources (DWR) property (then owned by the Bureau of Reclamation) was pumped dry in July 1996. In January 1997, the island flooded when the levees breached again. Repair of the Miner Slough levee breach was completed in November 1998, and repair of the cross-levee was completed in January 1999. The levees breached again in 2006, including a failure of the internal cross-levee. These levee failures were eventually repaired, but lands remained flooded for extended periods following each breaching event before the island was again pumped dry. Farming operations have not resumed in the area since March 1995. With the exception of farming activities that have occurred on a 17.7 ac of land north of the northern cross-levee, Prospect Island has been fully or partially submerged and unusable for agricultural purposes for approximately 20 years. Note that only 10.9 ac of this 17.7 ac, which is part of the Fahn property, is currently actively farmed. The other 6.8 ac is owned by DWR and is not currently used for agriculture.

CEQA Guidelines (Section 15125(a)) and case law state that the baseline for EIR review is existing conditions on the ground at the time that the Notice of Preparation (NOP) is issued[16]. Therefore, with the exception of farming activities that have occurred on 17.7 ac north of the northern cross-levee (10.9 ac of the adjacent Fahn property), the Proposed Project site is not considered to be agricultural lands for the purposes of CEQA analysis.

Prospect Island is not designated as agricultural land in the California Department of Conservation's "Important Farmland" map for Solano County (California Department of Conservation 2012). Instead, Prospect Island is designated as "Other Land", reflecting flooded conditions and its current use as wildlife habitat. "Other Land" is defined by the California Department of Conservation as land not included in any other mapping category. Common examples include low density rural developments; brush, timber, wetland, and riparian areas not suitable for livestock grazing; confined livestock, poultry or aquaculture facilities; strip mines, borrow pits; and water bodies smaller than 40 ac.

Adjacent farmlands to the south and east of the Proposed Project site (i.e., Ryer Island) are designated as Prime Farmland (California Department of Conservation 2012). Prime Farmland is defined as "farmland with the best combination of physical and chemical features able to sustain long-term

[16] The California Supreme Court clarified the CEQA baseline issue in its Neighbors for Smart Rail v. Exposition Metro Line Construction Authority (2013) 57 Cal.4th 439.

agricultural production. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date." The agricultural land north of the northern cross-levee, adjacent to Prospect Island, is not mapped as Prime, Unique, or Important Farmland.

According to a 2013 California Supreme Court decision (Neighbors for Smart Rail v. Exposition Metro Line Construction Authority (2013) 57 Cal.4th 439), CEQA considers the setting to be existing conditions unless use of those conditions would deprive the public and decision makers of important information or otherwise mislead them. Therefore, this EIR considers the agricultural setting to be the existing non-agricultural use of the Proposed Project site, as reflected in its "Other Land" designation in the County Agricultural Element, which is based on California Department of Conservation mapping.

Legal and regulatory setting

State laws and regulations

Unless otherwise noted, the Proposed Project would comply with the following state laws and regulations.

Williamson Act

The California Land Conservation Act of 1965 (referred to as the Williamson Act) allows local governments to create agricultural preserves and enter into contracts with private property owners to protect land for agricultural and open space purposes. This voluntary program offers preferential tax rates that assess lands based on actual use (agricultural or open space) as opposed to their Proposition 13 determined value, usually creating a financial incentive to maintain farmland and open space, as opposed to allowing conversion to other uses. The Williamson Act program uses rolling 10-year contracts that renew annually until either party files a "notice of non-renewal." If an owner decides to opt out, the land is still protected for 10 years while the tax liability increases in annual increments up to its full market value. While most adjacent farmlands to the east and south are under Williamson Act contracts, the Proposed Project site is not (Solano County Board of Supervisors 2008, Figure AG-2, Williamson Act Contracts).

Delta Protection Commission's Land Use and Resource Management Plan

The goal of the Delta Protection Commission (DPC) is to ensure orderly, balanced conservation and development of the Sacramento-San Joaquin River

Delta (Delta) land resources, including agriculture, wildlife habitat, and recreational activities, and improved flood protection. As called for in the Delta Protection Act, a Land Use and Resource Management Plan (LURMP) for the Primary Zone of the Delta was prepared and adopted by the DPC in 1995 and revised in 2002 and 2010. The Management Plan outlines the long-term land use requirements for the Primary Zone of the Sacramento-San Joaquin Delta, which includes Prospect Island.

The LURMP promotes the maintenance of Delta agriculture and notes that the continued viability of agriculture in the Delta would require the protection of sufficient farmland and fresh water to support commercially viable operations and provide ways for agriculture to coexist with habitat restoration. Farming in the Delta would have to respond to changing conditions and new challenges in the coming years. Among these challenges are shifting commodity markets and consumer demand, changes in climate and water supplies, and subsidence of reclaimed agricultural lands. To support both Delta agriculture and species recovery, farmers in the Delta are encouraged to implement “wildlife-friendly” management practices to maximize habitat value. Relevant agricultural policies of the LURMP include:

- P-1: Support and encourage agriculture in the Delta as a key element in the state’s economy and in providing the food supply needed to sustain the increasing population of the state, the nation, and the world.
- P-2: Conversion of land to non-agriculturally oriented uses should occur first where productivity and agricultural values are lowest.
- P-6: Encourage acquisition of agricultural conservation easements from willing sellers as mitigation for projects within each county. Promote use of environmental mitigation in agricultural areas only when it is consistent and compatible with ongoing agricultural operations and when developed in appropriate locations designated on a countywide or Delta-wide habitat management plan.
- P-7: Encourage management of agricultural lands, which maximize wildlife habitat seasonally and year-round, through techniques such as fall and winter flooding, leaving crop residue, creation of mosaic of small grains and flooded areas, wildlife friendly farming, controlling predators, controlling poaching, controlling public access, and others.
- P-8: Encourage the protection of agricultural areas, recreational resources and sensitive biological habitats, and the reclamation of those areas from the destruction caused by inundation.

Delta Plan

In November 2009, the California Legislature enacted SB 1 X7, also known as the Sacramento–San Joaquin Delta Reform Act. The Act and related legislation on Delta activities contemplates that these activities would involve the conversion of agricultural land to other uses and requires consideration of the agricultural values of the Delta. The Delta bill created a new Delta Stewardship Council (DSC) and gave this body broad oversight of Delta planning and resource management. The DSC adopted a long-term plan (the "Delta Plan") in 2013. The Delta Plan sets forth regulatory policies and recommendations. With respect to agricultural uses, the Delta Plan states that the continued viability of agriculture in the Delta would require the protection of sufficient farmland and fresh water to support commercially viable operations and provide ways for agriculture to coexist with habitat restoration. To support both Delta agriculture and species recovery, farmers in the Delta are encouraged to implement "wildlife-friendly" management practices to maximize habitat value. The Delta Plan includes the following applicable policy:

- DP R10: Encourage Wildlife-friendly Farming. The California Department of Fish and Wildlife, the Delta Conservancy, and other ecosystem restoration agencies should encourage habitat enhancement and wildlife-friendly farming systems on agricultural lands to benefit both the environment and agriculture (DSC 2013).

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, the following have been considered in the analysis of potential impacts and identification of mitigation, as needed.

Unless otherwise noted, the Proposed Project would comply with the following local policies.

Solano County General Plan

Prospect Island and the surrounding area are designated in the Solano County General Plan Land Use Element as Agriculture with a Resource Conservation Overlay (Solano County Board of Supervisors 2008). The Agriculture designation provides areas for the practice of agriculture as the primary use, including areas that contribute significantly to the local agricultural economy, and allows for secondary uses that support the economic viability of agriculture. Agricultural land use designations protect these areas from intrusion by nonagricultural uses and other uses that do not directly support the economic viability of agriculture. The Resource Conservation overlay identifies and protects areas of the county

with special resource management needs. This designation recognizes the presence of certain important natural resources in the county while maintaining the validity of underlying land use designations. The overlay protects resources by: (1) requiring study of potential effects if development is proposed in these locations, and (2) providing mitigation to support urban development in cities. Resources to be protected through this overlay are those identified through technical studies as the highest priority areas within the habitat conservation planning process. Conservation measures used to achieve the County's resource goals vary based on the targeted resource. As discussed above, the Prospect Island site is designated as Other Lands and has not been in agricultural use for approximately 20 years.

Prospect Island is in the Ryer Island Agricultural Region (RIAR), as designated by the Solano County General Plan (Solano County Board of Supervisors 2008). The RIAR is located in the southeastern-most corner of the county and is characterized by fertile soils and little development. Farmers in the area produce primarily field crops that are tolerant of spring flooding. Some producers have planted wine grapes and orchards as well. The RIAR is isolated from major transportation corridors and access is provided only by a narrow bridge or by ferry. Most of the crops grown on the RIAR are transported to and processed in San Joaquin, Sacramento, and Yolo Counties.

The goals and policies of the General Plan Agricultural Element are intended to provide a framework for achieving the agricultural vision. Applicable goals include:

- AR.G-1: Recognize, value, and support the critical roles of all agricultural lands in the stability and economic well-being of the county.
- AR.G-2: Preserve and protect the county's agricultural lands as irreplaceable resources for present and future generations.
- AR.G-3: Support the ability of farmers to earn sufficient income and expand the county's agricultural base by allowing for a wide range of economic activities that support local agriculture.
- AR.G-5: Reduce conflict between agricultural and nonagricultural uses in Agriculture-designated areas.
- AR.G-6: Recognize, support, and sustain agricultural water resources for farmlands.

Applicable policies include:

- AG.P-8: Maintain water resource quality and quantity for the irrigation of productive farmland so as to prevent the loss of agriculture related to competition from urban water consumption internal or external to the county.
- AG.P-9: Promote efficient management and use of agricultural water resources.
- AG.P-25: Facilitate partnerships between agricultural operations and habitat conservation efforts to create mutually beneficial outcomes. Although such partnerships are to be encouraged throughout the county, additional emphasis should be focused in locations where the Resource Conservation Overlay and Agricultural Reserve Overlay coincide.
- AG.P-35: Lands within the Agriculture designations may be re-designated to Watershed or Marsh.

Right-to-Farm Ordinance

Chapter 2.2 of the Solano County Code protects farm operations from nuisance complaints associated with residential uses located next to active agricultural operations. These complaints often cause farm operators to cease or curtail operations. They may also deter others from investing in farm-related improvements that would support the county's agriculture economy. This "right-to-farm ordinance", as it is commonly known, guarantees the right to continue agricultural operations, including, but not limited to, cultivating and tilling the soil, burning agricultural byproducts, irrigating, raising crops and/or livestock, and applying approved chemicals in a proper manner to fields and farmland. This ordinance limits the circumstances under which agriculture may be considered a nuisance. To prevent future conflicts, notice of this ordinance is given to purchasers of real property in the county.

3.12.2 Significance criteria

Criteria for determining significant impacts are based upon Appendix G *Environmental Checklist* of the CEQA Guidelines and professional judgment. These guidelines state that a project would have a potentially significant impact on agricultural resources if it would:

- Convert a substantial amount of Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Important Farmland), as shown on California Department of Conservation maps, to non-agricultural use.
- Conflict with existing zoning for agricultural use, or with a Williamson Act contract.

- Involve other changes in the existing environment that, due to their location or nature, could result in the conversion of farmland to non-agricultural uses.

The CEQA Statute (PRC Section 21060.1[a]) defines *Agricultural Land* as "prime farmland, farmland of statewide importance, or unique farmland, as defined by the USDA land inventory and monitoring criteria as modified for California."

3.12.3 Impacts and mitigation

Impact 3.12-1: Loss or conversion of prime, unique, or important agricultural lands

With the exception of the 17.7 ac of existing agricultural land north of the northern cross-levee, partially on DWR-owned land and partially on the neighboring Fahn property, the Proposed Project site has not been in agricultural use for approximately 20 years and is mostly submerged. No portion of Prospect Island is designated as Prime, Unique or Important Agricultural Land. During construction activities, up to 17.7 ac of existing agricultural land (noting that the 6.8 ac portion on Prospect Island is not currently used for agriculture) would potentially be converted to a temporary staging area (Table 2.2-2 and Figure 2.2-3). Following construction activities, the 6.8 ac of this area that is not currently used for agriculture would be planted with a riparian mix containing both canopy and understory trees and shrubs, creating complex, high value riparian area; the other 10.9 ac would remain in agriculture. The potential conversion of 6.8 ac to riparian habitat would be *less than significant* because it does not represent conversion of Prime, Unique, or Important Agricultural Land, and it is currently not used for agricultural activity on an island of approximately 1600 ac that has no other agricultural activity of any kind.

Impact significance
Less than significant

Impact 3.12-2: Conflicts with Williamson Act contracted lands

The Proposed Project site is not under a Williamson Act contract. Therefore, the Proposed Project would have no impact to any such contracted lands.

Impact significance
No impact

Impact 3.12-3: Potential effects to agricultural uses on adjacent lands

Adjacent lands to the south and east of the Proposed Project site are designated as Prime Farmland and are in active agricultural use. As described in Section 3.1 *Hydrology*, it is anticipated that the Proposed Project would not result in substantial seepage to nearby farmland on adjacent islands, therefore it would not significantly adversely affect agricultural uses on those lands.

Impact significance
Less than significant

3.13 Cultural Resources

This section describes the cultural resources present in the Proposed Project area and assesses impacts to those cultural resources. Cultural resources are defined as: all “built environment” resources (structures, levees, etc.), culturally important resources (sacred places and locations associated with traditional activities), and archaeological resources (both prehistoric and historic). The analysis is based on multiple cultural resource inventories and assessments, including literature review, field surveys on land and in the water, archival research, and Native American and historical society consultation. The study methods, findings, and results are summarized below by resource type. Paleontological resources also are considered in this section.

3.13.1 Setting

Environmental setting

Prospect Island is located in the northern Sacramento-San Joaquin River Delta (Delta). The Official Map of Solano County 1877 depicts the island as un-parceled marshland bordered on the north and west by Prospect Slough and on the east by Miner Slough. By 1915, The Official Map of Solano County depicts the southern three quarters of the island owned by the Anita Land Company and the northern portion owned by Schwan and Deming. Reclamation District 1667 was formed on Prospect Island on January 4, 1917 by the Anita Land Company. The levees were built at that time and farming began by the Prospect Farms Company. Prospect Island has been used for the production of beans, sugar beets, onions, hay, milo, and corn. In the mid-1990s, after the island passed into federal ownership, farming on the island ended.

Literature review

A literature search and an update for the Proposed Project area were conducted by the staff of the Northwest Information Center (NWIC) of the California Historical Resources Information System, Sonoma State University on March 20, 2012 and on September 30, 2013. The searches encompassed a 0.25 mi radius around the Proposed Project area.

References consulted include:

- *California Inventory of Historic Resources* (DPR 1976)
- Office of Historic Preservation *Archaeological Determinations of Eligibility* (OHP 2012a)
- Office of Historic Preservation *Historic Property Directory* (OHP 2012b) (which includes listings of the California Register of Historical Resources, California State Historical Landmarks, California State Points of Historical Interest and the National Register of Historic Places)

Archaeological resources

Based on the literature review, no prehistoric or historic-era archaeological sites are known to occur in the Proposed Project area. Four cultural resource surveys have been conducted on Prospect Island, three covering a small portion of the Proposed Project area (Welch 1998; Welch 2007; Bruce 2008), and one covering the entire island (Parus Consulting 2012). The three smaller studies consisted of pedestrian surveys of portions of the Proposed Project area. The large island-wide survey included a pedestrian survey of the accessible dry-land portions of the Proposed Project area using standard transect spacing no greater than 49 ft apart and a kayak survey of the areas that were inaccessible by foot. Much of the island was inundated during the recent island-wide study. No prehistoric archaeological resources were identified in the four cultural resource surveys.

Native American consultation

The Native American Heritage Commission (NAHC) was contacted by Parus Consulting on March 12, 2012 for a Sacred Lands File search and a Native American contact list. The reply from the NAHC, dated March 22, 2012, stated that the search failed to indicate the presence of Native American Sacred lands or traditional cultural properties in the immediate Proposed Project vicinity. Notification letters were sent to tribes and interested members of the public. No responses were received (Appendix B in Parus Consulting 2012).

Historical resources

Structures

Historic-era structures recorded within the Proposed Project area include the Prospect Island levee system (P-48-000787), a group of six buildings and outbuildings called the "Prospect Island Houses" (P-48-000417), and a house designated Parus-1H-12 (P-48-000956). The Prospect Island houses (P-48-000417) consist of three buildings and three associated outbuildings that were recorded in 1997 (Welch 1998): the Ferry Operator House, a single story house, a two story bunkhouse for farm labor, a pump house, a wash house, and a collapsed structure.

These structures were evaluated for historical significance and determined by the State Historic Preservation Officer to be ineligible for listing on the Natural Register of Historic Places (NRHP) on March 9, 1998 (OHP Project Reference No. BUR980123A) and the levee was likewise determined ineligible on July 7, 2008 (OHP Project Reference No. BUR080627B). Of the "Prospect Island Houses", only the pump house was relocated during the 2012 survey by Parus Consulting (Parus Consulting 2012). The levee remains intact but is not considered an historical property under NHPA or a historical resource under CEQA. The previously unrecorded structure (Parus-1H-12) and the previously recorded and evaluated pump house (P-48-000417) were recorded and evaluated by Parus Consulting (2012) and recommended ineligible for NRHP and California Register of Historical Resources (CRHR) listing. They currently remain intact on the island.

Shipwrecks

The California Department of Water Resources (DWR) requested a California State Lands Commission (CSLC) shipwreck query on August 27, 2013, because the Proposed Project could have in-water effects. The CSLC Shipwreck Database search returned two possible wrecks in the Proposed Project area, a steamer *Zinfandel* that sunk in 1922 and the gold rush-era schooner, *Goliah*. A series of steps were taken to identify whether and where the ships resided within the Proposed Project area. These steps included research of digital newspaper collections, archival research, historical society consultation, and a shipwreck survey (Parus Consulting 2014).

Archival and internet research led to the conclusion that *Goliah* is most likely located in Steamboat Slough near the confluence with Cache Slough, and not in the Proposed Project area. Conversely, research confirmed that the *Zinfandel* went down in 1922 in Miner Slough, although the exact location was not

recorded. Archival research and historical society consultation did not provide precise locational data on the wreck or whether the wreck was salvaged, therefore a shipwreck survey in Miner Slough adjacent to the Proposed Project area was performed. The shipwreck survey used side-scan sonar and magnetometer readings to locate the ship's remains. The *Zinfandel* was not located in Miner Slough adjacent to the Proposed Project area (Parus Consulting 2014).

Paleontological resources

The Proposed Project site is located in Holocene-aged sediments, which formed after the end of the last glacial maximum (URS 2013). Holocene sediments are recent, less than 11,000 years old, and are not considered to contain paleontological resources. Proposed Project activities would not extend beyond the Holocene geologic units and into older sediments. Thus, there is no possibility of the presence of paleontological resources.

Legal and regulatory setting

Multiple state and federal laws govern the treatment of cultural resources. Both CEQA and PRC 5024 apply to state owned resources and state sponsored projects. Because the Proposed Project includes actions that involve issuance of federal permits, there is a federal nexus and compliance with the National Historic Preservation Act (NHPA) and its implementing regulations (36 Code of Federal Regulations [CFR] 800, 36 CFR 60, and 36 CFR 63) is required.

Federal laws

Unless otherwise noted, the Proposed Project would comply with the following federal laws.

National Historic Preservation Act Section 106 and guidelines

The NHPA of 1966, as amended, sets forth national policy and procedures for historic properties, defined as districts, sites, buildings, structures, and objects included in or eligible for listing in the NRHP. Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties and to allow the Advisory Council on Historic Preservation the opportunity to comment on those undertakings, following regulations issued by the Council (36 CFR 800).

Under Section 106, cultural resource significance is evaluated in terms of eligibility for listing in the NRHP. The NRHP criteria for evaluation are defined at CFR Title 36, Section 60.4, as follows: "The quality of significance in American

history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling and association, and meet the following:

- Are associated with events that have made a contribution to the broad pattern of our history;
- Are associated with the lives of people significant in our past;
- Embody the distinct characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or,
- Have yielded, or are likely to yield, information important in prehistory or history."

If historic properties are identified in the Proposed Project area, effects of the Proposed Project on those properties must be assessed. If effects would be adverse, the federal agency would continue working with the consulting parties to resolve the adverse effects through Proposed Project modifications, avoidance, minimization, or mitigation (CFR Title 36, Sections 800.5-800.6).

State laws

Unless otherwise noted, the Proposed Project would comply with the following state laws.

California Environmental Quality Act—statute and guidelines

CEQA requires that public agencies that finance or approve public or private projects must assess the effects of the Proposed Project on cultural resources (CEQA Guidelines Section 15064.5). "Cultural resource" is a general term that encompasses CEQA's definition of historical resources (PRC Section 21084.1) and unique archaeological resources (PRC Section 21083.2). CEQA requires that alternative plans or mitigation measures must be considered if a project would result in significant effects on important cultural resources. Only significant cultural resources, however; need to be addressed (CEQA Guidelines Section 15064.5 [a][3]). Therefore, prior to the development of mitigation measures, the significance of cultural resources with the potential to be impacted by the Proposed Project must be determined. The criteria for determining historical significance are defined in PRC 5024.1.

The CEQA Guidelines also require that a lead agency make provisions for the accidental discovery of historical or archaeological resources. Pursuant to

Section 15064.5(f), these provisions should include “an immediate evaluation of the find by a qualified archaeologist. If the find is determined to be an historical or unique archaeological resource, contingency funding and a time allotment sufficient to allow for implementation of avoidance measures or appropriate mitigation should be available. Work could continue on other parts of the building site while historical or unique archaeological resource mitigation takes place.”

California Public Resources Code Sections 5024
PRC Section 5024.1 establishes the CRHR, which is the authoritative guide for identifying the state’s historical resources to indicate what properties are to be protected, if feasible, from substantial adverse change.

In order for a resource to be eligible for the CRHR it must be over 50 years old, retain its historic integrity, and satisfy one or more of the following criteria:

- Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.
- Is associated with the lives of persons important in our past.
- Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values.
- Has yielded, or may be likely to yield, information important in prehistory or history.

Discoveries of Human Remains under California Health and Safety Code Section 7050.5 (b-c) and Public Resources Code Section 5097.98 (a)
In the event of discovering human remains, there shall be no further excavation or disturbance of the remains until they are examined by the Solano County Coroner. The Coroner has two working days to determine the nature of those remains. If the Coroner determines that the remains are Native American, he/she would contact the NAHC by telephone within 24 hours.

Once the NAHC has been notified of the discovery of Native American human remains, it shall immediately notify those persons believed to be the most likely descendants. The most likely descendants may inspect the site of the discovery and recommend to the owner methods of treating, with dignity, the human remains and any associated grave goods. The descendants shall complete their inspection and make recommendations or preferences for treatment within 48 hours of being granted access to the site.

3.13.2 Significance criteria

Under CCR Section 15064.5 and Appendix G *Environmental Checklist* of the CEQA Guidelines, the Proposed Project would have a significant impact on archaeological or historical resources if it would result in any of the following threshold criteria:

- A substantial adverse change in the significance of an historical resource as defined in CCR Section 15064.5.
- A substantial adverse change in the significance of an archaeological resource as defined in CCR Section 15064.5.
- Disturb human remains, including remains interred outside of established cemeteries. For the purposes of this analysis disturbance may consist of direct excavation or damage through compaction even where the resource is not directly excavated.
- Under Section 106 of the NHPA, an adverse effect on an historic property is found when an activity may alter, directly or indirectly, any of the characteristics of an historic property that qualify it for inclusion in the NRHP. The alteration of characteristics is considered adverse if it may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association.

3.13.3 Impacts and mitigation

Impact 3.13-1: Impacts to historical resources on land

The Proposed Project would entail the demolition of existing buildings/structures on the island, and would include breaching the levee in two places. As mentioned above, previously recorded cultural resources at the Proposed Project site (i.e., Prospect Island levee system, Prospect Island houses, and the one other structure) were evaluated for historical significance and found not eligible for listing on the NRHP or the CRHR (Welch 1998; Bruce 2008; Parus Consulting 2012; SHPO reference No. BUR080627B). All but two of these buildings and the levees were demolished prior to 2012. The pump house and the house found during the 2012 survey are still standing and the levee is still intact. Both the levee and the extant buildings have been determined by the State Historic Preservation Officer to be historically insignificant and ineligible for listing on the NRHP and CRHR (SHPO reference No. COE-2014-0701-001). Since these remaining buildings and levees do not qualify as historical resources, no impact would occur as a result of their demolition for the Proposed Project.

Impact significance

No impact

Impact 3.13-2: Inadvertent discovery of a shipwreck during in-water construction

The shipwreck survey did not find the steamship *Zinfandel* in Miner Slough adjacent to the Proposed Project site (Parus Consulting 2014). Although a magnetometer and sidescan sonar survey covered the levee breach locations, it is possible that an unrecorded shipwreck may be buried in sediment in the Miner Slough channel and could be encountered during clamshell dredging. If an unknown shipwreck is discovered during the construction phase, then a potentially significant impact could occur. Implementation of Mitigation Measure 3.13-2.1 would reduce this impact to *less than significant*.

Mitigation Measure 3.13-2.1

The title to all abandoned shipwrecks, archaeological sites, and historic or cultural resources on or in the tide and submerged lands of California is vested in the state and under the jurisdiction of the CSLC (PRC Section 6313[a]). In the case of an inadvertent discovery of a submerged shipwreck or related artifacts, all work must cease in the immediate vicinity of the find and DWR cultural resources staff and the USACE archaeologist shall be notified immediately in order to initiate consultation with the CSLC staff within two business days of such discovery pursuant to CFR Title 36 *Parks, Forests, and Public Property*, Chapter VIII *Advisory Council on Historic Preservation,* Part 800.13 (b)(3).

PRC 6313 (c) states any submerged historic resource remaining in state waters for more than 50 years shall be presumed to be archaeologically or historically significant. If the DWR and U.S. Army Corps of Engineers (USACE) archaeologist, in consultation with the CSLC staff, determine that a historical resource may be present within the Proposed Project site, DWR shall retain the services of a qualified maritime archaeological consultant. The maritime archaeological consultant would recommend whether the discovery is an historical/archaeological resource that retains sufficient integrity and is of potential historical or scientific significance. The maritime archaeological consultant also would recommend as to what action, if any, is warranted and would document all recommendations in writing. Based on this information, the USACE, in consultation with the CSLC, may require additional measures to be implemented by DWR.

Measures might include preservation *in situ* of the historical resource or a data recovery program. The Proposed Project maritime archaeological consultant shall submit a Final Historical Resources Report to DWR, the USACE, and the CSLC staff. This report shall include an evaluation of the historical significance, with a description of the archaeological and historical research methods employed in any archaeological data recovery program undertaken.

Impact significance

Less than significant with mitigation

Impact 3.13-3: Impacts to unknown archaeological resources

No known prehistoric or historic-era archaeological resources meeting CRHR or NRHP eligibility criteria were previously recorded inside the Proposed Project area or found during archaeological surveys conducted at the Proposed Project site. However, excavation of channels and earth working activities during construction have the potential to impact unrecorded cultural resources. Should cultural resources be encountered during ground-disturbing activities during the construction and post-construction phases, then a potentially significant impact could occur. Implementation of Mitigation Measure 3.13-3.1 would reduce this impact to *less than significant*.

Mitigation Measure 3.13-3.1

To reduce potential impacts to unknown archaeological resources, the following measures shall be implemented before the start of ground-disturbing activities:

1. An archaeologist shall conduct cultural resources awareness training for contractors and staff prior to the start of construction.
2. If historical or unique archaeological resources are discovered during construction, work must be halted within 100 ft of the find until a qualified archaeologist meeting the Secretary of the Interior's Standards for archaeologists (NPS 1997) visits the site and assess the significance of the resource. Work may continue on other parts of the Proposed Project while evaluation and mitigation takes place (CEQA Guidelines Section 15064.5(f)). After the assessment is completed, the archaeologist shall submit a report describing the significance of the discovery with treatment recommendations. If the find is determined to be an historical or unique archaeological resource, time allotment and funding sufficient to allow for implementation of avoidance measures or appropriate mitigation must be available.

3. Should unique archaeological resources be found, the resources shall be treated in compliance with Public Resources Code Section 21083.2. If the Proposed Project can be modified to accommodate avoidance, preservation of the resource is preferred. Data recovery of the damaged portion of the resource also shall be performed pursuant to PRC Section 21083.2(d).

Impact significance
Less than significant with mitigation

Impact 3.13-4: Impacts to unknown human burials

No human remains or archaeological contexts have been identified in the Proposed Project area and it is unlikely that human remains would be encountered during construction activities. However, the potential to unearth human remains during construction still exists. Ground disturbing activities have the potential to result in the discovery or inadvertent damage of human remains and this possibility cannot be completely eliminated, therefore a potential for significant impact remains. Implementation of Mitigation Measure 3.13-4.1 would reduce the potential impacts to *less than significant*.

Mitigation Measure 3.13-4.1
If human remains are found, such remains are subject to the provisions of California HSC Section 7050.5-7055. The requirements and procedures shall be implemented, including immediately stopping work in the vicinity of the find and notification of the Solano County Coroner. The process for notification of the California NAHC and consultation with the individual(s) identified by the NAHC as the “most likely descendant” is set forth in Section 5097.98 of the California Public Resources Code. Work can restart after the remains have been investigated and appropriate recommendations have been made for the treatment and disposition of the remains.

Impact significance
Less than significant with mitigation

Impact 3.13-5: Impacts to paleontological resources

Geological units bearing paleontological resources are not present on the island (URS 2013); therefore, there would be no impact to paleontological resources. No mitigation is required.

Impact significance

No impact

3.14 Land Use and Planning/Population and Housing

This section describes and assesses land use impacts, including housing and population, on and near the Proposed Project site. Actual land use is considered on and adjacent to the site. The analysis is based on field reconnaissance and review of applicable maps, plans, and policies.

3.14.1 Setting

Environmental setting

Prospect Island is located at the eastern edge of Solano County, in an area dominated by agricultural land uses. The Proposed Project site, including both the north and south properties, is currently flooded, uncultivated land that, prior to flooding, was used for agriculture (see Section 3.12 *Agricultural Resources*). Currently, the south property is leased out for waterfowl hunting year-round.

Nearby land uses

Sacramento Deep Water Ship Channel (DWSC)

The western edge of Prospect Island is bounded by the Sacramento Deep Water Ship Channel (DWSC), a 45.8 mi-long navigation channel managed by the Port that runs from the confluence of the Sacramento and San Joaquin rivers in the western Sacramento-San Joaquin River Delta (Delta), up the Sacramento River, through lower Cache Slough, and north to the Port. The DWSC runs through Contra Costa, Solano, Sacramento, and Yolo counties and serves the marine terminal facilities of the Port. The most common cargo transported by ships using the DWSC are products related to the agricultural industry, with rice now comprising 96% of the total cargo tonnage (City of West Sacramento 2013).

Liberty Island

Liberty Island, which is approximately 4,525 ac, is located on the western side of the DWSC. The levees protecting the island failed during the El Niño floods of 1998, and they were never repaired. Prior to the levee breach, Liberty Island was used primarily for agricultural production. Since the breach, Liberty Island has served as flooded open space supporting fish populations and wetlands habitat. In January 2011, the Trust for Public Land transferred 4,308 ac of Liberty Island to the California Department of Fish and Wildlife (CDFW), for ongoing restoration and protection. The Liberty Island Conservation Bank, owned by Wildlands, Inc,

comprises the remaining northern 186 ac of Liberty Island, and functions as an on-going tidal restoration project (Reclamation District 2093 2009).

Prospect Island West

Completion of the DWSC in 1963 cut off the western section of Prospect Island, a sliver of land, from the main island. The levees were no longer maintained and subsequently failed in the early 1960s. These lands are now a combination of shallow tidal waters, tidal marsh, and riparian vegetation.

Miner Slough Wildlife Area

The Miner Slough Wildlife Area is located adjacent to the south end of Prospect Island and managed by California Department of Fish and Wildlife (CDFW). The Miner Slough Wildlife Area is a 37-ac tidal and riparian reserve composed of one small island and a narrow peninsula surrounded by waterways extending from Prospect Island.

Ryer Island

Ryer Island is to the east of Prospect Island across Miner Slough. The vast majority of Ryer Island is actively farmed. Ryer Island includes the Snug Harbor Resort residential area (on the southeastern portion of the Island), a marina on the southern tip of the island, and a managed wetland near Miner Slough. The island supports a resident community of 200 people as well as 250–300 seasonal migrant workers.

Hall Island

Hall Island is a privately-owned island almost completely enclosed by Prospect Island on Miner Slough. The 21-ac property was once connected by a road to Prospect Island and supported multiple residences. The island flooded sometime between 1993 and 2002 and has since reverted mainly to open water with a fringe of tidal marsh and riparian vegetation. Although there is an access easement that follows the Prospect Island levees along the DWSC and perimeter of the south property, there is currently no land access between Hall Island and the Prospect Island levees (Figure 2.1-2).

Arrowhead Harbor Marina

Arrowhead Harbor Marina is located just north of Prospect Island across Miner Slough, at the southwestern tip of the Clarksburg Agricultural District. This 5 ac marina is the closest marina to the Proposed Project site, and the only one currently operational on Miner Slough.

Little Holland Tract and Little Holland Tract East
A remnant of Little Holland Tract lies directly to the north of Prospect Island and is separated from Prospect Island by a restricted-height levee. Little Holland Tract was split into two pieces by construction of the DWSC. The levees around Little Holland Tract on the west side of the DWSC breached in 1983, were repaired in 1991, and breached again in 1992. The U.S. Army Corps of Engineers (USACE) assumed management upon purchase of the tract in 1999. Little Holland Tract is now a mixture of tidal marsh, riparian vegetation, and shallow tidal waters. On the east side of the DWSC, north of Prospect Island, lies Little Holland Tract East. This 600-ac privately owned parcel remains in agricultural production.

Miner Slough
Recreational vessels use Miner Slough, including the two small side channels, for fishing and recreational boating.

Nearby Municipal Areas
The City of Rio Vista and the Rio Vista Municipal Airport are located approximately 3 mi southwest of Prospect Island. The largest major metropolitan area in the vicinity, Sacramento, is located 30 mi to the northeast.

Legal and regulatory setting

Federal laws and regulations
There are no federal laws or regulations regarding land use on Prospect Island. However, the site is in the Yolo Bypass Floodway (Yolo Bypass), where development is limited to prevent floodplain restrictions and hazards to structures from flood flows.

State regulations
Unless otherwise noted, the Proposed Project would comply with the following state regulations.

Delta Land Use and Resource Management Plan (Delta Protection Commission)
The Delta Protection Commission (DPC) was created by the State Legislature in 1992 with the goal of developing regional policies for the Delta to protect and enhance the existing land uses in the Primary Zone: agriculture, wildlife habitat, and recreation. A large portion of the Yolo Bypass Wildlife Area (YBWA) is within the Primary Zone of the Delta. The DPC's Land Use and Resource Management Plan (LURMP) for the Primary Zone of the Delta (Delta Protection Commission 2010) includes the following policies and recommendations applicable to the land

use:

- **Land Use Policy P-2:** Local government General Plans and zoning codes shall continue to strongly promote agriculture as the primary land use in the Primary Zone; recreation land uses shall be supported in appropriate locations and where the recreation uses do not conflict with agricultural land uses or other beneficial uses, such as waterside habitat.
- **Land Use Recommendation R-2:** Public agencies and non-profit groups have or propose to purchase thousands of acres of agricultural lands to restore to wildlife habitat. The amount, type, and location of land identified to be enhanced for wildlife habitat should be studied by wildlife experts to determine goals for future acquisition and restoration. Lands acquired for wildlife habitat should also be evaluated for recreation, access, research and other needed uses in the Delta. Habitat restoration projects should not adversely impact surrounding agricultural practices. Public-private partnerships in management of public lands should be encouraged. Public agencies shall provide funds to replace lost tax base when land is removed from private ownership.
- **Land Use Recommendation R-3:** Multiple use of agricultural lands for commercial agriculture, wildlife habitat, and, if appropriate, recreational use, should be supported, and funding to offset management costs pursued from all possible sources. Public agencies shall provide funds to replace lost tax base when land is removed from private ownership.

The Delta Plan (Delta Stewardship Council)

The Delta Plan is a comprehensive, long-term management plan for the Delta. Required by the 2009 Delta Reform Act, it creates new rules and recommendations to further the state's co-equal goals for the Delta: Improve statewide water supply reliability, and protect and restore a vibrant and healthy Delta ecosystem, all in a manner that preserves, protects and enhances the unique agricultural, cultural, and recreational characteristics of the Delta. The Delta Plan contains a set of regulatory policies that would be enforced by the Council's appellate authority and oversight. The Delta Plan designates the Proposed Project site as being in a Priority Habitat Restoration Area. Relevant Delta Plan policies include the following "recommended policies":

- **ER R2. Prioritize and Implement Projects that Restore Delta Habitat.** California Department of Fish and Wildlife, California Department of Water Resources, and the Delta Conservancy should prioritize and implement habitat restoration projects in the areas shown on Figure 4-8 of the Delta Plan (DSC 2013). Habitat restoration projects should ensure connections

between areas being restored and existing habitat areas and other elements of the landscape needed for the full life cycle of the species that would benefit from the restoration project. Where possible, restoration projects should also emphasize the potential for improving water quality.

- **DP R10. Encourage Wildlife-friendly Farming.** CDFW, the Delta Conservancy, and other ecosystem restoration agencies should encourage habitat enhancement and wildlife-friendly farming systems on agricultural lands to benefit both the environment and agriculture.

Central Valley Flood Protection Board

Pursuant to CCR Title 23 *Water Code*, the Central Valley Flood Protection Board (CVFPB) is responsible for enforcing standards for construction, maintenance, and protection of adopted flood control plans within the Central Valley of California, including the Yolo Bypass. An encroachment permit from the CVFPB is required for any project or plan of work that: (1) is within federal flood control project levees and within a CVFPB easement; (2) may have an effect on the flood control functions of project levees; (3) is within a CVFPB designated floodway; or (4) is within the regulated Central Valley streams listed in Table 8.1 of CCR Title 23. The CVFPB exercises jurisdiction over the levee section, the waterward area between project levees, a 10 ft-wide strip adjacent to the landward levee toe, within 30 ft of the top of the banks of un-leveed project channels, and within designated floodways adopted by the CVFPB. Proposed restoration and levee work within the Proposed Project area would require an encroachment permit from the CVFPB.

CCR Title 23, Section107 provides for uses that may be permitted in a designated floodway, provided they would not unduly impede the free flow of water in the floodway or jeopardize public safety. Some of these uses that may apply to Proposed Project activities include: (a) open space uses not requiring a closed building, such as agricultural croplands, orchards, livestock feeding and grazing, or public and private recreation areas; (b) fences, fills, walls, or other appurtenances which do not create an obstruction or debris-catching obstacle to the passage of floodwaters; (f) improvements in stream channel alignment, cross-section, and capacity; and (i) other uses which are not appreciably damaged by floodwaters.

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, the following have been considered in the analysis of potential impacts and identification of mitigation, as needed.

Unless otherwise noted, the Proposed Project would comply with the following local policies.

Solano County General Plan—land use chapter

The Solano County General Plan designates both the north and south properties as intensive agriculture, a non-essential agricultural land-use designation, with a "Resource Conservation Overlay" (Solano County Board of Supervisors 2008). As described in Section 3.12 *Agricultural Resources*, the agriculture designation provides areas for the practice of agriculture as the primary use, including areas that contribute significantly to the local agricultural economy, and allows for secondary uses that support the economic viability of agriculture. Agricultural land use designations protect these areas from intrusion by nonagricultural uses and other uses that do not directly support the economic viability of agriculture.

The Resource Conservation overlay identifies and protects areas of the County with special resource management needs. This designation recognizes the presence of certain important natural resources in the county while maintaining the validity of underlying land use designations. The overlay protects resources by (1) requiring study of potential effects if development is proposed in these locations, and (2) providing mitigation to support urban development in cities. Resources to be protected through this overlay are those identified through technical studies as the highest priority areas within the habitat conservation planning process. Conservation measures used to achieve the County's resource goals vary based on the targeted resource.

The Land Use Chapter (Chapter 2) of the Solano County General Plan describes present and planned land uses and their relationship to the County's long-range goals for the future. It provides a framework for other issues examined in the General Plan and identifies how land is used throughout the county for agriculture, housing, business, community facilities, transportation, recreation, and open space.

Two applicable land use strategies are expressed in the General Plan vision statement:

- Promoting city-centered development consistent with longstanding County policy that “What is urban shall be municipal”; and,
- Sustaining diverse land uses that define the character and identity of Solano County.

Solano County General Plan—resources chapter

The Resources Chapter of the Solano County General Plan functions as the plan’s Open Space Element. The purpose of the Resources Chapter is to identify the goals, policies, and implementation measures that would be used by the County in day-to-day decision making to protect natural, cultural, and open space resources. The chapter focuses on conserving, preserving, and enhancing these resources to ensure a high quality of life for current and future county residents. The Open Space Element is used to manage all open space areas, including undeveloped wilderness lands and outdoor recreation uses. The California Government Code defines that open space should be preserved for the preservation of natural resources, managed production of resources, recreation, and public health and safety.

The following policies of the Resources Chapter are applicable to the Proposed Project site:

- RS.G-1: Manage and preserve the diverse land, water, and air resources of the county for the use and enrichment of the lives of present and future generations.
- RS.G-2: Ensure continued presence and viability of the county’s various natural resources.
- RS.G-3: Repair environmental degradation that has occurred, and seek an optimum balance between the economic and social benefits of the county's natural resources.
- RS.G-4: Preserve, conserve, and enhance valuable open space lands that provide wildlife habitat; conserve natural and visual resources; convey cultural identity; and improve public safety.
- RS.G-6: Preserve the visual character and identity of communities by maintaining open space areas between them.
- RS.G-10: Foster sound management of the land and water resources in Solano County's watersheds to minimize erosion and protect water quality using best management practices and protect downstream waterways and wetlands

Solano County zoning ordinance
The site is zoned A-80, which is intended exclusively for agriculture with an 80 ac-minimum lot size (Solano County Zoning Map, 16-N, 7/26/77).

3.14.2 Significance criteria

Criteria for determining significant impacts are based upon Appendix G *Environmental Checklist* of the CEQA Guidelines and professional judgment. These guidelines state that a project would have a potentially significant impact on land use and planning if it would:

- Physically divide an established community.
- Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Proposed Project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect.
- Conflict with any applicable habitat conservation plan or natural community conservation plan. This criterion is addressed in the biological resources sections and therefore is not evaluated in this section.

In addition, the following criterion is used to determine significant impacts on land use and planning if it would:

- Cause a substantial conflict with adjacent or nearby land uses.

3.14.3 Impacts and mitigation

Impact 3.14-1: Potential conflicts with adjacent land uses

The Proposed Project would not result in increased seepage of groundwater onto Ryer Island (Impacts 3.1-6 and 3.12-3), and therefore would not be incompatible with agricultural uses in those areas. In addition, the Proposed Project would not result in navigational hazards for boats accessing the Arrowhead Harbor Marina (Impact 3.16-2).

The existing Hall property easement along the southern portion of the Miner Slough levee would be interrupted at the location of the southern breach of the Proposed Project. However, because there is currently no land access to Hall Island from the Miner Slough levee and the property is flooded, there would be no potential conflicts with existing land uses on the property.

Impact significance
Less than significant

Impact 3.14-2: Potential conflict with plans and policies

The Proposed Project would not change existing land uses on the site nor conflict with the plans and policies discussed in setting section of this resource area. The Proposed Project would be consistent with the Solano County General Plan's land use and zoning designations. The Proposed Project supports the policies in both the LURMP and the Delta Plan. Therefore, there would be no impact.

Impact significance
No impact

Impact 3.14-3: Population and housing effects

The Proposed Project would not affect population or housing. No residents would be displaced or added to the site and no residences would be removed or built. As described in Section 17 *Transportation and Traffic*, vehicular access to one house would be adversely affected, but the house would remain habitable. Additionally, no impact to local and regional population or housing would occur because employment changes due to the Proposed Project would be limited to the construction period and most workers would likely live in in the region. There is no community on the Proposed Project site that would be divided or changed. Therefore, there would be no impact.

Impact significance
No impact

3.15 Public Services

This section describes existing police and fire protection services to the Proposed Project site. Other public services, including libraries, schools, and parks are not relevant to the Proposed Project because it does not include new housing or commercial uses, and therefore would not result in new demand for those services. Solid waste generation would be minimal, and limited to the construction period, so is not evaluated further in this section. Mosquito control services are addressed in Section 3.6 *Hazards and Hazardous Materials*.

3.15.1 Setting

Environmental setting

The Proposed Project site currently requires minimal public services. Police service is provided by the Solano County Sherriff's Office Main Station in Fairfield and fire and emergency services are provided by California Department of Forestry and Fire Prevention (CAL FIRE) as well as by the Montezuma Fire Protection District, which provides ambulance and emergency medical services. Prospect Island and the adjacent Wildlife Refuge also are patrolled by California Department of Fish and Wildlife (CDFW) law enforcement officers. The property is owned by the State of California, which falls within the jurisdiction of the California Highway Patrol (CHP). The CHP acts as the State Police, and may back up or assist CDFW law enforcement officers as needed.

Solano County provides law enforcement services to prevent, respond to, and apprehend criminal activity. The majority of the law enforcement services are administered by the Solano County Office of the Sheriff. The sheriff is responsible for a variety of law enforcement services, such as safety patrol services, dispatch of safety personnel, holding custody of adult law offenders, operation of the jail and security at court facilities. The sheriff operates two jails in Solano County: the Fairfield Main Facility and the Claybank Facility. Compared with more densely populated areas in California, unincorporated Solano County has low crime rates (Solano County General Plan, page PF-31).

Fire protection service to Prospect Island is provided by CAL FIRE (J. Isaac, Solano County, pers. comm., March 2014). Prospect Island is served by CAL FIRE's Solano Lake Napa Unit, which provides fire protection services for several unincorporated communities in Solano County.

The Montezuma Fire District provides emergency medical service to Prospect Island. Emergency services are provided by paramedics and emergency medical technicians (EMTs) who perform pre-hospital medical procedures to aid injured victims who require immediate medical attention. Montezuma has seven stations, two of which are on Ryer Island.

Legal and regulatory setting

Federal and state laws and regulations

There are no federal or state laws or regulations applicable to provision of public services to Prospect Island. Local regulations are discussed below.

Local policies

The Solano County General Plan (Solano County Board of Supervisors 2008) outlines the following information and policies for Law Enforcement and Fire Protection and Emergency Services in Chapter 8 (Public Facilities and Services).

County law enforcement policies

- PF.P-40: Provide an effective and responsive level of police protection (including facilities, personnel, and equipment) through the Solano County Office of the Sheriff and in coordination with city police departments.
- PF.P-41: In the review and approval of County and City projects, identify and consider the law enforcement needs generated by the Proposed Project.

County fire protection and emergency services policies

- PF.P-38: Ensure accessible and cost-effective fire and emergency medical service throughout the county. Facilitate coordination among city and county fire agencies and districts to improve response times, increase services levels, provide additional training, and obtain essential equipment.
- PF.P-39: Identify and require incorporation of fire protection and emergency response measures in the review and approval of new projects.

3.15.2 Significance criteria

Criteria for determining significant impacts are based upon Appendix G *Environmental Checklist* of the CEQA Guidelines and professional judgment. These guidelines state that a project would have a potentially significant impact on public services if it would:

Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:

i) Fire protection
ii) Police protection
iii) Schools
iv) Parks
iv) Other public facilities - Vector Control, Solid Waste

3.15.3 Impacts and mitigation

Impact 3.15-1: Potential conflict with existing police and fire protection services

The Proposed Project, which would construct a northern and a southern breach on the Miner Slough levee and breach the cross-levee that separates the north and south areas of the island, would not result in new housing or commercial uses; therefore, would not generate additional demand for police or fire protection. During construction there would be no change in access, but some additional people (construction workers) would be on the Proposed Project site, who could require police and/or fire protection services. After construction, the Proposed Project would not increase in demand for services. Implementation of Mitigation Measure 3.17-1.1 would reduce this impact to *less than significant*. No additional mitigation measures are required.

Impact significance

Less than significant with mitigation

3.16 Recreation

This section describes existing recreation uses in the vicinity of the Proposed Project, the various plans and policies related to the Sacramento-San Joaquin River Delta (Delta) recreation planning and development, and the regulatory agencies that oversee recreation planning and use. Although the Proposed Project does not include any recreation development, the potential impacts and benefits to recreation from implementation of the Proposed Project are discussed in this section.

3.16.1 Setting

Environmental setting

Regional recreation

The greater Delta is a maze of channels and islands at the confluence of the Sacramento and San Joaquin Rivers. The Delta region is approximately 1,150 square miles (mi^2) in area and provides more than 500 mi) of navigable waterways, equaling more than 57,000 navigable surface acres. This vast network of river channels, sloughs, and islands provides a unique and important recreation resource in California.

Recreation uses in the Delta encompass many activities. Boating and fishing are the most popular, but recreationists also take part in wildlife viewing, sightseeing, walking, picnicking, and camping. Many of these activities overlap, and can be both water- and land-based.

Facilities supporting these activities are distributed throughout the Delta. More than 100 marinas and marina resorts operate within and on the margins of the Delta. These range from small facilities with fewer than 50 long-term berths to large facilities with more than 500 berths and additional amenities such as boat ramps, recreational vehicle (RV) and tent campgrounds, cabins, restaurants and bars, convenience stores, and picnic areas. Numerous yacht clubs are based at commercial marinas in the Delta, and more than 20 yacht clubs operate Delta facilities for their members that are separate from marinas.

Publicly owned facilities in the Delta comprise several large city-operated marinas situated on Delta waterways; several county parks that offer boat ramps, fishing access, camping, and picnic sites; and two State Park units. Federal Wildlife Refuges, State Wildlife Areas, and public and private nature preserves also are used for recreation.

Proposed Project site recreation

There are no formal recreation areas located at the Proposed Project site. Prospect Island is posted against both trespassing and hunting, though unauthorized access for hunting purposes reportedly occurs on occasion. The south property is currently leased for use by an informal “hunting club,” allowing about a half-dozen participating individuals private access for waterfowl hunting. Some of these individuals may occasionally access the south property at other times, typically to install and maintain blinds and for other limited recreational purposes (C. Hagen, CDFW, pers. comm., September 2014).

The only developed recreation facility near the Proposed Project site is the Arrowhead Harbor Marina, located on Miner Slough directly across the slough from the Proposed Project site. Arrowhead Harbor Marina offers long-term berthing, dock services, recreational vehicle camping (no tents), and boat launching. The recreation and access offered at Arrowhead Harbor Marina is year-round; use typically ranges from a few to a few-dozen launches per day, with peak usage reportedly corresponding to the peak months of popular fishing seasons (e.g., sturgeon from October through May; Striped Bass in November and May). According to the marina owners, their clientele primarily uses this marina for access to the Sacramento Deep Water Ship Channel (DWSC) and

other Delta waters, with relatively little recreation (such as waterskiing) occurring on channels immediately adjacent to the marina (J. Fonss, Arrowhead Harbor Marina, pers. comm., May 2014).

The only public recreation area near the Proposed Project site is the Miner Slough Wildlife Area. This State Wildlife Area (SWA) is situated adjacent to the southern end of the Proposed Project site, at the confluence of Miner Slough and Cache Slough, bounded on the north by Prospect Island and on the east by Ryer Island. It is a 37 ac SWA consisting of two small islands and narrow peninsula from Prospect Island. Approximately 10 ac are above high tide; the remainder is submerged with the exception of some mudflats during low tide. This SWA is accessible only by boat and includes riparian vegetation that supports shorebirds, waterfowl, raptors, and beavers. Bird watching, wildlife viewing, and fishing are allowed. Fishing in the surrounding sloughs is primarily for catfish, Largemouth Bass, crappie, and Striped Bass. Hunting for waterfowl is allowed year-round (no rifles or handguns allowed). There are no recreation facilities in this SWA and no permits, passes, or reservations are required.

Some informal public use of the levees and banks along the northern portion of the DWSC occurs, primarily for hunting and fishing access off of Jefferson Boulevard (State Route 84 [SR-84]). However, in the vicinity of the Proposed Project, such access to the DWSC levee is deterred by locked and signed gates, as well as other signs along area roadways that are posted and maintained by respective Reclamation Districts.

Legal and regulatory setting

Federal regulations

Unless otherwise noted, the Proposed Project would comply with the following federal regulations.

Boat Navigation Jurisdiction, Rules, and Regulations

U.S. Coast Guard

While boating law enforcement is often performed at the local level by local agencies such as county sheriff and municipal marine patrols, the Coast Guard and other federal regulators have enforcement authority in federally navigable waters. Title 14 of the United States Code (USC), CFR Title 33 and other portions of the CFR, give the U.S. Coast Guard authority for maritime law enforcement on the navigable waters of the United States, as well as responsibilities for search and rescue, marine environmental protection, and the maintenance of river aids to navigation, among other roles. Included within the

Coast Guard's authority are inland waters, which are those waters shoreward of the territorial sea baseline, as defined within Title 33, Part 2. Furthermore, Title 33, Part 162 Inland Waterways Navigation Regulations, Section 162.205 addresses Suisun Bay, San Joaquin River, Sacramento River, and connecting waters within which the Coast Guard has authority and jurisdiction. Specific to the Delta, CFR, Title 33, Section 162 provides regulations for the navigation by both commercial and noncommercial vessels on the DWSC (between Suisun Bay and Stockton) and the DWSC (between Suisun Bay and West Sacramento).

State laws and regulations

Unless otherwise noted, the Proposed Project would comply with the following State of California laws and regulations.

Delta Protection Commission Plans and Policies

Delta Protection Act and Land and Resource Management Plan

The Delta Protection Act of 1992 (PRC Section 21080.22, 26 Division 19.5) established the Delta Protection Commission (DPC), a state entity to plan for and guide the conservation and enhancement of the Delta's natural resources while sustaining agriculture and meeting increased recreational demand. The Delta Protection Act defines a Primary Zone, which comprises the principal jurisdiction of the DPC. The Secondary Zone is the area outside the Primary Zone but within the "Legal Delta"; the Secondary Zone is not in the planning area of the DPC. The DPC has appeal authority over local government actions in the Delta's Primary Zone.

Chapter 1 of the Delta Protection Act (Findings and Declarations) includes the following sections.

> Section 29702 indicates that the basic goals of the state for the Delta include the protection, maintenance, and, where possible, the enhancement and restoration of the overall quality of the Delta environment, including, but not limited to, agriculture, wildlife habitat, and recreational activities.
>
> Section 29705 indicates that the Delta's wildlife and wildlife habitats are valuable, unique, and irreplaceable resources of critical statewide significance and should be preserved and protected for the enjoyment of current and future generations.

> Section 29710 declares that agricultural, recreational, and other uses of the Delta can best be protected by implementing projects that protect wildlife habitat before conflicts arise.
>
> Section 29712 acknowledges that the Delta's waterways and marinas offer recreational opportunities of statewide and local significance, are a source of economic benefit to the region, and that public safety requirements would heighten over time because increased recreational demand and use is anticipated.

Chapter 5 of the Delta Protection Act (Resource Management Plan) requires DPC to prepare and adopt a "comprehensive long-term resource management plan for land uses within the primary zone of the Delta." DPC completed the Land Use and Resource Management Plan for the Primary Zone of the Delta in 1995. In February 2010, after two years of collaborative effort to revise the plan, DPC adopted a new draft Land Use and Resource Management Plan that includes the following recreation and access policies (Delta Protection Commission 2010, p. 22-23).

> Policy P-1: Ensure appropriate planning, development, and funding for expansion, ongoing maintenance, and supervision of existing public recreation and access areas.
>
> Policy P-2: Encourage expansion of existing privately-owned, water-oriented recreation and access facilities that are consistent with local General Plans, zoning regulations, and standards.
>
> Policy P-3: Assess the need for new regional public and private recreation and access facilities to meet increasing public need, and ensure that any new facilities are prioritized, developed, maintained, and supervised consistent with local, state, and federal laws and regulations. Ensure that adequate public services are provided for all existing, new, and improved recreation and access facilities.
>
> Policy P-4: Encourage new regional recreational opportunities, such as Delta-wide trails, which take into consideration environmental, agricultural, infrastructure, and law enforcement needs, as well as private property boundaries. Also, encourage opportunities for water, hiking, and biking trails.

Policy P-5: Encourage provision of publicly funded amenities such as picnic tables and boat-in destinations that compliment and are in or adjacent to private facilities, particularly if the private facility would agree to supervise and manage such amenities, thus lowering the long-term cost to the public.

Policy P-6: Support multiple uses of Delta agricultural lands, such as seasonal hunting and provisions for wildlife habitat.

Policy P-7: Support improved access for bank fishing along state highways, county roads, and other appropriate areas where safe and adequate parking, law enforcement, waste management and sanitation facilities, and emergency response can be provided and where proper rights-of-access have been acquired.

Policy P-10: Promote and encourage Delta-wide communication, coordination, and collaboration on boating and waterway-related programs including, but not limited to, marine patrols, removal of debris and abandoned vessels, invasive species control, clean and safe boating education and enforcement, maintenance of existing anchorage, mooring, and berthing areas, and emergency response in the Delta.

California Department of Parks and Recreation

Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh

The Sacramento-San Joaquin Delta Reform Act mandated that the Department of Parks and Recreation (DPR) develop recommendations to expand state recreation areas in the region. To comply with the legislation, DPR issued the *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh* in May 2011 (DPR 2011). Although the Recreation Proposal is not a binding policy document, and funding is not currently available to implement the recommendations, the Recreation Proposal does represent DPR's vision for the region. The document states, "The proposal recommends a network of recreation areas, including parks, resorts, boating facilities, historic communities, agritourism attractions, and other visitor-oriented businesses. These areas would be connected by scenic driving routes, boating trails, or bicycling and hiking trails… Proposal recommendations aim to provide visitors and residents authentic outdoor experiences rooted in the unique and enduring character of the Delta and Suisun Marsh."

Among recommendations for development and expansion of recreation at several Delta locations, the Recreation Proposal also recommends working cooperatively with other state agencies including the California Department of Water Resources (DWR). Specific areas for DWR recreation consideration relevant to Prospect Island include:

- Consider recreation opportunities at flooded islands that cannot be reclaimed cost-effectively after disasters.
- Incorporate shoreline access, trails, boat ramps, hunting opportunities, and interpretive facilities as appropriate in restoration projects at Dutch Slough, McCormack-Williamson Tract, Suisun Marsh, *and other sites* (emphasis added).

State Parks' Division of Boating and Waterways regulations and programs
The primary mission of DPR's Division of Boating and Waterways (DBW) is to promote a safer and more enjoyable boating environment. Although boating law enforcement in California is typically performed at the local level by local agencies, such as county sheriff and municipal marine patrol units, DBW, through its Boating Law Enforcement Unit, acts to meet the goals of providing for adequate and consistent law enforcement through local agencies throughout the state. California boating laws are contained in instruments of state law, including the California Harbors and Navigation Code, Vehicle Code, Penal Code, and California Code of Regulations, among others. California boating laws and regulations apply uniformly on all waters of the state. California law does not replace the U.S. Coast Guard and other federal regulations in force on federally navigable waters, but it is in general conformity with these.

DBW conducts a program focused on providing funding for local boating law enforcement agencies and training of law enforcement personnel. Another DBW program aimed at boating safety is the Aquatic Center Grant Program, through which the department makes grants available for nonprofit organizations, colleges and universities, and local agencies for boating safety education.

DBW supports the purpose of providing boaters with adequate facilities on the water by providing boat launch facility grants and small craft harbor development loans to public entities. Private marina owners can also apply for construction loans for improvements, such as berthing, restrooms, vessel pump-out stations, boat launching and parking facilities, and dry boat storage.

The Aquatic Weed Control Program is authorized to control water hyacinth (*Eichhornia crassipes*), Brazilian waterweed (*Egeria densa*), and South American

spongeplant (*Limnobium laevigatum*) in the Delta, its tributaries, and Suisun Marsh. The program is focused on controlling water hyacinth and Brazilian waterweed, which are highly invasive aquatic plant species that are widespread in the Delta and have substantial impacts on recreational activities in the Delta, its tributaries, and Suisun Marsh.

The Abandoned Watercraft Abatement Fund is administered by DBW with the purpose of providing funds to public agencies to remove and dispose of abandoned or wrecked vessels that pose a significant hazard to navigation.

California Department of Fish and Wildlife land management

California Department of Fish and Wildlife (CDFW) owns and manages seven areas in the Delta, primarily for habitat and species protection and enhancement. Miner Slough Wildlife Area consists of approximately 37 ac situated at the confluence of Cache Slough and Miner Slough in Solano County. This State Wildlife Area is managed under the current regulations found in the California Fish and Game Code and CCR Title 14. Regulations for wildlife areas and ecological reserves, as well as hunting and fishing regulations, can also be found in Title 14. The Minor (*sic*) Slough Management Plan (CDFG 1977) asserts five management objectives, the most relevant being the preservation of this area in its natural state, and the continuation of public access (by boat) and recreation "on a non-permit basis."

California State Lands Commission regulations

The California State Lands Commission (CSLC) has jurisdiction over lands that underlie navigable and tidal waterways (Sovereign Lands). These include lands under Miner Slough adjacent to the Proposed Project site. The CSLC offers leases and permits for marinas, and developers of marinas along the state's navigable rivers, natural lakes, and bays are required by law to lease state land at marina sites. Private landowners who wish to install a recreational pier adjacent to their waterfront residence must likewise obtain a lease from the commission.

The CSLC has entered into a Memorandum of Understanding with the California Department of Water Resources to allow DWR access to Sovereign Lands required for the development, operation, and maintenance of the State Water Project and its related activities and projects.

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, the following have been considered in the analysis of potential impacts and identification of mitigation, as needed.

Unless otherwise noted, the Proposed Project would comply with the following local ordinances and policies.

Solano County General Plan

The Solano County General Plan identifies policies to maintain and expand public access and recreational activities in the Delta and Suisun Marsh, such as duck hunting, boating, fishing, and nature study. The Park and Recreation Element (Solano County Board of Supervisors 2008), adopted in 2003 and incorporated into the most recent general plan, identifies general policies for managing and improving the county's park and recreational facilities.

Solano County land located in the statutory Delta is designated as Agricultural, with a Resource Conservation overlay. The general plan includes the following policies specific to recreation in the Delta:

> Policy RS.P-26: Promote continued recreational use of the land and waters of the Delta, including fishing and boating; ensure needed recreational facilities are constructed, maintained, and supervised; protect landowners from unauthorized recreational uses on private lands; and maximize dwindling public funds for recreation by promoting public private partnerships and multiple uses of Delta lands consistent with the Land Use and Resource Management Plan for the Primary Zone of the Delta.

Additional objectives and associated policies in the Park and Recreation Element include the following:

- Objective 3: Identify, preserve and manage significant regional recreation and natural areas.
- Policy C: The County shall work to protect identified recreational sites and natural resource areas.
- Objective 5: Encourage appropriate multiple uses of public land for recreation and other uses.

3.16.2 Significance criteria

The criteria used for determining the significance of an effect on recreational resources are based on Appendix G *Environmental Checklist* of the CEQA Guidelines and professional standards and practices. Effects on both water-dependent and water-enhanced (land-based) recreation opportunities may be considered significant for purposes of CEQA if an alternative would result in any one of the following conditions:

- The permanent loss or closure of well-established recreational facilities or activities.
- The substantial long-term reduction of recreation opportunities and experiences, such as reduction in the amount of area available for a particular type of recreation.
- Cause an increase in the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated.
- Result in potential inconsistencies with plans and policies related to the protection of recreation resources in the Proposed Project area.

3.16.3 Impacts and mitigation

Impact 3.16-1: Short-term construction-related impacts to recreational boating in Miner Slough and Arrowhead Harbor Marina

Proposed Project construction may have minor impacts upon existing (public and private) recreation use in the Proposed Project area. Use of the Arrowhead Harbor Marina and Miner Slough may be limited or prohibited during levee breaching activities due to safety hazards. Implementation of Mitigation Measure 3.16-1.1 would reduce these impacts to *less than significant*.

Leased recreation access on the south property may not be allowed during the construction period due to safety hazards similar to those described above, so existing use by a few individuals would be diminished over the three-year construction period. This activity is managed at the discretion of DWR.

The interruption in recreational use of the Proposed Project area due to construction activities may be significant, but implementation of Mitigation Measure 3.16-1.1 would reduce this impact to *less than significant*.

Mitigation Measure 3.16-1.1
Speed limit zones or channel closure shall be established by DWR during in-water construction along Miner Slough. The construction contractor shall post and distribute notifications at Arrowhead Harbor Marina and other local boating access sites of any scheduled imposition of boating safety speed limits or channel closure 14–30 days in advance of water-based construction work.

Impact significance
Less than significant with mitigation

Impact 3.16-2: Long-term impacts to recreational boating in Miner Slough and Arrowhead Harbor Marina

Post-project hydrologic conditions in Miner Slough may have indirect minor impacts upon future public recreation use in the area, primarily recreational boating.

Prospect Island Tidal Habitat Restoration Project Phase 1 modeling indicated that potential changes to water velocity and flow direction at the Arrowhead Harbor Marina entrance may be adversely affected by a levee breach located along Miner Slough and relatively close to the marina (SWS and WWR 2012). Therefore, the breach location was moved 2,640 ft (0.5 mi) downstream. Subsequent modeling of the re-located breach under Phase 2 indicated that there would be negligible change in velocity at the Arrowhead Harbor Marina's entrance under normal and low-flow conditions (Appendix D in WWR and SWS 2014). Under high and flood flows, the modeled water velocity tangential to the marina entrance increases from approximately 1 foot per second (fps) to approximately 2.5 fps (WWR and SWS 2013). Modeled mid-channel velocity in Miner Slough increases from approximately 1.5 fps to 2 fps under normal tidal low-flow conditions, and from approximately 3 fps to approximately 5 fps under high-flow flooding conditions.

The anticipated minor changes in Miner Slough water velocity profiles during normal tidal conditions are not expected to discernibly affect boating safety or the ease of access to Arrowhead Harbor Marina. While higher water velocities would be expected to occur in Miner Slough during high-flow and flood conditions, little or no boat traffic is typically present during such conditions (J. Fonss, Arrowhead Harbor Marina, pers. comm., May 2014). Furthermore, high flow conditions and velocities would be within the range of such conditions in other nearby Delta channels, and thus Miner Slough navigation under such conditions would not present challenges to boat operators or require skills that would not otherwise be

reasonably encountered and required elsewhere in the Delta. Overall, boating impacts of increased velocities in Miner Slough near the entrance of the Arrowhead Harbor Marina would be *less than significant*.

Impact significance
Less than significant

Impact 3.16-3: Long-term impacts on recreational use of Prospect Island

There is currently no authorized recreational use of the interior of the north property, and limited hunting use of the south property (Section 3.16.1 *Recreation – Setting*). The Proposed Project does not include any facilities for recreation or watercraft use. After the levee is breached and construction is complete, the Proposed Project would provide navigable sloughs and open-water areas. Access for recreation would be dependent on the property's legal designation and compatibility with project goals, objectives, and mitigation requirements. The potential for enhanced or additional developed recreation opportunity would remain for future consideration, although no such development or partnerships are currently included in the Proposed Project.

Impact significance
No impact

Impact 3.16-4: Consistency with existing plans

The Proposed Project does not include developed facilities for increased public recreation or watercraft use. However, the restored area may, dependent upon compatibility with project goals, objectives, and mitigation requirements, allow opportunity for public access by watercraft; increase the amount of open-water available for boating; and potentially provide new hunting, fishing, and wildlife viewing opportunities. Restoration of Prospect Island to a tidal system may increase the availability of wildlands and wetlands for recreational use. The potential for enhanced or additional developed recreation opportunity would remain for future consideration, even though no such development or partnerships are initially part of Proposed Project implementation. Providing these opportunities is consistent with multiple-use and general recreation enhancement policies in the Delta Plan and Solano County General Plan.

Impact significance
Less than significant

3.17 Transportation and Traffic

This section describes and assesses the impacts of transportation and traffic on and near the Proposed Project site. The Proposed Project would generate some short-term traffic from mobilization and demobilization of construction equipment, workers accessing the site during construction, and importation of fill. Following levee breaching and natural revegetation, access along a portion of the easternmost Prospect Island levee and internal cross-levee would be eliminated in the long-term, but this would not impede access for any neighbors to the site. This analysis is based on field reconnaissance and review of applicable maps, plans, and policies.

3.17.1 Setting

Environmental setting

Regional traffic

From the directions of either San Francisco Bay Area or from Sacramento, construction vehicle access would be via State Route 84 (SR-84) to local roads north of Prospect Island. From the Sacramento area to Prospect Island, travelers would use Interstate 80 (I-80) to SR-84 south at West Sacramento.

From the San Francisco Bay Area, travelers would use I-680 to State Route 12 (SR-12) at Rio Vista, then River Road (Road 160) to Courtland Road, and SR-84, also accessing Prospect Island from the north (Figure 2.1-1). Although SR-84 would not be used for truck traffic within Solano County from the south, due to truck length and weight restrictions, the Ryer Island Ferry provides the crossing over Cache Slough from Rio Vista to Ryer Island. The ferry, a diesel-powered boat operated by CalTrans, is in operation 24 hours per day and charges no toll.

Local traffic

Local construction traffic would use SR-84 (Ryer Ave) and existing easements to the Sacramento River Deep Water Ship Channel (DWSC) levee road. Access for major construction equipment and materials transport would use SR-84, Courtland Road and/or Teal Road (part of Road 107), and Road 107 to access the DWSC levee road north of Prospect Island, then would follow the DWSC levee road south to the Project site. Access for smaller equipment and construction workers would use SR-84 and Holland Road, which passes the Arrowhead Harbor Marina at Five Points to access the northern cross-levee at the northeast end of the Project site. On Prospect Island, there are access roads on the Prospect Island–DWSC levee, Prospect Island–Miner Slough levee, the northern cross-levee (i.e., extending from the end of Holland Road), and the

interior (southern) cross-levee separating the northern and southern portions of the island.

Legal and regulatory setting

Federal laws and regulations

No federal traffic/transportation laws or regulations are applicable to the Proposed Project.

State regulations

Unless otherwise noted, the Proposed Project would comply with the following state regulations.

CalTrans State Route 84 Corridor Systems Management Plan

The Corridor Systems Management Plan (CSMP) (CalTrans 2010) is a transportation planning document. The CSMP reports on existing and future traffic conditions and proposes traffic management strategies and capital improvements to maintain and enhance mobility within each corridor (SR84, CSMP, December 2010).

Local ordinances and policies

While the Proposed Project need not comply with local ordinances and policies, they have been considered in the analysis of potential impacts and identification of mitigation, as needed. Unless otherwise noted, the Proposed Project would comply with the following local ordinances and policies:

Solano County General Plan

The Transportation and Circulation chapter of the Solano County General Plan (Solano County Board of Supervisors 2008) sets forth the policy framework to shape circulation within Solano County. Roadways carrying vehicular traffic represent the primary components of circulation, but other methods of travel are also addressed—bicycle systems, pedestrian connectivity, bus transit, air service, rail service, and waterway activity. Solano County is expected to continue to experience traffic growth because of development within local jurisdictions and the unincorporated county, and continued growth in the surrounding counties.

The Solano County General Plan (Solano County Board of Supervisors 2008) includes the following policies relevant to Proposed Project impacts:

- TC.P-1: Maintain and improve current transportation systems to remedy safety and congestion issues, and establish specific actions to address these issues when they occur.
- TC.P-10: Anticipate increases in vehicular traffic on rural roads that serve agricultural-tourist centers, value-added agricultural uses in the interior valleys, and other unique land uses; complete related roadway improvements that support the viability of such uses.

3.17.2 Significance criteria

Criteria for determining significant impacts are based upon Appendix G *Environmental Checklist* of the CEQA Guidelines and professional judgment. These guidelines state that a project would have a potentially significant impact on public services if it would:

- Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system. Components of the circulation system include, but are not limited to, intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit.
- Conflict with an applicable congestion management program, including, but not limited to: level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways.
- Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks.
- Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment).
- Result in inadequate emergency access.
- Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities.

3.17.3 Impacts and mitigation

Impact 3.17-1: Potential traffic impacts during construction

Construction activities that could affect traffic include: transportation of construction equipment and imported materials after the site is dewatered, traffic

from workers accessing the Proposed Project site, site revegetation, and demobilization of equipment once construction is completed.

Depending on location and operation of these activities, they may temporarily impede access to the agricultural properties north of Prospect Island, the DWSC levee road, and access to the Arrowhead Harbor Marina. The Hall property is an abandoned island with no previously existing access; thus, loss of access to the Miner Slough levee road is a nonissue for this property (Figure 2.1-3). This construction access impact would be potentially significant and reduced to a *less than significant* level with mitigation (see Mitigation Measure 13.17-1.1 below).

Construction activities would also generate off-site traffic, primarily on SR-84, Courtland Road, Teal Road, Rd. 107, and Holland Road, during construction. Construction equipment would be brought to the site on flatbed trucks, requiring trips for each mobilization and de-mobilization event, with an estimated 94 trips (187 one-way trips) at the start and end of each construction season, assuming no equipment will be allowed to remain on-site during winter under the Central Valley Flood Protection Board (CVFPB) permit. It is expected that these trips would be spread over approximately two weeks. Potentially affected neighbors would be notified beforehand (see Mitigation Measure 3.17-1.1). Traffic related to workers accessing the Proposed Project site throughout the construction period would be limited to approximately 40 trips/day (80 one-way trips), with workers expected to access the site via Holland Road. Towards the end of the construction period prior to Miner Slough levee breaching, import of planting materials and any temporary sheet pile removal would occur by truck, resulting in approximately 70 truckloads over a one-month period. There would be some additional haul truck trips during the construction period associated with demolition and removal activities (see Impact 3.13-1).

In addition to the construction activities discussed above, two options are being considered for importing rip-rap / armoring material for erosion protection, import fill, and aggregate base used for roads: 1) importation by local barge, with unloading at Prospect Island; 2) importation by trucks. In the first construction year, assuming all import materials would be transported directly to the Proposed Project site by barge, there would not be substantial use of public roadways by haul trucks carrying fill and aggregate. Barged materials would be unloaded by crane or conveyor, and other than small turnouts and other levee road improvements anticipated for the Proposed Project, no additional unloading facilities would be necessary. Loading and unloading of the barges would require trucks at the material source (assumed to be Rio Vista) and destination (levee

roads at the Proposed Project site); however, none of this truck traffic at the source or destination would occur on public roadways. Under the barge alternative, an estimated 700 round trips with various types of trucks would be required for materials from alternative sources. These trips would occur during a roughly 4-week period at the beginning of the construction period, with a maximum of 35 round trips/work-day (70 one-way trips). These trips would occur at a rate of approximately five trucks/hour over an eight-hour work-day.

Under option 2, on-road trucks would be used to transport materials from their sources to Prospect Island. This option would potentially generate up to 7,840 trips over approximately 120 work days (6 months) involving use of Courtland Road and/or Teal Road, Road 107, and easements. The six-month period would probably not be consecutive and likely spread over two construction seasons (i.e., two three-month periods). Traffic during these periods could be as high as 65 round trips/work-day (130 one-way trips).

Depending on the transportation option selected by the contractor for imported materials, traffic loading on public roads may be high. Such loading is within the normal traffic loads expected for most highways and state routes that are designed for, and regularly receive, haul trucks. On Courtland Road, Teal Road, and Road 107 loading may result in premature deterioration of the road base or pavement. Although these roads are currently used by multi-axle trucks and farm vehicles like those for the Proposed Project, the potential number of trips generated means mitigation may be required to reduce the potentially significant impact to local roads to *less than significant* (see Mitigation Measure 13.17-1.2). Overall, with implementation of a traffic control plan (Mitigation Measure 3.17-1.1) and local road repairs if required (Mitigation Measure 13.17-1.2), potential construction generated traffic impacts would be reduced to *less than significant*.

Mitigation Measure 3.17-1.1

The construction contractor shall submit a traffic control plan to the California Department of Water Resources (DWR) for review and approval that shall limit impacts to affected landowners and businesses. The control plan shall include temporary measures, such as the following:

1. Advance public notification signage at areas that might be affected by traffic going to the Project site prior to the start of construction activities, to alert drivers to pending construction work and traffic restrictions.
2. Notification to Arrowhead Harbor Marina, the Port of West Sacramento, and property owners adjacent to haul routes used for site access during construction, 10 days prior to initiation of construction traffic.

3. Temporary railing, barricades, crash cushions, signage, lighting and flashing lights, pavement markings, and the service of qualified flaggers; all as required to provide for the safe passage of public traffic.
4. Other safety measures as required to control vehicular and pedestrian traffic.

Mitigation Measure 3.17-1.2
Before- and after-Project construction an assessment of road surface conditions, and photographic or videographic documentation, will be conducted by DWR and its contractor at the following locations, if used for site access during construction: segments of Courtland Road and/or Teal Road, Road 107, Holland Road, as well as the DWSC levee. If local road conditions deteriorate during construction, DWR or its construction contractor will implement necessary repairs to bring the road up to pre-Proposed Project construction conditions.

Impact significance
Less than significant with mitigation

Impact 3.17-2: Potential long-term loss of access to the Miner Slough levee

The Proposed Project would create two breaches in the Miner Slough levee and a single breach in the interior cross-levee. This would eliminate vehicle access across the interior cross-levee, and to the portion of the Miner Slough levee between the breaches, following Proposed Project construction; however, there are no privately-owned residences that the loss of access would impact. Because there is currently no land access to Hall Island from the Miner Slough levee and the property is flooded, there would be no potential conflicts with existing land uses on the property.

Impact significance
Less than significant

3.18 Utilities

This section describes the utility infrastructure and easements in the Proposed Project area. The utilities impact assessment focuses on potential impacts to electrical, gas, communications, water supply, sewer infrastructure, solid waste facilities, and deeded easements for the Proposed Project. Mitigation measures are provided for any significant impacts. For discussion of potential impacts

related to irrigation infrastructure (i.e., intakes, drains) in the Prospect Island area see Section 3.1 *Hydrology*.

3.18.1 Setting

Utility infrastructure and deeded easement locations are based on field surveys performed by the California Department of Water Resources (DWR) in 2010, a title report map showing property boundary and easement holders (DWR 2014e, Figure 2.1-2, Figure 2.1-3), nautical charts (NOAA 2014), aerial photograph interpretation (Google Earth), Division of Oil, Gas, and Geothermal Resources Well Finder online database (DOGGR; DOGGR 2014), and past known land use activities.

Environmental setting

Overview

Historically, Prospect Island was used for agricultural purposes, with two associated residences: the Hall property on the south property and a formerly privately-owned parcel connected to the central portion of the north property along Miner Slough. To serve the agricultural uses and the residences, overhead electrical and telecommunication utilities were established. Surveys for underground utilities have not been performed on Prospect Island. An examination of desktop resources such as National Marine and Atmospheric Administration (NOAA) Nautical Charts, Google Earth, Google Street View, etc. did not show signs (natural gas paddles, signs indicating buried lines, storm drain inlets, etc.) of any underground utilities. Due to the rural setting, water and wastewater service is most likely supplied through on-site sources (i.e., wells, water pumps, septic systems, and outhouses). Transmission and distribution natural gas lines also do not appear to have been constructed most likely due to the rural location and the small potential service population within the vicinity. Pacific Gas and Electric Company (PG&E) confirms no existing natural gas pipelines are located within the Proposed Project site (P. Davis, pers. comm., 2015). A number of exploratory natural gas wells exist in the Proposed Project area. However, these wells at present have been capped and abandoned (DOGGR 2014), and no above-ground infrastructure associated with these wells exists.

Several maintenance and flood control easements owned by PG&E and the Sacramento San Joaquin Drainage District (District) are recorded on Prospect Island. These infrastructure elements are described in detail below.

Electrical and telecommunication systems

The existing electrical/telecommunication distribution infrastructure on the north property is owned by PG&E, and is currently inactive. Electrical distribution lines cross over Miner Slough from Ryer Island via spliced wooden poles (Figure 3.18-1) approximately 2,000 ft south of the State Route 84 (SR-84)/Elevator Road intersection, or approximately 1 mi north of the Prospect Island internal cross-levee. These lines then connect to poles located along the landside toe of the west levee of Miner Slough and travel 1,000 ft northwest moving into Prospect Island's interior. The distribution lines then veer southwest making a "C" shape and run to the formerly privately-owned parcel (Figure 2.1-3). The California Department of Water Resources (DWR) field surveys found these distribution lines were downed and/or submerged under-water, entangled in existing vegetation, and PG&E has confirmed that these lines are currently inactive.



Figure 3.18-1. View of Spliced Wooden Poles, Looking North from Within Miner Slough.

PG&E also owns an electrical distribution tower which is located approximately 0.86 mi north from the Prospect Island internal cross-levee along the Sacramento Deep Water Ship Channel (DWSC) (western side of Prospect Island) landside levee toe. This tower once held electrical distribution lines that spanned the DWSC, which originated from the west on Liberty Island and traveled in a southeast direction into the interior of Prospect Island. Recently PG&E has contacted DWR about their plans to remove the tower (D. Riordan, pers. comm., July 2014). To ensure that the tower would not impact restoration efforts in the event of structural failure, DWR has opted to have PG&E completely remove the structure which includes the lattice framework, cement footings, and 1 to 2 ft of soil.

Field research has not yet been undertaken for the south property; typically field surveys occur after DWR takes title of the property. An examination of NOAA nautical charts do not indicate the presence of distribution lines across Miner Slough or the DWSC onto this portion of the island, and no above-ground distribution lines are visible on current Google Earth aerial imagery going back to 1993.

Water, wastewater, and stormwater systems

As discussed above, no municipal potable water, wastewater, or storm water infrastructure occurs on the north property. Information gathered from desktop resources indicates that these utilities were most likely supplied by domestic sources for the former agricultural and residential needs.

No known field surveys have been conducted on the south property; currently no underground surveys are planned as DWR does not perform underground utility surveys when acquiring new properties. A desktop review of nautical charts and of Google Street View does not indicate the presence of pipelines within the DWSC, Miner Slough, or within the vicinity of the Proposed Project.

Natural gas transmission/distribution lines

The DWR property boundary and easement maps, nautical charts, aerial photograph interpretation, and Google Street View do not provide evidence of underground natural gas lines on either the north or south property. PG&E confirms no existing natural gas pipelines are located within the Proposed Project site (P. Davis, pers. comm., 2015). Currently no surveys are planned as DWR does not perform underground utility surveys when acquiring new property.

Natural gas wells

Six capped exploratory natural gas wells exist on the north property along the northwestern side of the island. Of these six, five were found to be non-productive/dry at the time of drilling and were subsequently capped and abandoned. The sixth well was open from 1956 to 1965, after which it was capped and abandoned (DOGGR 2014). As a result, no active natural gas lines which service these natural gas wells exist on the north property. Currently, these six gas wells are believed to be capped to industry standards. Industry standards for capping natural gas wells typically require (a) filling the casing with a sealing material (typically cement), (b) cutting the casing off 5 to 10 ft below the surface, and then (c) backfilling the area with native soil.

Field surveys have not been performed for the south property and there are no planned surveys in the foreseeable future since DWR does not perform underground utility surveys when acquiring title of a new property. A review of the Division of Oil, Gas, and Geothermal Resources (DOGGR) database for natural gas wells on the south property did not return any well listings.

See Section 3.9 *Mineral Resources* for more information and further discussion regarding these natural gas wells.

Solid waste

The following landfills are located 30–35 mi (driving distance) away from Prospect Island and could accommodate the Proposed Project solid waste disposal needs:

- *Potrero Hills Landfill, Suisun City, California.* At present this facility is permitted to handle various waste types, including construction material & debris (i.e., asphalt, bricks, concrete, dirt /clean fill, dry wall /gypsum/ sheetrock), scrap metal, appliances, organics (i.e., pallets, plywood scrap, sawdust, straw/hay, untreated wood debris and scraps, and yard trimmings) (http://www.co.contra-costa.ca.us/4911/Recycling).
- *L and D Landfill and Material Recovery Facility, Sacramento, California.* At present this facility primarily receives construction and demolition debris and other non-hazardous waste (http://www.landdlandfill.com/).
- *Yolo County Central Landfill, Woodland, California.* At present this facility receives mixed construction and demolition debris, restricted green waste, and other non-hazardous waste (http://www.yolocounty.org/community-services/planning-public-works/integrated-waste-management-division/central-landfill).

Although located further away (approximately 50 mi driving distance), the Recology Hay Road Landfill near Vacaville also accepts contaminated soils and some types of hazardous waste.

Utility easements

Pacific Gas and Electric

PG&E maintains easements on the north property for electrical and communication purposes. As shown in Figure 2.1-2, an "X" shaped easement has been established for the electrical distribution steel tower located near the DWSC. An additional 20 ft-wide by 400 ft-long easement is located around the remnant distribution line associated with the steel tower. PG&E also has an easement along a power pole line that originates within the south property just

south of the internal cross-levee and extends into the north property for a little over 1 mi (Section 3.18.*1 Utilities – Setting – Electrical and Telecommunication Systems*).

DWR has not conducted research for the south property; however, there is no evidence that PG&E owns any additional easements within this area.

Sacramento San Joaquin Drainage District
The District currently holds an easement for the passage of the floodwaters from the Yolo Bypass Floodway across the north property.

DWR has not conducted research for the south property; however, it is anticipated that the District does not currently own any easements within this area.

Legal and regulatory setting

Federal laws and regulations

No federal laws or regulations that regulate utilities would apply to the Proposed Project.

State laws and regulations

Unless otherwise noted, the Proposed Project would comply with the following state laws and regulations.

California Integrated Waste Management Act
The California Department of Resources Recycling and Recovery (CalRecycle) provides regulatory oversight of solid waste management facilities. The California Integrated Waste Management Act (Assembly Bill [AB] 939, Sher, Chapter 1095, Statutes of 1989, as amended) made all California cities, counties, and regional solid waste management agencies responsible for planning and implementing diversion of solid waste from solid waste disposal facilities. CalRecycle oversees and assists local governments to develop and implement the mandates and subsequent legislation. Furthermore, activities involving removal and disposal of sediments within irrigation and flood control facilities or the use of inert materials in levee or flood control work by federal, state, or local governments may be excluded from solid waste permitting by CalRecycle Tiered Regulatory Placement criteria for construction and demolition waste and inert debris disposal. However, these activities would require permitting by the Regional Water Quality Control Boards in implementing CCR Title 24 *Waters* and State

Water Resources Control Board requirements for dredging, filling, and disposal of dredge wastes (CalRecycle 2006).

CalOSHA Title 8: Section 1541

This policy requires that subsurface installations be identified and marked prior to excavation activities. The excavator must receive a response from all known owners/operators of subsurface installations and must meet with owners/operators of high priority (such as high-pressure pipelines, natural gas/petroleum pipelines, electrical lines greater than 60,000 volts, etc.) subsurface installations within 10 ft of the proposed excavation before opening the excavation. Only qualified persons (persons that meet training and competency requirements) can perform subsurface installation locating activities. All proposed employees must be trained in excavator notification/excavation activities. Excavators must immediately notify the subsurface installation owner/operator of any damage discovered during or caused by excavation activities.

Protection of Underground Infrastructure (California Government Code, Section 4216)

Utility locator qualification requirements are published under California Government Code 4216, which require that: (a) only a qualified person shall perform subsurface locating activities (4216.3) and (b) a qualified person performing subsurface installation locating activities on behalf of a subsurface installation operator shall use a minimum of a single-frequency utility locating device and shall have access to alternative sources for verification if necessary (4216.3).

Public Resources Code [PRC 3208.1]

Section 3208.1 of the PRC authorizes the State Oil and Gas Supervisor of the DOGGR to order the re-abandonment of a previously abandoned well when construction of any structure over or in the proximity to a well could result in a hazard. The cost of re-abandonment operations is the responsibility of the owner or developer of the project upon which the structure would be located.

Local ordinances

The Solano County Municipal Code Chapter 26.5-10 through Chapter 26.5-19 deal with the placement of utilities. However, these sections within Chapter 26.5 deal specifically with the establishment of district areas to facilitate the removal of above ground utilities in lieu of underground utilities. No other specific Solano County Municipal Code deals with only the installation/removal of utilities.

3.18.2 Significance criteria

Criteria for determining significant impacts are based on the Appendix G *Environmental Checklist* of the CEQA Guidelines and professional judgment. Guideline criteria regarding wastewater treatment facilities are excluded from this list because the Proposed Project would not have any potential to affect or require any such facilities. Applicable guidelines state that the Proposed Project would have a significant impact on utilities if it would:

- Be served by a landfill with insufficient permitted capacity to accommodate the Proposed Project's solid waste disposal needs; or
- Be unable to comply with federal, state, and local statutes and regulations related to solid waste.

The following additional criteria would be used to assess potential impacts to utilities and easements:

- Result in an adverse effect on existing utilities.
- Result in an adverse effect to deeded easement holders

3.18.3 Impacts and mitigation

Impact 3.18-1: Solid waste disposal impacts

A small volume (less than 100 cubic yards) of cleared materials may be hazardous and would need to be off-hauled to a landfill that would accommodate these materials. Hazardous materials may include such items as the wooden electrical distribution poles, which may have been treated with quantities of pentachlorophenol, copper naphthenate, and/or other materials on the State Toxic Characteristic List. Other hazardous materials may include lead paint from old buildings, and soil excavated from areas where activities related to the remnant natural gas wells may have contaminated the soil with drilling fluids additives like Barite (barium salt), polymers, and oil-based compounds (DWR 2009).

As described in Section 3.18.1 *Utilities – Setting*, above, there are four local landfills that could accommodate the Proposed Project solid waste disposal needs (i.e., Recology Hay Road Landfill, Vacaville; Potrero Hills Landfill, Suisun City; L and D Landfill and Material Recovery Facility, Sacramento; Yolo County Central Landfill, Woodland) and therefore the impact would be *less than significant*.

Impact significance
Less than significant

Impact 3.18-2: Potential for adverse effects on existing utilities

The Proposed Project would require the removal of the PG&E distribution lines and poles within Prospect Island. These distribution lines at one time served the residences and provided power for the Island's agricultural needs (i.e., water pumps). These lines have fallen in a state of disrepair and are no longer active. DWR is currently in discussions with PG&E about removing the distribution lines within the Proposed Project area following site dewatering. Because the power lines are shut off there would be no impact on existing utilities.

The various sources consulted (as mentioned previously) failed to find evidence of underground utilities within the Proposed Project area. Therefore, the Proposed Project would be unlikely to impact underground utilities. However, it is possible that some unknown or unmarked subsurface utilities may exist on the site (i.e., old pipelines or septic tanks) that could be encountered during grading operations. This impact would be reduced to a less-than-significant level by implementation of Mitigation Measure 3.18-2.1, below.

Mitigation Measure 3.18-2.1
In order to reduce the potential for adverse effects to existing utilities, the following actions will be taken by DWR and its contractor, prior to any ground disturbing activities:

- Coordinate with local utility owners to discuss the potential for the existence of underground utilities within the Project area.
- If utility owners verify the potential for underground utilities, a qualified person shall perform a subsurface survey to identify the exact location of underground utilities within the Project area, so those utilities may be avoided. If the utilities cannot be avoided, they shall be removed in a manner consistent with CalOSHA Title 8, Sections 1539 through 1541.1.

Impact significance
Less than significant impact with mitigation

Impact 3.18-3: Potential for adverse effects to easement holders

The Proposed Project restoration extent would include all of Prospect Island, and as a result the easements maintained by PG&E and the District on the north property would be restored into tidal marsh land. While the easement maintained

by the District for the passage of the floodwaters would be compatible with the planned purpose of the Proposed Project, the easements maintained by PG&E would not. The restoration component feature would not inhibit PG&E from accessing their easements, but the placement of materials and/or structures (i.e., dredge materials, or electrical infrastructure) may impact restoration efforts within the Proposed Project area. Currently, DWR plans to manage this conflict of land use through negotiations with PG&E about quitclaiming their easements within Prospect Island.

Impact significance

Less than significant

3.19 Cumulative Impacts

3.19.1 Approach

CEQA requires the evaluation of a project's cumulative impacts on the physical environment (CEQA Guidelines Section 15130). Cumulative impacts are "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts" (CEQA Guidelines Section 15355).

Cumulative impacts may arise when individual effects originate from a single project over its multiple phases, or from a number of separate projects that are occurring within similar timeframes and geographical areas as that of the Proposed Project. Moreover, potential adverse changes to the physical environment due to cumulative impacts may arise with the incremental impact of the Proposed Project when combined with other closely related past, present, and reasonably foreseeable future projects (PRC Section 21083(b) and CEQA Guidelines Section 15355(b)).

To determine if an impact is cumulative, three determinations must be made:

1. Does the project have an impact on the resource in question?
2. Is the combined impact of the project and other projects significant and adverse (CEQA Guidelines Section 15130(a)(2))?
3. Is the project's incremental effect cumulatively considerable (CEQA Guidelines Section 15130(b))?

A cumulative impact is considered significant if the combined impact is significant and the Proposed Project's incremental effect is found to be cumulatively

considerable, in the context of impact intensity and sensitivity of the resource. Additionally, CEQA states that when a project's contribution is not cumulatively considerable, then the EIR need only note the reason why, and then no further discussion is required.

CEQA states that when a project's contribution is not cumulatively considerable, then the EIR need only briefly describe supporting reasoning for this conclusion (CEQA Guidelines Section 15130(a)(2)).

To perform the cumulative impact analysis, CEQA recommends relying on one of two approaches (or a combination of these):

- List Approach: a list of past, present, and probable future projects producing related or cumulative impacts; or,
- Projection Approach: a summary of projections contained in an adopted general plan or planning document, or in a prior environmental planning document, which has been adopted or certified, that describes or evaluates regional or area-wide conditions contributing to the cumulative impacts.

When utilizing a list, the following factors should be considered: (1) the nature of each environmental resource being examined, and (2) the location of the project and its type (CEQA Guidelines Section 15130(b)(1)(B)(2)).

3.19.2 Cumulative projects considered in this EIR

This EIR uses the "List Approach", which involved developing a list of past, present, and probable future projects producing related or cumulative impacts (Table 3.19-1). The list includes planned, approved, or reasonably foreseeable future wetlands restoration, structural fish habitat enhancement projects, resource management projects and programs, flood protection, and water supply, and navigation projects and programs.

This cumulative impact analysis focuses on projects that are not already considered in the analysis of potential impacts on environmental resources due to actions and elements included in the Proposed Project (Section 2). Past environmental conditions, including significant projects implemented before NOP issuance (2013) and DEIR preparation (2015), are captured by the assessment of existing conditions in the *Environmental Setting* section of each resource area analysis. This includes projects identified on Figure 2.4-1, including Mound Farms, Peter's Pocket, Prospect West, and Ryer wetland. Some future projects have been added to Table 3.19-1 and considered in the cumulative impact

analysis since the 2016 DEIR was prepared, following comments on the 2016 DEIR and 2019 Partial Recirculated DEIR. These additional projects did not change the significance determinations for cumulative impacts.

A number of development activities are proposed in Sacramento County, to the east of the Proposed Project. At the time the 2016 DEIR was prepared, 62 private projects were listed on the Sacramento County planning projects website (http://www.planningdocuments.saccounty.net/). In July 2019, there are 129 "Delta" private projects listed on the same website, and Prospect Island is directly west of the Sacramento "Delta" boundary identified on the project viewer (note that Prospect Island is in southeastern Solano County). However, none of these private projects would result in an overlapping contribution with any of the Proposed Project's impacts. A number of private development projects are also proposed in Solano County and Yolo County, which is to the north (http://www.solanocounty.com/depts/rm/documents/default.asp and https://www.yolocounty.org/community-services/planning-public-works/planning-division/current-projects, respectively). Similarly, none of the private development projects in Solano and Yolo counties would result in an overlapping contribution with any of the Proposed Project's impacts. Therefore, no County development projects are included on the list.

Table 3.19-1. List of Related Projects Utilized in Conducting the Cumulative Impacts Analysis for the Proposed Project

Names of Related Projects and Lead Agencies	Location	Brief Descriptions	Status as of July 2019
TIDAL WETLAND RESTORATION PROJECTS			
Bradmoor Island Tidal Habitat Restoration Project (DWR)	Suisun Marsh, Solano County	Bradmoor Island is located in the Nurse-Denverton Slough Complex of Suisun Marsh. This project will restore tidal action to 500 ac of currently managed wetlands, enhance and protect another 115 ac of existing tidal habitat, and provide an upland edge to create terrestrial habitat and help provide sea level rise accommodation. This project restores brackish tidal marsh.	DWR anticipates completion of the CEQA document in summer/fall 2019. Construction is planned to begin in summer 2020. http://resources.ca.gov/docs/ecorestore/projects/Bradmoor_Island.pdf
Decker Island Tidal Habitat Restoration Project (DWR)	Solano County	This project restores freshwater tidal marsh. The project will enhance up to 140 ac of tidal wetland, associated high marsh, and riparian habitats, benefiting special-status species like Delta Smelt and Chinook Salmon. The project consists of three main elements: lowering a section of levee, reconfiguring internal berms, and excavating a southern breach.	Construction completed in 2018. https://water.ca.gov/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects https://ceqanet.opr.ca.gov/Project/2016082013
Dutch Slough Tidal Marsh Restoration Project (California Department of Water Resources [DWR] and California State Coastal Conservancy)	Oakley, Contra Costa County	Create and manage approximately 560 ac of freshwater tidal marsh, as well as enhance or restore an additional 400 ac of managed non-tidal marsh, subtidal open-water, irrigated pasture, riparian forest, and native grassland. The project has three goals: 1) benefit native species by re-establishing natural ecological process and habitats, 2) contribute to scientific understanding of Delta habitat restoration and 3) provide shoreline access and educational and recreational opportunities.	Construction on two of the parcels, Emerson and Gilbert, started in May 2018 and construction is expected to be completed in 2019, followed by revegetation planting. Restoration of the third parcel, Burroughs, will begin in 2020. https://water.ca.gov/Programs/Integrated-Regional-Water-Management/Delta-Ecosystem-Enhancement-Program/Dutch-Slough-Tidal-Restoration-Project
Little Egbert Tract Project (Westerveldt Ecological Services)	Cache Slough Region, south of Liberty Island	The 3,500 ac site provides an opportunity to restore freshwater tidal habitat for sensitive fish and wildlife species, while allowing increased flood conveyance at the Cache Slough – Lower Yolo Bypass confluence. The project would: create valuable wetlands beside side channels; soften hardened shorelines with a vegetated margin; maximize aquatic – terrestrial exchange with a crenulated wetland ridge; provide opportunities for sediment accretion that can promote tidal wetland expansion; open an expanse of subtidal flats and channels for benthic and pelagic species; increase structural complexity and niche diversity for aquatic species; increase connectivity of tidal wetland patches; and enhance riparian habitat for wetland birds	Project was not initiated as of July 2019. The project is still in the planning phase. Although planning occurred later than the Prospect Island Proposed Project baseline, this project has been considered following comments on the 2019 Partial Recirculated DEIR. http://cacheslough.com/little-egbert-tract/
Goat Island Tidal Restoration Project (Solano County Resource Management Department)	Suisun Marsh, Solano County	The restoration project would restore tidal influence within a 80 ac diked marsh situated in the northwest corner of Rush Ranch Open Space Preserve, and includes two small stream restoration projects. This project restores brackish tidal marsh.	Currently, there is no funding nor timeline for Goat Island. http://www.landtrustalliance.org/climate-change-toolkit/adapt/habitats/tidal-marsh-preservation-at-rush-ranch http://resources.ca.gov/docs/ecorestore/projects/Goat_Island.pdf
Hill Slough Tidal Marsh Restoration Project (CDFW)	Suisun Marsh, Solano County	This project would restore brackish tidal marsh and associated upland ecotone at the northern Suisun Marsh to benefit endangered, as well as migratory and resident, species. This project involves creating 940 ac of tidal wetlands in Suisun Marsh. The project is consistent with the Ecosystem Restoration Program (ERP) goals and objectives because it reduces the risk of entrainment of at-risk, native anadromous species of concern, including spring-run and winter-run Chinook Salmon, Steelhead Trout, and Green Sturgeon, as well as other resident and transitory fish species in the Suisun Bay.	Construction was completed in 2018. http://www.dfg.ca.gov/ERP/erp_proj_hill_slough.asp http://resources.ca.gov/docs/ecorestore/projects/Hill_Slough_Tidal_Restoration.pdf https://ceqanet.opr.ca.gov/2011052078

Names of Related Projects and Lead Agencies	Location	Brief Descriptions	Status as of July 2019
Lindsey Slough Freshwater Tidal Marsh Enhancement Project (California Department of Fish and Wildlife [CDFW])	Lindsey Slough, Solano County	The project would enhance approximately 165 ac of tidal marshes on an approximate 927 ac parcel by removing features that restrict flow through the slough, excavate starter channels to initiate channel evolution, promote tidal flow, and potentially block Calhoun Cut. This activity is part of the Cache Slough Area Restoration effort and DWR's Interim Delta Actions.	Project is complete. CDFW (2013).
North Delta Flood Control and Ecosystem Restoration Project (McCormack-Williamson Tract) (DWR)	Confluence of Mokelumne and Cosumnes Rivers, Sacramento County	The Nature Conservancy, UC Davis, and DWR are partnering to restore the 1,600 ac site to tidal marsh, as part of the North Delta Flood Control and Ecosystem Restoration Project. The project provides flood control improvements to reduce damage from overflows caused by insufficient channel capacities and levee failures in the project study area. It benefits native species by re-establishing natural ecological functions and habitats; contributes to scientific understanding of ecological restoration; and enhances public recreation opportunities in a manner that does not compromise flood protection infrastructure or operations, compromise habitat integrity, or disturb wildlife.	The Final EIR was completed in 2010. Construction is expected to continue through 2019. http://resources.ca.gov/docs/ecorestore/projects/McCormack_Williamson_Tract_Project.pdf https://ceqanet.opr.ca.gov/2003012112/3
Mein's Landing Wetland Restoration Project (DWR)	Suisun Marsh, Solano County	The project would restore 666 ac to tidal marsh habitat in Suisun Marsh, which would provide habitat for marsh-dependent sensitive plant and animal species. The property is currently operated as a duck club and managed wetland. Project planning is currently on hold.	Project planning currently on hold. For more information: https://water.ca.gov/LegacyFiles/deltainit/docs/6-16-08Meins.pdf
Montezuma Wetlands Restoration Project, Phase I Montezuma Wetlands Montezuma Dam Montezuma Wetland Project (Solano County)	Solano County	The phase 1 project will restore approximately 630 ac of tidal and seasonal wetlands along Montezuma Slough and will enhance adjacent upland habitats. Project activities include placement of sediment dredged from sites in the San Francisco Estuary to raise the project site elevations, construction, planting/weeding, and the breach of existing dikes to enable tidal action on the project site. This project restores freshwater tidal marsh.	A Notice of Determination was filed with the State Clearinghouse in April 2018.
Lookout Slough Tidal Habitat Restoration Project (DWR)	Cache Slough Region, northwest of Liberty Island, unincorporated Solano County	The project would restore tidal hydrology and promote habitat conditions suitable for special-status species such as Delta Smelt, Longfin Smelt, Chinook Salmon, Steelhead, and Giant Garter Snake at the site, while protecting nearby infrastructure through the following actions: 1) construct a new setback levee along Duck Slough; 2) breach the Cache Slough Levee; 3) breach the Shag Slough Levee (also called the Yolo Bypass West Levee); 4) breach the Vogel Island levees; 5) protect, relocate, and replace infrastructure; and 6) restore approximately 3,400 ac of native habitat, including tidal and subtidal marsh, through grading, fill placement, and natural revegetation. This project restores freshwater tidal marsh.	The NOP was publicized on March 21, 2019. Although initiated later than the Prospect Island Proposed Project baseline, this project has been considered following comments on the 2019 Partial Recirculated DEIR. https://water.ca.gov/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects https://ceqanet.opr.ca.gov/2019039136/2
Lower Putah Creek Realignment Project (CDFW)	Lower Putah Creek from the Toe Drain to Yolo Bypass Wildlife Area west boundary, in central Yolo Bypass, Yolo County	The project would reroute Lower Putah Creek across the Yolo Bypass through four to 5 mi of new stream channel and seasonal wetland complex, and construct fish passage migration access to Lower Putah Creek upstream of the Yolo Bypass Wildlife Area. The new realigned channel would connect to tidal channels that would also be enhanced. The project would establish between 300 to 700 ac (5 mi of stream) of creek and associated floodplain and tidal marsh habitat.	This project is on hold. The Notice of Determination on the Final Program EIR was approved on 6/8/2017, then withdrawn on 8/15/2017. https://www.putahcreekcouncil.org/lower-putah-creek-restoration-project-draft-program-eir-released-review-and-public-comment-meeting https://www.putahcreekcouncil.org/lower-putah-creek-restoration-planning https://ceqanet.opr.ca.gov/2015022022/4

Names of Related Projects and Lead Agencies	Location	Brief Descriptions	Status as of July 2019
Tule Red Wetland Enhancement Project (SFCWA)	Suisun Marsh, Solano County	The project would restore approximately 350 ac of tidal wetlands in Suisun Marsh to provide habitat for important native fish species, such as Delta Smelt and Salmon. The Project is part of current restoration requirements for the State and Federal Water Projects. This project would be a brackish tidal marsh restoration.	Notices of Determinations were issued for habitat management, preservation, and restoration in 2003, 2011, 2014, and 2016. Construction is expected to be completed in 2019. http://resources.ca.gov/docs/ecorestore/projects/Tule_Red_Restoration.pdf https://ceqanet.opr.ca.gov/Project/2003112039
Wings Landing Tidal Restoration Project (DWR)	Suisun Marsh, adjacent to the Peytonia Ecological Reserve, the Hill Slough Restoration Area and the Solano Land Trust's Rush Ranch	The project aims to restore approximately 270 ac of managed marsh to tidal and sub-tidal marsh, to benefit native fish species. This project would be a brackish tidal marsh restoration.	The project permitting was completed in 2018. Project construction will occur in 2019. http://resources.ca.gov/docs/ecorestore/projects/Wings-Landing-Project.pdf https://water.ca.gov/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Suisun-Projects
Winter Island Tidal Habitat Restoration Project (DWR)	Directly north of the City of Pittsburg, Winter Island is separated by the New York Slough and Broad Slough, Suisun Bay, and the Middle Slough; the confluence of the Sacramento and San Joaquin Rivers is located north of Winter Island	The project would restore approximately 586 ac of muted brackish wetlands with muted tidal connectivity to fully tidal habitat. The project consists of three main elements: 1. 100 ft breach at the southern water control structure; 2. Excavation to widen an existing eastern channel; and 3. Removal of the northern water control structure with no breach widening.	CEQA and other planning is almost complete, and construction will commence in 2019. Although initiated later than the Prospect Island Proposed Project baseline, this project has been considered. https://water.ca.gov/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects http://resources.ca.gov/docs/ecorestore/projects/Winter_Island_Tidal_Habitat_Restoration.pdf https://ceqanet.opr.ca.gov/Project/2018082025
Yolo Flyway Farms Restoration Project (Department of Water Resources)	Yolo County	The project involves restoring and enhancing approximately 300 ac of tidal freshwater wetlands, and an additional 30 ac of seasonal wetlands, at the southern end of the Yolo Bypass in the northwestern Delta. The project seeks to partially restore historical ecological functions in the current, highly altered, regional landscape.	A Notice of Determination was filed with the State Clearinghouse in March 2018. Construction was completed in 2018. http://resources.ca.gov/docs/ecorestore/projects/Yolo-Flyaway-Farms-Tidal-Habitat-Restoration-Project.pdf
Lower Yolo Bypass Restoration Project (Westland Water District)	Yolo County	The project would restore approximately 1,782 ac of freshwater tidal marsh to provide important new sources of food and shelter for Delta Smelt and other native fish species, and provide rearing habitat for out-migrating salmonids. As part of California EcoRestore, the project would partially fulfill the state and federal requirement to restore 8,000 ac of wetland habitat in the Delta.	The Final EIR was completed in July 2013 and certified. Construction of lower Yolo Ranch is anticipated to be completed by 2021. https://ceqanet.opr.ca.gov/2011032001/3
OTHER WETLAND RESTORATION AND ENHANCEMENT PROJECTS			
Capital Conservation Bank (America's Habitats)	North end of County Road (CR) 107, east of CR 152 in the Southern Yolo Bypass, Yolo County	Establish and manage a Giant Garter Snake conservation bank on 137 ac of land (Phase 1). Phase 2 may be implemented following success of the first 137 ac parcel.	Project is in the planning stage. Habitat Development Plan released April 2013. http://yoloagenda.yolocounty.org:8085/agenda_publish.cfm?id=&mt=PC&get_month=5&get_year=2013&dsp=agm&seq=1791&rev=0&ag=203&ln=13800&nseq=1789&nrev=0&pseq=1763&prev=0#ReturnTo13800

Names of Related Projects and Lead Agencies	Location	Brief Descriptions	Status as of July 2019
Conaway Ranch Floodway Corridor and Habitat Enhancement Project (California Waterfowl Association [CWA])	North-central Yolo Bypass, Yolo County	The project would establish an approximately 17,300 ac seasonal floodplain habitat for both flood protection (i.e., transitory storage of over 66,000 ac-ft of flood water during large storm events) and habitat restoration. The project would re-create historical floodplain habitat for salmon, splittail, and other native fish spawning and/or juvenile rearing, and construct improvements to New Sacramento River Bypass/Weir to provide for fish passage (e.g., new vertical slot weir and/or fish ladders or improvements). Other opportunities include integrated water management and recreation/open space.	In 2012, the Wildlife Conservation Board issued a grant to the California Waterfowl Association to acquire a conservation easement on the ranch for protection of agricultural-friendly habitat areas, supporting migratory waterfowl and other bird, amphibian, and reptile species. https://ceqanet.opr.ca.gov/2012128039
Lower Elkhorn Basin Levee Setback (Department of Water Resources)	Yolo County	The project entails the following flood-risk reduction elements (1) widening the Yolo Bypass by constructing a setback levee approximately 1,500 ft east of the Tule Canal in the Lower Elkhorn Basin (between I-5 and the Sacramento Bypass), (2) widening the Sacramento Bypass by constructing a setback levee approximately 1,500 ft north of the existing levee (3) potential degrading of all or portions of existing levees; and (4) implementing ecosystem improvements in the lower Elkhorn Basin to mitigate project impacts.	A draft of the EIR was released for public comment; comment period closed on July 9, 2018. https://water.ca.gov/Programs/Flood-Management/Flood-Projects/Lower-Elkhorn-Basin
Honker Bay Conservation Bank (Solano County)	Northern Honker Bay, east of Roaring River and south of Campion Slough on Wheeler Island, Southern edge of Suisun Marsh, Solano County	The 112.34 ac conservation bank would be restored, enhanced, and permanently protected, providing compensatory mitigation for development activities. The project is designed to benefit Green Sturgeon, Steelhead, Chinook Salmon, Delta Smelt, and Longfin Smelt.	Currently under review by the Conservation Bank Review Team, consisting of NMFS, USFWS, and CDFW. https://www.wildlandsinc.com/banks/honker-bay-conservation-bank-salm/ https://ceqanet.opr.ca.gov/Project/2014092063
Knaggs Ranch Project (Formerly known as the Elkhorn Basin Ranch) (Sacramento Area Flood Control Agency [SAFCA])	Northern Yolo Bypass, Yolo County	The 1,682 ac property was acquired in 2008 to permanently preserve for agriculture, wildlife habitat, and open space use. The project plans to develop and manage approximately 850 ac of seasonal floodplain habitat, while allowing for continued agricultural production on the remaining portion of the ranch. The project also includes 400 ac available to develop mixed riparian forest and shaded riverine habitat for mitigating impacts of DWR flood project construction and maintenance.	Pilot studies were implemented between 2012-2013. The project was fully implemented and considered a success by 2016. https://watershed.ucdavis.edu/files/biblio/Knaggs%202013%20final%20BOR%20report_0.pdf https://caltrout.org/our-work/steelhead-salmon/knaggs-ranch-agricultural-floodplain-study/ https://caltrout.org/2016/12/growing-fish-food-rice-fields/
North Delta Fish Conservation Bank (The Trust for Public Land and Reclamation District 2093)	Southern Yolo Bypass, Yolo County	This is an 811 ac bank located on Liberty Island at the southern end of the Yolo Bypass, in the Sacramento-San Joaquin Delta. After implementation, the project would result in the enhancement of over 657 ac of tidal marsh complex, over 68 ac of tidal channel enhancement, and over 32 ac of tidal emergent marsh creation, through the removal of levees and lowering a portion of the existing floodplain habitat.	Approved in October 2013 by NMFS, USFWS, and CDFW. http://www.wildlandsinc.com/wildlands-receives-final-approval-for-mitigation-banks/#sthash.3eR2q00Q.dpuf https://ceqanet.opr.ca.gov/Project/2010122078
Winters Putah Creek Nature Park / Floodplain Restoration and Recreational Access Project (Central Flood Protection Board)	Yolo and Solano Counties	The project would restore the existing Putah Creek floodplain, fill-in the south branch of the low-flow channel, create a side channel lined with spawning gravel, realign the low-flow channel to a more natural condition, and remove and plant vegetation.	Phases I and II were completed in 2011. The third phase is tentatively scheduled to be completed in summer 2018. A Notice of Determination was filed with the State Clearinghouse in May 2018. https://www.wintersexpress.com/local-news/winters-putah-creek-nature-park-fate-finally-fixed/).
North American Wetlands Conservation Act 3 – Lower Putah Creek Floodplain Restoration (Solano County Water Agency)	Yolo and Solano Counties	The project would regrade the existing Putah Creek floodplain to a uniform 1-2% slope, fill-in the south branch of an existing split low-flow channel, create a side channel lined with spawning gravel, and realign the low-flow channel to a more natural condition. Existing native and non-native vegetation will be removed prior to grading activities. After grading is complete, native vegetation will be planted along the floodplain.	A Notice of Determination was filed with the State Clearinghouse in December 2015; a Central Valley Flood Protection Board Encroachment Permit was approved in May 2018.

Names of Related Projects and Lead Agencies	Location	Brief Descriptions	Status as of July 2019
Programmatic EIR for the Lower Putah Creek Restoration Project – Upper Reach Project (Solano County Water Agency)	Solano and Yolo Counties	The project would restore and enhance geomorphological and ecological function on approximately 24.2 mi of Putah Creek between the Putah Diversion Dam and the western boundary of the Yolo Bypass Wildlife Area. Project activities include the following: modify channel geometry, construct grade/flow control structures, stabilize channel banks, improve fish spawning gravel, fill abandoned gravel pits, remove invasive vegetation, plant native vegetation, irrigate native vegetation sites, manage non-native vegetation at restored sites, and maintain long-term access points.	The Notice of Determination was withdrawn on 8/15/17.
Yolo Bypass Wildlife Area Habitat and Drainage Improvements (Department of Fish and Wildlife)	Yolo County	The project includes five major improvements / components that are being proposed to enhance CDFWs ability to manage wetland resources and agricultural operations within the Yolo Bypass Wildlife Area. Specific improvements include installing new water control structures, expanding canals, installing box culverts and two con-span bridges, replacing existing culverts, raising road grades, separating dual function ditches, relocating an existing water pump, and installing two new pumps.	A Notice of Determination was filed with the State Clearinghouse in January 2018.
Wildlife Corridors for Flood Escape on the Yolo Bypass Wildlife Area (Yolo County Resource Conservation District)	Yolo County	The project comprises habitat restoration on three areas of the Yolo Bypass Wildlife Area: a 2.7 mi corridor, a 2.2 mi corridor, and 0.5 ac of planting. The project will treat noxious plant species and establish a diverse mix of native plant species appropriate to the region.	A Notice of Exemption was filed with the State Clearinghouse in March 2017.
STRUCTURAL FISH ENHANCEMENT PROJECTS			
Anadromous Fish Screen Program (United Stated Bureau of Reclamation [USBR], United States Fish and Wildlife Service [USFWS], CDFW)	All five Delta counties	The project would protect juvenile Chinook Salmon (all runs), Steelhead, Green and White Sturgeon, Striped Bass and American Shad from entrainment at priority diversions throughout the Central Valley, including Sacramento and San Joaquin rivers, their tributaries, the Delta, and the Suisun Marsh. The types of projects eligible for cost-share funds under the AFSP include: construction fish screens on unscreened diversions; rehabilitating existing fish screens; replacing existing non-functioning fish screens; and relocating water diversions to less fishery-sensitive areas. Since 1994, the AFSP has screened 35 high-priority diversions ranging from 11 cfs up to 960 cfs. Cumulatively, the AFSP has screened over 5,412 cfs in the Central Valley and the Delta.	Ongoing program. http://www.fws.gov/cno/fisheries/cvpia/AnadromFishScreen.cfm
Fremont Weir Modifications Project (CDFW, DWR, and USBR)	Northern end of Yolo Bypass, Yolo County	The project would create and manage approximately 21,500 ac of seasonal floodplain habitat. It would increase the duration of Yolo Bypass flooding in winter and spring by modifying the Fremont Weir to allow low flows of the Sacramento River to pass through the Yolo Bypass.	The Fremont Weir Modification Project is part of the Yolo Bypass Fisheries Enhancement Plan, which addresses fish passage improvements mandated by the NMFS. http://resources.ca.gov/docs/ecorestore/projects/Fremont_Weir_Fish_Passage.pdf https://ceqanet.opr.ca.gov/Project/2017022012
Lisbon Weir Fish Passage Enhancement (USBR and DWR)	Yolo County	The project would improve agriculture and habitat water control structures for fish and wildlife benefits.	Project is in the planning stage. For more information, see pages 19-20 of the following: http://www.water.ca.gov/fishpassage/docs/yolo2.pdf The Lisbon Weir Fish Passage Enhancement is part of the Yolo Bypass Fisheries Enhancement Plan, which addresses fish passage improvements mandated by NMFS. http://resources.ca.gov/docs/ecorestore/projects/Lisbon_Weir.pdf

Names of Related Projects and Lead Agencies	Location	Brief Descriptions	Status as of July 2019
Tule Canal Fish Passage Enhancement (USBR and DWR)	Yolo County	The project would identify passage impediments and evaluate the feasibility of improving fish passage or removing fish passage impediments.	Project is in the planning stage. For more information, see page 18 of the following: http://www.water.ca.gov/fishpassage/docs/yolo2.pdf The Tule Canal Fish Passage Enhancement is part of the Yolo Bypass Fisheries Enhancement Plan, which addresses fish passage improvements mandated by NMFS.
Yolo Bypass Salmonid Habitat Restoration and Fish Passage (USBR and DWR)	Yolo Bypass, Yolo County (within the Sacramento Valley region)	The project would create more suitable conditions for fish in the Yolo Bypass and/or lower Sacramento River basin by implementing the Reasonable and Prudent Alternative actions (i.e., I.6.1 and I.7) as described in the 2009 NMFS Biological Opinion and the 2012 Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan. The project would install an inflatable barrier to induce overbank flooding out of the Tule Canal/Toe Drain or modify the Tule Canal/Toe Drain to create an excavated, shallow flooded region.	Notice of Intent and Notice of Preparation for the Draft EIS/EIR was released on March 4, 2013. Permitting is scheduled to continue through 2020, with anticipated construction in 2022. http://resources.ca.gov/docs/ecorestore/projects/Yolo_Bypass_Salmonid_Habitat_Restoration_and_Fish_Passage_Project.pdf
RESOURCE MANAGEMENT PROJECTS AND PROGRAMS			
Aquatic Invasive Species Programs (Formerly known as the Aquatic Weed Control Program) (California Department of Boating and Waterways [CDBW])	Delta and its tributaries (all five Delta counties)	The project would implement both short- and long-term measures to control Brazilian waterweed (*Egeria densa*) and water hyacinth (*Eichhornia crassipes*). Beginning in 2001, this weed control program includes treatment with herbicides, environmental monitoring, regulatory compliance, and surveillance. Permits restrict program treatment in the Delta from April 1 through October 15. Since 1982, the water hyacinth program included treatment with herbicides, mechanical methods, and biological controls. Permits restrict program treatment of chemicals in the Delta from July 1 through October 15. Seasonal surveys are done in the Delta region to determine where water hyacinth is located, and which areas are in most need of treatment. During 2012, Assembly Bill 1540 (Buchanan) was approved giving the California Department of Boating and Waterways authority to control a new aquatic weed that has been recently found in the Delta, the South American Spongeplant (*Limnobium laevigatum*).	The program had been fully implemented as of 2018. http://dbw.parks.ca.gov/?page_id=29465 https://ceqanet.opr.ca.gov/Project/2017082031
California EcoRestore (Resources Agency)	All five Delta counties	Over the next five years, California will pursue more than 30,000 ac of critical Delta restoration under the California EcoRestore program, pursuant to pre-existing regulatory requirements such as the 2008 and 2009 Biological Opinions, described below, and various enhancements to improve the overall health of the Delta ecosystem.	This program was initiated in April 2015. Acreage targets were partially met by several projects shown in this table. http://resources.ca.gov/ecorestore/
Biological Opinions and Conference Opinions on the Long-term Operations of the Central Valley Project and State Water Project for Delta Smelt and Salmonids (USFWS 2008 and NMFS 2009a)	All five Delta counties	Issuance of final Biological Opinions by each regulatory agency with findings that continued operations of the Central Valley Project (CVP) and the State Water Project (SWP) would likely jeopardize several listed species, including Delta Smelt and Salmonids. These agencies identified reasonable and prudent alternatives that, if implemented, would avoid the likelihood of jeopardizing the continued existence of those listed species. Included in these opinions are actions, such as the restoration of 8,000 ac of land to intertidal habitat and associated subtidal habitat for Delta Smelt, and 17,000 to 20,000 ac of seasonal floodplain for Salmonids.	Implementation of the reasonable and prudent alternatives identified in the USFWS 2008 and NMFS 2009a BOs is ongoing. https://www.fws.gov/sfbaydelta/HabitatConservation/CalWaterFix/Index.htm http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/ocap.html

Names of Related Projects and Lead Agencies	Location	Brief Descriptions	Status as of July 2019
Delta Smelt Permanent Refuge (University of California at Davis, DWR, CDFG, USFWS, USBR)	Possibly in Rio Vista, Solano County	The project would create a permanent facility, possibly at the proposed USFWS Science Center in Rio Vista, to provide Delta Smelt refugia to ensure the conservation of the genetic diversity of Delta Smelt.	Program under development. See pages 3D-06 and 3D-103 of the Bay Delta Conservation Revised DEIR (DWR and USBR 2016).
Yolo Habitat Conservation Plan/Natural Community Conservation Plan (Yolo County)	Yolo County	This is a comprehensive, county-wide plan designed to provide long-term conservation and management of natural communities, sensitive species, and the habitats upon which those species depend, while accommodating other important uses of the land. The Plan area encompasses the entire area of Yolo County - approximately 653,549 ac plus additional conservation on up to 1,174 ac along Putah Creek in Solano County.	A Notice of Determination was filed with the State Clearinghouse in May 2018. https://www.yolohabitatconservancy.org/about
Delta Research Station (Department of Water Resources)	Solano and San Joaquin Counties	The project includes construction and operation of the Estuarine Research Station (ERS) resulting from a multi-year collaboration between DWR, USFWS, CDFW, and other agencies involved in the Interagency Ecological Program (IEP). It will consolidate existing IEP programs currently located in the Delta. Approval includes approximately 116,000 ft^2. of buildings for office, laboratories, warehouse, and covered boat storage. In addition, there will be open yard storage for equipment, and a marina for approximately 23 vessels. IEP monitoring activities assist DWR in complying with conditions of its water right permits and licenses.	A Notice of Determination was filed with the State Clearinghouse in May 2017. http://www.deltaresearchstation.com/Review.html
FLOOD PROTECTION, WATER SUPPLY, AND NAVIGATION PROJECTS AND PROGRAMS			
Delta Conveyance (previously California Water Fix – Water Conveyance) (DWR and USBR)	All five Delta Counties	Under the Water Fix proposal, the proposed conveyance project includes the following: (1) the construction of water intake facilities with a total capacity of 9,000 cfs; (2) operations that would be phased in over several years; and (3) a conveyance system including two tunnels designed to use gravity flow. The existing SWP and CVP south Delta pumping facilities would remain. The Delta Conveyance is now proposed as a single tunnel configuration, as directed by the Governor.	Weblinks relating to the Water Fix project have been removed. Information on Delta Conveyance can be found here: https://water.ca.gov/deltaconveyance
Central Valley Flood Protection Plan – 2017 (DWR and Central Valley Flood Protection Board [CVFPB])	All five Delta Counties	The Plan would guide California's participation (and influence federal and local participation) in managing flood risk along the Sacramento and San Joaquin rivers' systems. The Plan is a system-wide investment approach for sustainable, integrated flood management in areas currently protected by facilities of the State Plan of Flood Control (SPFC).	Information on the Plan can be found here: https://water.ca.gov/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan
Davis Woodland Water Supply Project (City of Davis, City of Woodland, and University of California at Davis)	East-central portion of Yolo County	Divert up to approximately 45,000 ac-ft annually of surface water from the Sacramento River and convey it for treatment and subsequent use in the cities of Davis and Woodland, including at the University of California Davis Campus. Project activities include construction and operation of a water intake/diversion, conveyance, and water treatment facilities. Water rights were granted in March 2011, subject to conditions imposed by the state. Water diversions would be limited during summer and other dry periods. A water right for 10,000 ac-ft was purchased from the Conaway Preservation Group to provide summer water supply. Groundwater would continue to be used by Woodland and Davis when demand for water cannot be met with surface water supplies alone.	The Final EIR was certified in 2009. Construction ended in 2016. https://www.wdcwa.com/project-overview https://ceqanet.opr.ca.gov/Project/2015012062

Names of Related Projects and Lead Agencies	Location	Brief Descriptions	Status as of July 2019
North Bay Aqueduct Alternative Intake Project (DWR and SCWA)	Solano and Yolo counties	The project would construct and operate an alternative intake on the Sacramento River, generally upstream of the Sacramento Regional Wastewater Treatment Plant in Freeport, and connect it to the existing North Bay Aqueduct (NBA) system by a new segment of pipe. The proposed alternative intake would be operated in conjunction with the existing NBA intake at Barker Slough. The Project would be designed to improve water quality and to provide reliable deliveries of SWP supplies to its contractors, the Solano County Water Agency and the Napa County Flood Control and Water Conservation District.	The Project was completed in 2018. http://www.scwa2.com/water-supply/north-bay-aqueduct http://bondaccountability.resources.ca.gov/Project.aspx?ProjectPK=9455&PropositionPK=4
Southport Sacramento River Early Implementation Project (USACE and West Sacramento Area Flood Control Agency)	Yolo County	The project would implement flood risk-reduction measures along the Sacramento River South Levee in the city of West Sacramento. The Project reach extends along the right (west) bank of the Sacramento River south of the Barge Canal downstream approximately 6.4 mi to the South Cross-Levee, protecting the Southport community of West Sacramento. The 3.3 mi^2 study area encompasses the area of levee improvement along the river corridor and the potential soil borrow sites east and west of southern Jefferson Blvd.	The project was CEQA approved in 2017. https://www.cityofwestsacramento.org/government/departments/community-development/flood-protection https://ceqanet.opr.ca.gov/2011082069/14
Sacramento Deep Water Ship Channel (DWSC) Project (USACE and Port of West Sacramento)	Within the Sacramento River Deep Water Ship Channel ,Yolo, Solano, Sacramento, Contra Costa counties	The project would improve navigation of the 46.5 mi shipping channel via dredging and establishing wetland/riparian habitat on lower Sherman Island. The project would involve both deepening portions of the DWSC to a depth of -35 ft MLLW and selective widening from RMs 0.0 to 35.0, completing the construction that was suspended in 1990, and conducting maintenance dredging from RMs 35.0 to 43.4. This project would involve the excavation and disposal of between 8.1 and 10 cy of material. Dredging is proposed for six-month windows (June 1 –December 31) over four years.	A Limited Reevaluation Report (LRR) and Final Supplemental EIS/EIR are being prepared, but are currently on hold. https://www.spn.usace.army.mil/Missions/Projects-and-Programs/Projects-A-Z/Sacramento-River-Deep-Water-Ship-Channel-C/Main/ https://ceqanet.opr.ca.gov/Project/1987011307
MAINTENANCE PROJECTS			
Sacramento Yacht Club Maintenance Dredging (Department of Fish and Wildlife)	Yolo County	The project is limited to maintenance dredging of the Sacramento River to maintain navigable depths for recreation boats using the marina. Approximately 5,000 cy of sediment will be removed from the marina annually.	A Notice of Exemption was filed with the State Clearinghouse in November 2016. A 401 Certification was issued in April 2016 and allows maintenance dredging until 2021.
2016 Sacramento Deep Water Ship Channel Maintenance Project (USACE)	Yolo County	The project would dredge the Sacramento DWSC to a depth of 30 ft for navigation.	A Notice of Exemption was filed with the State Clearinghouse in Summer 2016. A General Order Waste Discharge Requirement was issued in August 2016 for maintenance dredging to take place between August and October 2016.
Knights Landing Outfall Gates (Reclamation District 108)	Yolo County	The project would reconstruct an existing earthen weir (Wallace Weir) with all related structures including the installation of rock slope protection, installation of two new waterside levee access ramps, installation of a weir and gate control building on the crown of the levee, in-channel grading, reconstruction of a private levee on the east side of the weir, and the installation of six PG&E power poles within the Yolo Bypass.	A public draft Mitigated Negative Declaration was released in June 2015. A Notice of Determination was filed with the State Clearinghouse in July 2015. http://www.rd108.org/klog/
Miner Slough Bridge Project (CalTrans)	Solano county	The project would rehabilitate or replace the existing bridge on SR-84 over Miner Slough (the Minor Slough Bridge Project). The project proposes two alternatives for the bridge based on a current planning study. Alternative 1 (bridge replacement), is to build a new swing-span bridge approximately 100 ft west of the existing alignment. Alternative 2 (bridge rehabilitation) is to rehabilitate the existing bridge.	A Notice of Determination was filed with the State Clearinghouse in March 2018. This project is complete.

Names of Related Projects and Lead Agencies	Location	Brief Descriptions	Status as of July 2019
Decker Island Levee Repair Demonstrations Project (Department of Water Resources)	Solano County	The project would repair 210 ft of eroded bank in the habitat restoration area of Decker Island, across Horseshoe Bend from the Threemile Slough Bridge. The project will compare the viability of the "gripper system" from Maverick Solutions to riprap that is traditionally used for erosion repairs in the Delta. The gripper system utilizes interlocked, non-woven geo-textile bags, fill with soil and vegetation interspaced among the bags, to create a highly resilient erosion control wall while providing vegetation along the channel's edge.	A Notice of Determination was filed with the State Clearinghouse in December 2016. https://ceqanet.opr.ca.gov/Project/2016032048
Yolo 84 Overlay Project (CalTrans #3)	Yolo County	Work would consist of replacement of existing asphalt concrete with Cold-In-Place recycle process, placement of new shoulder backing without removal of existing shoulder backing, and removal and replacement of traffic striped and metal beam guardrail.	A Notice of Exemption was filed with the State Clearinghouse in August 2017. Project is complete. http://www.dot.ca.gov/d3/projects/

This table originated in the Lower Yolo Tidal Restoration Project Final EIR (July 2013). All projects in the source document were reviewed for current status in 2015. Projects were removed from the list if they have been implemented, or if no potential cumulative impacts were identified. The statues of the listed projects were updated in July 2019, and some projects were added based on public comments received on the 2016 DEIR and 2019 Partial Recirculated DEIR. This table includes public agency and private projects that may require public agency approvals.

3.19.3 Summary of cumulative impacts

Cumulative impacts of the Proposed Project plus other projects listed in Table 3.19-1 have been assessed by the technical experts preparing each section of this EIR. The overall significance of the cumulative impacts is evaluated and the significance of the Proposed Project's contribution to any potentially significant cumulative impacts is then considered. Significance criteria for cumulative effects vary by resource considered, and they are identical to those used to determine significance for Proposed Project impacts in each resource area. The significance determinations are based on whether effects would be cumulatively considerable (CEQA Section 15065(a)(3)). Mitigation measures for any cumulatively considerable Proposed Project contributions to cumulative impacts are identified.

Hydrology

The Proposed Project would have no impact on the Sacramento River Flood Control Project and the Yolo Bypass Floodway flood conveyance; compliance with Water Rights Decision 1641 (D-1641) flow requirements on the Sacramento River at Rio Vista; stability of nearby bridges, trestles, culverts or other structures; or water rights from diversion of surface water. Therefore, the Proposed Project would not contribute cumulatively to any impacts to these resources.

No planned projects or future restoration project opportunity areas considered in the analysis of potential cumulative effects have the potential to increase flows or velocities in Miner Slough. Therefore, there would be no cumulative impacts associated with potential Miner Slough bed scour and/or groundwater seepage on adjacent lands.

Localized tide range impacts of the Proposed Project have the potential to affect the design capacity of agricultural water supply pumps. As discussed in Section 3.1-1, conceptual Phase 1 modeling predicted generally low tidal range reductions for all modeled alternatives, which diminish with distance from Prospect Island. The relatively small tidal restoration footprints of two nearby projects, the North Delta Fish Conservation Bank (32 ac) and the Calhoun Cut Tidal Habitat Enhancement Project (165 ac) (Table 3.19-1), are expected to produce only small, localized reductions in tide range as compared with the Proposed Project. Therefore, the combined cumulative impacts of these two small projects, in conjunction with the Proposed Project, on agriculture would be *less than significant*.

In addition, the larger Lower Yolo Ranch Tidal Restoration Project (1,100 ac) would not have impacts that overlap the Proposed Project's effects on agricultural irrigation and drainage infrastructure (SFCWA 2013). Currently, no other planned projects in the vicinity of Prospect Island are expected to reduce local tide ranges. Therefore, there would not be any cumulative impacts to local agricultural water supply and drainage.

On a regional scale, future tidal habitat restoration projects, including the Proposed Project, would cumulatively dampen tide ranges (i.e., decrease the heights of high tides and increase the heights of low tides) in the Sacramento-San Joaquin River Delta (Delta) within the larger context of external processes including seasonal and event-based climatic variability, El Niño/La Niña cycles, storm flows throughout the estuary watershed, changes in Delta water operations, and sea level rise. Projected regional increases in mean sea level would increase regional flood risk by increasing the frequency, intensity, and duration of extreme water levels (Ekstrom and Moser 2012).

Future tidal habitat restoration projects that may be planned for Delta Conveyance and in nearby EcoRestore project areas could increase the tidal prism and further reduce the tidal range in the Proposed Project vicinity. Thus, overall, the Proposed Project and other tidal habitat restoration projects in the Delta have the potential to reduce flood risks associated with projected increases in regional mean sea level by decreasing water surface elevations during high tides. This would be a *beneficial* cumulative effect.

Water quality

The Proposed Project with Mitigation Measures 3.2-1.1 through 3.2-1.3, 3.2-2.1, and 3.2-3.1 and 3.2-3.2 would have a *less than significant* impact on water quality due to potential short-term releases of turbidity, contaminants, or aquatic-approved herbicides due to site preparation and construction of the Proposed Project (Impacts 3.2-1 through 3.2-3). There would be a *less than significant* impact with respect to water temperature in adjacent waterbodies due to dewatering of Prospect Island during construction activities (Impact 3.2-4). All short-term construction-related impacts would occur on, or immediately adjacent to, the Proposed Project site. Other related projects in the vicinity of Prospect Island (e.g., North Delta Fish Conservation Bank, 32 ac; Lindsey Slough Freshwater Tidal Marsh Enhancement Project, 165 ac; Lower Yolo Ranch Tidal Restoration Project, 1,100 ac; Lookout Slough, 3,400 ac) (Table 3.19-1) would be subject to the same stringent requirements to avoid impacts to water quality

during construction activities, regardless of whether they overlap in time with construction activities at Prospect Island. Therefore, the cumulative impact of the Proposed Project and other related Delta projects would be *less than significant with mitigation* with respect to short-term construction-related increases in turbidity (see Mitigation Measure 3.2-2.1 in Section 3.2.3 *[Water Quality (Surface and Groundwater) Impacts and mitigation*), contaminants (see Mitigation Measures 3.2-1.1, 3.2-1.2, 3.2-1.3 in Section 3.2.3), and herbicides (see Mitigation Measures 3.2-3.1 and 3.2-3.2 in Section 3.2.3), and *less than significant* with respect to water temperature. The potential for cumulative impacts to salinity, dissolved organic carbon, and methylmercury are discussed below.

Salinity

Combined, the Proposed Project, other tidal restoration projects in the Delta (Table 3.19-1), and projected regional mean sea level rise, have the potential to change the long-term hydrodynamics of the San Francisco Estuary and Delta such that salinity may extend farther inland. Salinity modeling conducted in support of the BDCP / California WaterFix Final EIR/EIS [now withdrawn and replaced by the 'Delta Conveyance' single tunnel configuration https://water.ca.gov/deltaconveyance] used breach configurations at Prospect Island similar to the Proposed Project, in combination with other reasonably foreseeable restoration projects in the Delta. The conclusions included that: tidal flow, net flow, and tidal trapping affect salt intrusion, and any change to these competing mechanisms would affect how salinity responds in time; maximum potential changes from Base EC are modeled to occur in late September and October; upstream of restored areas, EC tends to be reduced due to tidal flow and mixing; increased net flows in Sacramento River below the Delta Cross Channel would reduce EC in the vicinity of Rio Vista and Emmaton (i.e., a reduction near CCWD's intake); and a reduction of average flows in Georgina Slough and the Delta Cross Channel would increase EC in the San Joaquin River in the vicinity of San Andreas Landing. This modeling indicates that as Delta outflows decrease, the effect of regional mean sea level rise and tidal habitat restoration on increasing salinity becomes more prominent. At lower outflows, the combined effect of the Proposed Project, in combination with other planned tidal habitat restoration projects, on salinity in the Delta could be potentially significant; therefore, the cumulative impact of increasing tidal prism is considered, and the incremental effect of the Proposed Project is assessed below.

Cumulative salinity modeling has been conducted for the Proposed Tule Red Tidal Marsh Restoration, Grizzly Island, California (RMA 2016b) (Tule Red Salinity Analysis), which incorporated seven tidal restoration projects: Tule Red Tidal Restoration Project (focus project); Mallard Farms Conservation Bank; Honker Bay Conservation Bank; Dutch Slough Tidal Marsh Restoration Project; Lower Yolo Restoration Project; Prospect Island Tidal Restoration Project; and the McCormack Williamson Tract Project. Computed EC was analyzed at Beldons Landing, Mallard Island (CCWD), Jersey Point, Emmaton, Rock Slough (CCWD), Old River at Highway 4 (CCWD), Victoria Canal (CCWD), Clifton Court intake, and at the CVP intake. Modeled cumulative change in EC from base conditions (i.e., without any of the seven projects) to post-implementation of all seven projects did not exceed 9%, with the highest modeled changes reported at Rock Slough in October and November. The incremental cumulative contribution to salinity impacts in the Delta of the Prospect Island Tidal Habitat Restoration Project is not specifically assessed in the Tule Red Salinity Analysis (RMA 2016b); therefore, it is not possible to know what percentage of the potential maximum 9% increase could be attributed to the Prospect Island Project and when such increases, if any, would occur, although it appears that the increase is most likely attributed to projects other than the Prospect Island Tidal Habitat Restoration Project.

The Proposed Project-specific salinity impacts are small, there is limited modeling available that combines various other projects (e.g., WaterFix and Tule Red Salinity Analysis modeling described above), and many of the “other” projects that could contribute to Delta salinity are only in the planning phase; therefore, the following paragraphs of this analysis primarily consider the relative contribution of the Proposed Project based on technical modeling. For the Proposed Project (Alternative 26 of the Phase 2 Modeling), modeled electrical conductivity (EC) differences varied by Delta region and seasonally. Modeling results showed decreases in computed EC in the western Delta, with only small increases for central and south Delta locations (Appendix D in WWR and SWS 2014).

For the Proposed Project, maximum salinity increases during a dry-year hydrology (2009) are less than 6% at all seven modeled and reported Water Rights Decision 1641 (D-1641) compliance locations within the Delta, and salinity is only modeled to increase more than 3.2% at the San Joaquin river at Prisoners Point (D29), which is not designated for municipal, industrial, or agricultural beneficial uses (see Table i in Appendix D in WWR and SWS 2014). During a below- or near-normal year hydrology (2010), modeled salinity increases are

considerably less, and are not modeled to exceed 2% for the Proposed Project at any of the seven modeled and reported locations during any month. All of the seven modeled and reported locations are within D-1641 salinity (EC / chloride) compliance limits for all beneficial uses (Appendix D in WWR and SWS 2014), and the Proposed Project does not cause any of the locations to approach exceedance levels during relevant compliance periods.

For the eight supplemental compliance stations modeled, maximum salinity increases under the Proposed Project are less than 1% for all locations except for the San Joaquin River at San Andreas (C-4), which shows a potential maximum salinity increase up to 7.8% during a dry-year hydrology, and up to 2.9% during a below- or near-normal year hydrology (Tables 34 and 35 of Appendix D in WWR and SWS 2014). The C-4 location is an *agricultural beneficial use* site within the Interior Delta. The Proposed Project would not increase the number of days of non-compliance with D-1641 salinity (EC / chloride) standards from existing conditions at any of the eight supplemental locations (Appendix D in WWR and SWS 2014).

The incremental effect of increased tidal prism by the Proposed Project is modeled to result in a maximum increase of approximately 30 uS/cm (7.8%) above baseline conditions, which may occur in Fall (the baseline condition is a monthly average of 377 uS/cm for this location and month; see Impact 3.2-5). Project-specific salinity changes modeled for the Proposed Project show both increases and decreases of salinity depending on the water-year type and time of year, and any increases are small and would not approach exceedances of D-1641 salinity standards at compliance locations, and thus avoid unreasonable effects on beneficial uses of water (see **General Responses G** and **H**). Salinity impacts are, thus, not cumulatively significant. D-1641 compliance would still be required in all years, including lower outflow years.

Dissolved organic carbon

The Proposed Project and other wetland restoration projects in the Delta (Table 3.19-1) have the combined potential to increase beneficial levels of on-site primary productivity. At the same time, increased algal production, as well as plant productivity, in these projects have the potential to export dissolved organic carbon (DOC) to Delta waterways. Among other factors, increased DOC levels would be potentially problematic for water treatment facilities with intakes in the Delta, due to the formation of carcinogenic disinfection by-products during chlorination. This EIR has determined that the Proposed Project would have relatively small potential for increased DOC export from the Proposed Project site

that could be transported to municipal drinking water intakes (Impact 3.2-7) compared to tidal influence and, therefore, is not significant. The incremental effect on DOC due to the Proposed Project would also not be cumulatively considerable for the same reason.

Methylmercury

The Proposed Project would slightly increase the area of infrequently flooded habitat between mean high water (MHW) and mean higher high water (MHHW) along the interior of the Prospect Island perimeter levees, which would potentially result in increased methylmercury production compared with existing conditions. This increase would be offset by increases in open-water habitat associated with relatively low production and bioaccumulation potential under the Proposed Project. Given ongoing DWR and California Department of Fish and Wildlife (CDFW) mercury compliance control studies, and the small or negligible degree of anticipated increased methylmercury export, this would be a *less than significant* impact (Impact 3.2-8).

While other planned tidal restoration projects in the Delta may further increase the area of infrequently flooded habitat associated with higher methylmercury production, many of these (e.g., Dutch Slough Tidal Marsh Restoration Project, Lower Putah Creek Realignment Project, Lower Yolo Wetland Restoration Project, North Delta Flood Control and Ecosystem Restoration Project [McCormack-Williamson Tract]) are located in the northern Delta and would thus be freshwater tidal restoration projects, with scientific uncertainty regarding the degree to which these wetlands may or may not contribute to Delta methylmercury loading now and in the future. Others are located farther south and west, in or near Suisin Marsh (e.g., Tule Red Enhancement, Overlook Club Wetland Restoration Project, Hill Slough Restoration Project), and thus would be brackish tidal marsh projects. The latter are subject to more studies and reports in the scientific literature regarding the potential for increased methylmercury production and bioaccumulation; however, there is still general uncertainty regarding methylmercury impacts from these types of projects at the broader scale of the Delta.

Although scientific studies are currently sparse, existing science suggests that methylmercury levels in restoration sites are no higher than reference (non-restored and muted) sites and there is no increase of methylmercury in response to restoration (Robinson et al., 2014; Robinson et al., 2018). One study found that tidal wetlands more frequently act as sinks, rather than sources, of methylmercury (Lee et al., 2015). Another study suggests that methylmercury production within tidal marshes has greater consequences for biota inhabiting the

marsh and salt marsh food-web, than for the efflux of methylmercury from the marsh and the coastal zone (Mitchell and Gilmour, 2012). These studies, together with the analysis in the EIR, document the best available science regarding methylmercury impacts associated with wetland restoration.

When combined with other related projects in the Delta, many of which would also be freshwater tidal restoration projects, the anticipated increased methylmercury production, export, and bioaccumulation as a result of the Proposed Project would be small. Given the *less than significant* project-specific impact, and ongoing DWR and CDFW mercury compliance control studies which will help to address existing scientific uncertainty regarding the degree to which freshwater tidal wetlands contribute to Delta methylmercury loading now and in the future, the cumulative impact would not be cumulatively considerable.

Aquatic biological resources

The most substantial restorations that have occurred in the Proposed Project region resulted from the natural levee failures of Little Holland Tract (~1,500 ac) and Liberty Island (more than 4,300 ac), both west of the Proposed Project site. Northwest of the Proposed Project site are the 185 ac Liberty Island Conservation Bank, the 1,226 ac Lower Yolo Ranch Project, and the 1,700 ac Liberty Farms Project. These projects, in addition to other Delta projects listed in Table 3.19-1, were evaluated for cumulative impacts to aquatic biological resources.

The Proposed Project would have beneficial long-term impacts to special-status fish, essential fish habitat, and critical habitat. The completed Proposed Project would result in the creation of 462 ac of tidal perennial aquatic habitat and 1,053 ac of tidal wetland habitat (Table 2.2-2) by reconnecting Prospect Island to tidal action and establishment of intertidal habitat features.

The Proposed Project would have short-term construction-related impacts to special-status fish and fish habitat. However, there would be no significant overlap in time and space of construction-related impacts to special-status fish and habitat between the Proposed Project and other cumulative projects. Therefore, the Proposed Project would not contribute to cumulative construction-related impacts to aquatic resources.

In the long-term, other restoration projects and the Proposed Project would have beneficial impacts, resulting in an overall net benefit to fish and fish habitat. Even though some projects on the list may result in a loss of aquatic habitat or

significant long-term impacts to special-status fish, the Proposed Project would not contribute to any long-term cumulative adverse impacts to aquatic biological resources. Therefore, the impact would not be cumulatively considerable.

Wetland and terrestrial biological resources

The completed Proposed Project would result in the creation of 462 ac of tidal perennial aquatic (open-water) habitat and 1,053 ac of tidal wetland habitat (Table 2.2-2) by reconnecting Prospect Island to tidal action and establishment of intertidal habitat features. While there would be potential short-term construction-related impacts to sensitive and special-status wetland and terrestrial plants and wildlife and their habitat, these impacts would not overlap in space and time with short-term impacts of other tidal wetland restoration projects, resource management programs, or flood protection, water supply, and navigation projects (Table 3.19-1). Therefore, the Proposed Project would not contribute to cumulative construction-related impacts for wetland and terrestrial resources.

In the long-term, the conversion of perennial aquatic habitats and wetland communities to tidal habitat types would have a *less than significant* impact on special-status plant species adapted to existing conditions. Since the Proposed Project, along with other tidal wetland restoration projects (e.g., Lindsey Slough Freshwater Tidal Marsh Enhancement Project, Dutch Slough, Lower Yolo), would partially restore the historical pre-reclamation tidal regime and potentially support small numbers of giant garter snakes in a Delta location where populations of this snake are not currently found, overall there would not be a cumulatively significant impact. Increased tidal inundation of low-lying riparian habitats under the Proposed Project and other tidal wetland restoration projects may result in reduced availability of mature trees suitable for nesting and roosting habitat by western red bat and special-status and migratory birds. This would potentially contribute to long-term cumulative impacts to these species. However, the combined impact would not be cumulatively considerable due to preserved riparian habitat and riparian plantings at the Proposed Project site, as well as the availability of other suitable riparian habitats along channel margins in the Proposed Project vicinity.

Further, while other Delta restoration and resource management projects may result in a loss of habitat or significant long-term impacts to wetland and terrestrial resources, the Proposed Project would beneficially offset these impacts through the creation of high-quality habitat for numerous wetland and terrestrial species (e.g., valley elderberry longhorn beetle, western pond turtle, nesting and foraging birds that use tidal freshwater emergent habitat). Overall,

the Proposed Project would not contribute to long-term cumulative impacts to wetland and terrestrial biological resources. There would be no cumulatively considerable impact.

Geology and soils

The Proposed Project would not contribute to long-term exposure of people and structures to seismic- and landslide-related hazards or sediment erosion in the Proposed Project vicinity.

Modeling conducted to assess the potential effects of the Prospect Island Tidal Habitat Restoration Project on sediment transport and turbidity in the Proposed Project vicinity indicated that the Proposed Project would accumulate sediment under existing sediment supply conditions, with deeper areas of the Proposed Project site accreting more rapidly than those at higher elevations (Impact 3.5-2). At a regional scale, current observations suggest a decreasing trajectory of sediment supply to the Delta over time, due to diminishment of the legacy hydraulic mining sediment pulse, deposition in flood bypasses, erosion protection (hardening) of river banks, as well as sediment trapping behind upstream dams (Schoellhamer et. al. 2012, Schoellhamer 2011). However, historical Delta landscapes were built from both inorganic sediment accumulation and organic (peat) accumulation (Whipple et al. 2012), with plant litter providing a much larger contribution to vertical accretion in freshwater marshes than inorganic sedimentation (Schoellhamer et al. 2012). The Proposed Project along with future tidal habitat restoration projects are expected to support sediment accretion, as well as peat soil accumulation, to help reverse existing land subsidence, offset future subsidence, and promote system resiliency to mean sea level rise throughout the Delta (see also Section 3.19.3 *Summary of cumulative impacts: Climate change resiliency*). This would be a cumulatively *beneficial* effect.

Hazards and hazardous materials

If encountered, hazards and hazardous materials would be removed from the Proposed Project site or reduced to *less than significant* levels, which would eliminate the potential for contribution to cumulative hazards. Furthermore, implementation of the Proposed Project does not include any features that would be considered a hazard or create a hazardous condition. As a result, the Proposed Project would not contribute to any potentially significant cumulative impacts associated with health or safety issues. There would be no cumulatively considerable impact.

Air quality

The impacts to the air quality pollutants are inherently of a cumulative nature. There are two groups of air pollutants and their cumulative impacts are discussed separately in the following paragraphs.

The first group includes reactive organic gases (ROG) and nitrogen oxides (NO_x), the precursors of ozone. The SVAB was designated as non-attainment for ROG and NO_x, therefore these pollutants are of regional concern. ROG and NO_x emissions from a single project are unlikely to raise the ozone concentration to levels that exceed the state and federal ozone ambient air quality standards (AAQS). Instead, a project's emissions may be individually limited, but cumulatively considerable, when taken in combination with past, present, and future development projects. Yolo-Solano Air Quality Management District (YSAQMD) and other air districts in the region prepared air quality plans, such as the Regional Ozone Plan, that address attainment of the state and federal ozone AAQS. These plans accommodate cumulative growth by projecting growth in ozone precursor emissions based on different indicators. Through the air quality planning process, ozone precursor emission growth is offset by regional controls on stationary, area, and transportation sources of air pollution. The project-level thresholds for ROG and NO_x were established to be consistent with the air quality plans. A project with ROG and NOx below the YSAQMD threshold would be considered to have *less than significant* cumulative impacts on regional air quality. Accordingly, a project with ROG or NOx emissions that exceed the YSAQMD threshold would be considered to have significant cumulative impacts. As discussed in Impact 3.7-1, the Proposed Project would generate annual NOx emissions exceeding the 10 ton per year YSAQMD threshold; however, Mitigation Measures 3.7-1.1 and 3.7-1.3 would reduce this impact to *less than significant*. With mitigation, the impact would not be cumulatively considerable.

The second group of pollutants includes those with localized health impacts caused by the exposure of sensitive receptors to high concentrations of such pollutants. The pollutants in this category include Particulate Matter (particulate matter less than 10 microns in diameter [PM_{10}] and particulate matter less than 2.5 microns in diameter [$PM_{2.5}$]) and carbon monoxide (CO). Construction of the Proposed Project would generate emissions in a rural and agricultural area with few sensitive receptors in the close vicinity. PM_{10} emissions (mostly fugitive dust) would not be high in an area currently under water and surrounded by open-waters, and the estimated PM_{10} emissions would be below the YSAQMD threshold. CO emissions would be primarily due to construction equipment. All of

the projected air pollutant emissions would occur within a construction zone of approximately 200 ac. In addition, no other projects would be carried out within the same timeframe in the vicinity of, or at, the Proposed Project site; therefore, Proposed Project and cumulative emissions would be highly unlikely to form hot spots that have localized high concentrations thereby exceeding corresponding state and federal AAQS. Transport of construction materials or waste would generate trips on public roads and at public intersections. However, as described in Impacts 3.7-1 and 3.7-3, the Proposed Project would be unlikely to create CO hot spots at intersections with degraded level of service. Therefore, cumulative impacts associated with these localized air pollutants would be *less than significant* and would not be cumulatively considerable.

Greenhouse gases

Because global climate change, by its very nature, is a global cumulative impact, an individual project's compliance with a qualifying GHG Reduction Plan may suffice to mitigate the project's incremental contribution to that cumulative impact to a level that is not "cumulatively considerable" (CEQA Guidelines Section 15064(h)(3)).

Based on the analysis provided in the Greenhouse Gas Emissions Reduction Plan (GGERP) and the demonstration that the Proposed Project is consistent with the GGERP (as shown in the attached Consistency Determination Checklist), DWR as the lead agency has determined that the Proposed Project's incremental contribution to the cumulative impact of increasing atmospheric levels of GHGs is not cumulatively considerable and, therefore, *less than significant*.

Mineral and Gas resources

The Proposed Project would have no impact on mineral resources (Section 3.9 [*Mineral and Gas Resources] Impacts and mitigation*). Therefore, the Proposed Project would not contribute to any cumulative impacts on mineral resources. There would be no cumulatively considerable impact.

Noise

The Proposed Project would generate noise during construction. While the Proposed Project would require mitigation to ensure that noise levels remain *less than significant*, Proposed Project noise would be highly localized and would not overlap in space and time with noise from other planned regional projects.

Therefore, the Proposed Project would not contribute to cumulative noise impacts on sensitive receptors and there would be no cumulatively considerable noise impact.

Aesthetics

The Proposed Project would result in small long-term changes to the visual quality of the site and area as viewed by the public. Because of the site's low-lying location and surrounding levees, project changes which would still be natural views normally found in the Delta, would be minimally visible in the context of views of the regional landscape. Therefore, it would not contribute considerably to any substantial changes to regional visual character or quality as a result of the cumulative projects. There would be no cumulatively considerable impact to aesthetics.

Agricultural resources

The Proposed Project would have a *less than significant* impact on agricultural lands. It would not represent conversion of Prime, Unique, or Important Agricultural Land. At the maximum, there would be a potential temporary conversion of 10.8 on an island of approximately 1600 ac that has no other agricultural activity of any kind (Impact 3.12-1). Therefore, there would be no cumulative considerable impact on the loss or conversion of agricultural lands in the Delta.

Cultural resources

The Proposed Project would not result in the destruction of culturally important resources, archaeological resources, historically significant structures, shipwrecks, or paleontological resources. Additionally, the Prospect Island levee would not to contribute to impacts on the potential historically significant Sacramento San Joaquin Delta Levee and Flood Control System; therefore, the Proposed Project would not contribute to cumulative impacts to historical or archaeological resources. There would be no cumulative considerable impact to cultural resources.

Land use and planning/Population and housing

Other than the conversion of agricultural land, which is discussed under the topic of agriculture, there are no other potential impacts on land use and planning or population and housing. Therefore, the Proposed Project would have no effect on cumulative changes to these resources in the region, and no mitigation is

required. There would be no cumulatively considerable impact to land use and planning or population and housing.

Public services

As described above, the Proposed Project's potential impacts to public services would be limited to on-site access issues. Therefore, it would not contribute to any cumulative impacts to services. There would be no cumulatively considerable impact to public services.

Recreation

Temporary impacts of Proposed Project construction on recreation would not overlap with any other projects' impacts on recreation. The Proposed Project would have a long-term positive effect on recreation by potentially providing additional wild lands for recreation access via boat. No contribution to cumulative impacts to regional recreation is anticipated to be caused by Proposed Project construction, or by post-project conditions. There would be no cumulatively considerable impact to recreation.

Transportation and traffic

The Proposed Project would generate construction-related traffic, the peaks of which would be concentrated in short periods within the construction window (see Table 2.2-6). Transportation and traffic impacts associated with Proposed Project construction would be *less than significant with mitigation*. Mitigation includes a traffic control plan, and should any pavement deterioration occur, bringing the road up to pre-Proposed Project construction conditions (see Mitigation Measures 3.17-1.1 and 3.17-1.2). The traffic control plan would serve to eliminate or reduce any conflicts with other traffic. Based on Table 3.19-1, the peak generation periods for the Proposed Project are unlikely to overlap with construction traffic impacts from other projects in the vicinity. Therefore, traffic generation from the Proposed Project would not be cumulatively considerable.

Utilities

The Proposed Project would neither result in the need for additional services from local utility providers, nor result in the temporary disruption of utility services to any providers' customers. As such, the Proposed Project would not generate a cumulative impact as a result of implementation of the Proposed Project on utilities.

Implementation of the Proposed Project would result in an increase in solid waste disposal at regional landfills, and may include the disposal of some hazardous materials. A small volume (less than 100 cy) of cleared materials may be hazardous and would need to be off-hauled to a landfill that would accommodate these materials. In the context of the permitted annual capacity of the regional landfills, the Proposed Project would not contribute a cumulatively considerable amount of solid waste in comparison to the total amount which is received annually. As such, the Proposed Project would not have a cumulatively considerable impact on utilities or services.

Climate change resiliency

The Proposed Project site is part of the Yolo Bypass floodway and thus serves as an overflow area for floodwaters. This effectively allows for storage of riverine floodwaters and dampens storm surges. The Proposed Project may be impacted by changes in hydrology, increases in air and water temperatures, changes in salinity, and increases in mean sea level rise associated with climate change (see also the discussions above regarding *Hydrology*, *Water quality*, and *Geology and soils*). Since tidal wetlands form at the land-sea interface, they are particularly susceptible to an increase in frequency and duration of inundation resulting from a rise in mean sea levels.

Habitat and Subsidence

Over the long-term, more frequent and longer inundation could contribute to erosion and changes in species composition at the Proposed Project site. Depending on the total increase in mean sea level, intertidal habitat could transition to shallow subtidal habitat and shallow subtidal habitat to tidal perennial aquatic habitat (open water). However, while the low elevations (-3 to 8 ft) increase the vulnerability of the Proposed Project to sea level rise, the excavation of the tidal slough channels along with the construction of the toe berm, the intertidal bench, and the internal topographic features would increase both sedimentation and marsh development at rates that may allow the Proposed Project site to keep pace with projected increases in regional mean sea level rise for 2050. More specifically, sea level rise projections for 2050 range from 5 to 24 in, with a mean of 11 in. Based on the Phase 2 modeling results, the Proposed Project would result in a maximum annual sediment accretion amount on the order of 4 in. While accretion would be unevenly distributed across the Proposed Project site, over time it would help to reverse existing subsidence, offset projected future subsidence (1.6 ft by 2050; Deverel and Leighton 2010), and promote resiliency to projected regional mean sea level rise.

Habitat and Water Temperature

As reported by Dettinger et al. (2016), water temperature increases will be one of the most significant climate-change stressors in the Delta. Statistical modeling of water temperatures by Wagner et al. (2011) has projected that water temperature will likely become stressful for Delta Smelt through much of their range during the summer, and will likely change the timing of important events in their life history, such as migration and spawning timing (Brown et al. 2013). Nevertheless, because tidal wetlands tend to have rates of evapotranspiration greater than open water, the Proposed Project will generally contribute to local reductions in water temperatures, which may benefit native species (see Impact 3.2-6). Although many of the invasive fish species present in the Delta are better adapted to warm temperatures and low inflows than are native species (Moyle et al. 2013), greater variability in habitat conditions may favor native species in the future depending upon seasonal timing.

Salinity

Changes in the salinity gradient due to changes in the timing and amount of freshwater runoff and rising sea levels are not expected to affect the species composition at Prospect Island (e.g., a shift of freshwater emergent wetland vegetation to more brackish species). In support of the Bay Delta Conservation Plan (BDCP), MacWilliams and Gross (2010) used 3-dmensional modeling to evaluate salinity intrusion over one annual hydrologic cycle using existing inputs for water year (WY) 2002 and under five levels of sea level rise between 15 cm and 140 cm. For a 1.1 ft (30 cm) sea level rise scenario, projected changes in the X2 low salinity zone boundary[17] were on the order of 1-2 km eastward, which may potentially trigger SWRCB (2000) restrictions upon seasonal CCWD diversions to Los Vaqueros reservoir, as well as USBR diversions at the Banks Pumping plant in some years. Although MacWilliams and Gross (2010) projected larger changes in Electrical Conductivity (EC) in the vicinity of Suisun Marsh, projected changes at water supply locations in the Western and interior Delta locations were generally below 100 uS/cm. Recognizing that no more recent modeling has been conducted that integrates the effects of sea level rise with restoration projects planned in the future, the incremental effect of the projected 11-20 uS/cm EC increase due to the Proposed Project (see EIR Impact 3.2-5) upon a 100 uS/cm EC increase due to sea level rise represents a small (~10%)

[17] The X2 point is the distance measured in km from the Golden Gate Bridge upstream to where salinity measured one meter off the river bottom is 2 ppt. Over a 40 year period, from 1988 to 2007, the X2 point has averaged 74 km. [USBR et al. 2011]

change and would not affect compliance with D-1641 outside of the sea level rise related impacts.

Overall, the Proposed Project, along with future tidal habitat restoration projects, is expected to contribute to greater regional climate change resiliency by supporting sediment accretion and peat soil accumulation to help reverse existing land subsidence and offset future subsidence, increasing the amount of wetland habitat, providing temperature refugia for native aquatic species, storing riverine floodwater, and dampening storm surges. This would be a cumulatively *beneficial* effect.

3.20 Other CEQA Considerations

3.20.1 Growth inducement

CEQA requirements for evaluation of growth-inducing impacts are set forth in Section 15126.2(d) of the CEQA Guidelines. CEQA requires that both direct and indirect impacts of all phases of a Proposed Project be considered. Growth-inducement is typically considered to be a direct or indirect effect of an action that either directly fosters growth, or removes an obstacle to economic or population growth, or the construction of new housing. The CEQA Guidelines also require evaluation of new infrastructure and service facilities needed to serve growth induced by a project. The Guidelines note that “it must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment”. Therefore, the nature of the effects of any induced growth also must be considered to determine if the impacts of that growth are potentially significant.

Some projects may be considered growth inducing while others may be growth accommodating (i.e. they are intended to accommodate planned growth, but do not induce that growth). The distinction here is primarily whether a project removes an obstacle to growth. It is sometimes argued that, if growth is already planned for in a jurisdiction’s General Plan, then infrastructure supporting that development is growth accommodating rather than growth inducing. However, CEQA is concerned with on-the-ground impacts to the environment. Therefore, if planned development cannot move forward absent of a particular infrastructure project, or the development is substantially encouraged by that infrastructure, that project is generally considered growth inducing.

The CEQA Guidelines (Section 16064 (d)(3)) also state that an indirect physical change is to be considered only if that change is “a reasonably foreseeable

impact which may be caused by the project. A change which is speculative or unlikely to occur is not reasonably foreseeable".

The Proposed Project involves tidal habitat restoration, which would not have any effect on growth, as it would not provide any new housing, infrastructure, or economic activity. It also would not remove any obstacles to growth, expand infrastructure, or develop economic activity other than short-term employment for a small number of local workers in constructing the Proposed Project. Therefore, there would be no adverse growth inducing impacts.

3.20.2 Significant unavoidable adverse impacts

CEQA Guidelines Section 15126 requires a discussion of the: significant environmental effects of the Proposed Project, significant environmental effects which cannot be avoided if the Proposed Project is implemented, and significant irreversible environmental changes which would be involved in the Proposed Project should it be implemented. CEQA Guidelines Section 15382 defines a significant effect as a "substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project…" In accordance with CEQA, significant environmental effects of the Proposed Project are identified in Sections 3-1 through 3-19 above.

There would be no *significant and unavoidable* long-term impacts (Table ES-1).

The only *significant and unavoidable* environmental impact assessed is short-term. It concerns impacts to perennial aquatic habitats and wetland communities from site dewatering necessary to allow construction access and invasive aquatic plant species control (see Impact 3.4-1 above).

Note that short-term air quality impacts (Impacts 3.7-1 and 3.7-2) were originally assessed as *significant and unavoidable* in the 2016 DEIR; however, these significance determinations were revised as part of the 2019 Partial Recirculated DEIR, following coordination with the Yolo-Solano Air Quality Management District (YSAQMD) and the addition of a mitigation measure requiring an offset mitigation fee.

4 ALTERNATIVES

4.1 Introduction

Section 15126(d) of the CEQA Guidelines requires that an EIR describe a range of reasonable alternatives to the project, or to the location of the project, which could feasibly attain most of the basic project objectives, but would avoid or substantially lessen any of the significant environmental effects of the project. The "rule of reason" governing the range of alternatives specifies that an EIR should only discuss those alternatives necessary to allow a reasoned choice by the decision makers. Alternatives should, if feasible, avoid or substantially lessen one or more of the significant effects of the Proposed Project identified in the EIR. Of those alternatives, an EIR need examine in detail only the ones that could feasibly attain most of the basic objectives of the Proposed Project. Alternatives must be "feasible", taking into account cost, existing technology, and logistics relative to the Proposed Project's overall purpose and objectives. The EIR should include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the Proposed Project.

The basic objectives of the Proposed Project include (see also Section 1 *Introduction*):

1. Enhance primary and secondary productivity and food availability for Delta Smelt and other native fishes within Prospect Island and surrounding Sacramento-San Joaquin River Delta (Delta) waterways.
2. Increase the quantity and quality of salmonid rearing habitat within and in the areas surrounding Prospect Island.
3. Increase the amount and quality of habitats to support other listed species, to the extent they can be supported by site conditions and natural processes.
4. Provide other ecosystem benefits associated with increased Delta freshwater tidal marsh habitat, including water quality enhancement, recreation, and carbon sequestration.
5. To the greatest extent practical, promote habitat resiliency to changes in future Delta conditions, such as land use conversions, climate change, sea level rise, and invasive species.
6. Avoid promoting conditions adverse to Proposed Project biological objectives, such as those that would favor establishment or spread of invasive exotic species.

4.2 Development of Alternatives Considered in this EIR

The planning process for the Proposed Project used a two-phased evaluation to determine the Proposed Project and alternatives to be carried forward through the CEQA process. Phase 1, completed in fall 2012, involved developing screening criteria and conceptual design alternatives, conducting hydrodynamic modeling, and applying the screening criteria to evaluate those conceptual alternatives. Phase 2, completed in winter 2014, involved applying additional evaluation criteria, refining remaining alternatives, and performing a comparative analysis of these refined alternatives through hydrodynamic modeling and applying Phase 2 evaluation criteria.

4.2.1 Phase 1 screening of conceptual alternatives

In Phase 1, 30 conceptual restoration alternatives were initially developed. These alternatives involved different breach locations, numbers, and types (i.e., weir or breach) (SWS and WWR 2012). These alternatives were examined and compiled into five groups based on similar attributes (such as number, location, and type of breaches). Fifteen restoration alternatives representing these groupings were modeled. The modeling outcomes were compared using hydrodynamic modeling metrics to represent the following screening criteria:

- Phytoplankton production within the restoration site;
- Tidal mixing of exported productivity;
- Dissolved organic carbon (DOC) impacts at Barker Slough Pumping Plant;
- Flood conveyance impacts on the Yolo Bypass Floodway;
- Flood conveyance impacts on Miner Slough;
- Reduction of tidal range;
- Velocity cross currents in the Sacramento Deep Water Ship Channel (DWSC); and
- Scour potential to Ryer Island Miner Slough levee.

Based upon the similarity of modeling results amongst conceptual restoration alternatives, only the productivity criterion provided a key distinction between alternatives regarding restoration objectives. Phase 1 modeling results for the remaining screening criteria (listed above) were used in assessing Proposed Project effects under CEQA, but not for alternatives analysis.

4.2.2 DRERIP technical review, October 2012

In October 2012, the California Department of Fish and Wildlife (CDFW) Ecosystem Restoration Program convened a technical review utilizing the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) evaluation process, for the purpose of providing guidance on alternatives to carry forward into the second phase of restoration planning. This effort recommended a suite of alternatives focused upon high degrees of tidal connectivity. Its final report was completed in February 2013.

4.2.3 Phase 2 screening of conceptual alternatives

In Phase 2, the performance of alternative Project configurations with breaches only on Miner Slough were reexamined considering Phase 1 and supplemental modeling results, effects on property access, and outcomes in the DRERIP evaluation process (WWR and SWS 2014). Consideration was also given to the question of whether DWSC breaches may be added to the Project in the future, and how this action might affect Project outcomes. Based on this refined selection process, nine alternatives were selected for Phase 2 modeling and analysis and three of these alternatives were also used in sensitivity modeling to compare the extent of constructed channels and emergent vegetation. The modeling outcomes were compared using the evaluation criteria, which included:

- Phytoplankton production within the restoration-site;
- Tidal mixing of exported productivity;
- Temperature changes in adjacent water bodies;
- Turbidity in the Cache Slough region;
- Salinity changes at the Water Rights Decision 1641 (D-1641) compliance stations; and
- Regional flow alterations.

4.2.4 Selection of Proposed Project and EIR alternatives

Using the results from this screening, the Project Management Team met on February 10, 2014 to make tentative selections of the Proposed Project and two alternatives. The Proposed Project and CEQA Alternatives were selected by the California Department of Water Resources (DWR) and CDFW Fish Restoration Program (FRP) staff based on potential to meet objectives and potential to reduce or eliminate potential impacts. A consensus-based process, with group discussion of the factors above, was employed to select the alternatives. The selected alternatives were further reviewed by a Science Panel on March 4,

2014. That panel concurred that the alternatives were suitable for consideration in the EIR and made recommendations on “fine tuning” some of the restoration components.

4.2.5 Alternatives considered and rejected

Off-site alternatives

DWR obtained ownership of the approximately 1,600 ac site with the intent to develop a habitat restoration project for the purposes of fisheries enhancement. Although other sites in the Sacramento-San Joaquin River Delta (Delta) would be suitable for restoration, the alternatives were limited to Prospect Island because: (1) DWR already owns the vast majority of the site; (2) other potential restoration sites in the area would be needed to fulfill the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion (BiOp) for long-term coordinated operations of the State Water Project (SWP) and the federal Central Valley Project (CVP) (USFWS 2008) and, therefore, would likely be developed in addition to this site; (3) the site is already designated for wildlife purposes in the Solano County General Plan Land Use Element and is not in other use, therefore restoration on Prospect Island would not displace existing land uses or conflict with those uses; (4) the site’s location and elevations make it an ideal restoration candidate (consistent with the Sacramento- San Joaquin Delta Plan); and (5) restoration of Prospect Island would likely have reduced impacts compared to other upland sites, because Prospect Island is already flooded. Therefore, the alternatives considered in this section are limited to on-site options.

Breaching of the DWSC levee

On April 18, 2013, subsequent to selection of the eight alternatives, a meeting was held with the U.S. Army Corps of Engineers (USACE) Sacramento Navigation Operations office staff to discuss the federal regulatory process for the Proposed Project. In this meeting, USACE representatives voiced concerns about Proposed Project alternatives that included breaching the DWSC levee. The concern was that wave generation by shipping traffic on the DWSC would enter the restored Prospect Island site via the levee breaches, scour sediment from the island interior substrate, and transport that sediment back into the DWSC, and that this sediment would then be deposited in the DWSC, increasing the volume and/or frequency of required maintenance dredging. On the basis of this anticipated impact, USACE representatives indicated that approval of a permit pursuant to Section 14 of the Rivers and Harbors Act of 1899 (United States Code, Title 33, Section 408) (“408 Permit”), which would be required to construct breaches on the DWSC levee, would be extremely unlikely. It was

further stressed that the USACE would maintain this position regardless of the level of analysis undertaken by DWR to examine the potential for such impacts.

As a result of discussions with USACE, DWR and the CDFW FRP project team made the determination that project alternatives, including DWSC breaches, would not be feasible under the timeline. This determination restricted feasible alternatives to those with breaches along Miner Slough only.

4.3 Alternatives Considered in this EIR

This EIR describes and analyzes the comparative environmental impacts of the following alternatives:

- Alternative 1: No Project
- Alternative 2: Two Breaches and Weir on the Miner Slough – Prospect Island levee
- Alternative 3: Three Breaches on the Miner Slough – Prospect Island levee

The major components of the Proposed Project and selected alternatives are compared in Table 4.3-1, and summarized below.

Table 4.3-1. Comparison of Features—Proposed Project and Alternatives

Project Feature	Proposed Project	Alternative 2	Alternative 3
Project extent	North and south properties	Same as Proposed Project	Same as Proposed Project
Levee breaches/ excavation	Northern Miner Slough Southern Miner Slough Internal cross-levee	Central Miner Slough Southern Miner Slough Internal cross-levee	Northern Miner Slough Central Miner Slough Southern Miner Slough
Levee weir	None	Northern Miner Slough	None
Breach velocity dissipation	Include gentle side slope transition feature at one breach location	Same as Proposed Project	None
Soil disposal and re-use	Re-use all soils excavated on-site to construct eastern toe berm, eastern intertidal bench, interior topographic features, and to fill ditches	Same as Proposed Project	Same as Proposed Project
Eastern toe berm	Build toe berm along portions of interior side of Miner Slough levee on north property	Same as Proposed Project at locations not excavated for levee breaches	Same as Proposed Project at locations not excavated for levee breaches

Project Feature	Proposed Project	Alternative 2	Alternative 3
Eastern intertidal bench	Build 'bench' to intertidal elevations in subtidal areas adjacent to Miner Slough levee	Same as Proposed Project with slightly reduced area of eastern intertidal bench at the central Miner Slough levee breach	Same as Proposed Project with slightly reduced area of eastern intertidal bench at the central Miner Slough levee breach
Interior topographic features	Create small, isolated mounds along constructed channel network Top elevations approximately MHHW	Same as Proposed Project	Same as Proposed Project
Planting and revegetation	Upland areas along Miner Slough levee and eastern toe berm: limited planting with native riparian species Eastern intertidal bench: 1) If needed, plant tules in areas subject to wind-wave erosion to augment natural recruitment, but no more than 20' in width. 2) Limited experimental planting (up to 5 ac)	Same as Proposed Project, with slightly reduced area of eastern intertidal bench at the location of the central Miner Slough levee breach	Same as Proposed Project, with slightly reduced area of eastern intertidal bench at the location of the central Miner Slough levee breach

4.4 Alternative 1: No Project

4.4.1 Description

Alternative 1 represents the No Project Alternative, required to be evaluated under CEQA. Under this alternative, current management practices would continue. The USACE would continue to maintain the DWSC levee as a Navigation Project Levee. Ongoing maintenance activities for the DWSC and northern cross-levee would include periodic vegetation removal along the levee crown, for both access and levee inspection purposes. Minor and/or emergency levee repairs could require removal of mature riparian vegetation and import and placement of riprap and other fill material.

4.4.2 Environmental impacts

Hydrology

Under the No Project Alternative, the levees surrounding Prospect Island would not be intentionally breached and existing hydrology effects on site conditions would continue. If natural breaches occurred at one or more locations along the Miner Slough levee, either one, or both, of the properties would become tidally

connected to Miner Slough. Regardless of whether repairs are made or not, the No Project Alternative would have the same or a greater adverse environmental impact than exists under current conditions.

The continuation of existing hydrologic conditions under the No Project Alternative would not impact agricultural water supply and drainage, groundwater seepage to adjacent areas, groundwater supplies and third-party wells, and Miner Slough levee and/or bed scour. Under the No Project Alternative, these impacts would be the same as, or less than, those of the Proposed Project.

Similar to the Proposed Project, the No Project Alternative would have no impact on compliance with regional Water Rights Decision 1641 (D-1641) flow requirements. This alternative also would have no impact on flood conveyance or scour that could impact stability of nearby bridges, trestles, culverts or other structures, and it would not affect water rights due to surface water diversion.

Water quality

Under the No Project Alternative, the levees surrounding Prospect Island would not be intentionally breached and current water quality conditions would persist. There would be no construction activities and, therefore, no short-term construction-related impacts to water quality from increased turbidity, pollutants, herbicide use, or altered water temperature. The continuation of existing water quality conditions under the No Project Alternative would not impact salinity, water temperature, or dissolved organic carbon (DOC) in adjacent waterbodies.

Under the No Project Alternative, there would be no impact on methylmercury production, bioaccumulation, or export to surrounding waterways as compared with existing conditions and the Proposed Project, since there would be no change in flooding frequency for the existing perennial emergent marsh and Prospect Island would remain non-tidal.

Similar to the Proposed Project, the No Project Alternative would have no impact on groundwater quality.

Aquatic biological resources

Under the No Project Alternative, there would be no construction activities and, therefore, no short-term construction-related impacts to aquatic habitat or fish species, including dewatering, turbidity, noise, and herbicide application. Fish currently on Prospect Island, including native species, would remain there,

isolated from adjacent waterways. Delta Smelt, Chinook Salmon, and other native fishes would not have access to additional rearing habitat along Miner Slough or benefit from increased food web production in this stretch of the river.

Under the No Project Alternative, an unrepaired natural levee failure may result in the continued residency of invasive aquatic plants and fish. Without the design features (i.e., starter channels, channel velocities, invasive species control) inherent to the Proposed Project, special-status fish would not be likely to benefit from the newly connected habitat as much as under the Proposed Project, and there could be adverse impacts to special-status fish due to a potential increase in predator habitat on Prospect Island.

Wetland and terrestrial biological resources

Under the No Project Alternative, the levees surrounding Prospect Island would not be intentionally breached and conditions for existing perennial aquatic and wetland communities would continue. No construction would take place under this alternative; therefore, there would be no short-term construction-related impacts to sensitive and/or special-status species or their habitat.

If natural breaches occurred at one or more locations along the Miner Slough levee, either one, or both, of the properties would become hydrologically connected to Miner Slough. Fluctuating hydrology due to repeated breaching and repairs could be more detrimental to wetland-associated sensitive and/or special-status species (e.g., plants, giant garter snake, western pond turtle) than a long-term structured conversion of habitat.

Geology and soils

Under the No Project Alternative, no construction activities would occur and the levees surrounding Prospect Island would not be intentionally breached. The No Project Alternative would not support inorganic sediment accretion since there would be no connection to tidal flows and associated suspended sediments. Because organic (peat) accumulation would continue to occur at the site from existing non-tidal emergent marsh habitat, the No Project Alternative would continue to help reverse existing land subsidence and offset future subsidence within Prospect Island (see also Section 3.19.3 *Summary of cumulative impacts – Geology and soils*). However, since there would be no intentional connection to tidal flows, the No Project Alternative would have no effect on system resiliency to mean sea level rise in the Sacramento-San Joaquin River Delta (Delta).

Hazards and hazardous materials

Under the No Project Alternative, there would be no construction activities and thus no construction-related impacts due to leaks or spills of hazardous materials. There would be no construction-related disturbance or damage to the abandoned gas wells and/or groundwater monitoring wells at the site.

Remnants of the Prospect Island houses (P-48-000417) located on the north property, including the pump platform, would continue to be a safety concern. The pump lubricant container would still need to be secured and sealed to prevent leakage or over topping. Additionally, Structure P-48-000956 on the south property would continue to pose a potential hazard to public safety under the No Project Alternative. The No Project Alternative would not remove these structures, as would occur under the Proposed Project, and thus these existing hazards would remain.

The No Project Alternative would not reduce conditions favorable to mosquito production on the site. Non-tidal freshwater perennial emergent wetland habitat, with vegetation and hydrologic characteristics that can promote mosquito production, would continue to represent the majority of habitat on Prospect Island, and thus this existing hazard would remain.

Air quality

Under the No Project Alternative, there would be no short-term air quality impacts due to construction activities. Potential impacts of ongoing maintenance activities for the DWSC and northern cross-levees on air quality would be the same as existing conditions.

Greenhouse gases

Under the No Project Alternative, there would be no short-term greenhouse gas (GHG) impacts due to construction activities. Potential impacts of ongoing maintenance activities for the DWSC and northern cross-levees on GHGs would be the same as existing conditions.

Mineral resources

Under the No Project Alternative, no impacts to mineral rights would occur because there would be no changes to the gas fields underlying portions of the site due to activities occurring on Prospect Island, and there are no other locally known mineral resources.

Noise

Under the No Project Alternative, there would be no short-term noise impacts due to construction activities. Potential impacts of ongoing maintenance activities for the DWSC and northern cross-levees on noise would be the same as existing conditions.

Aesthetics

Under the No Project Alternative, there would be no impacts to existing views or visual quality of the site.

Agricultural resources

Under the No Project Alternative, there would be no impacts on agricultural lands. The site would remain flooded and more agricultural uses would not occur.

Cultural Resources

Under the No Project Alternative, there would be no impacts to cultural resources including undiscovered cultural resources. The remaining buildings would continue to deteriorate, and the levees would continue to be maintained in their current manner.

Land use and planning/Population and housing

Under the No Project Alternative, no impacts to land use or population/housing would occur because there would be no construction activity or intentional breaching of levees that could potentially affect adjacent land uses, local plans and policies regarding land use, or population and housing. Future levee repairs would occur only if existing access easements or public safety are affected by naturally occurring levee breaches.

Public services

Under the No Project Alternative, there would be no impacts to public services. Existing services and emergency access would continue on Prospect Island.

Recreation

Under the No Project Alternative, no impacts to recreation would occur, because there would be no construction activities or intentional breaching of levees.

Transportation and traffic

Under the No Project Alternative, no impacts to traffic or circulation would occur, because there would be no construction activity or intentional breaching of levees.

Utilities

Under the No Project Alternative, existing conditions would remain, and no impact to utilities, deeded easements, or solid waste facilities would occur.

Cumulative Effects

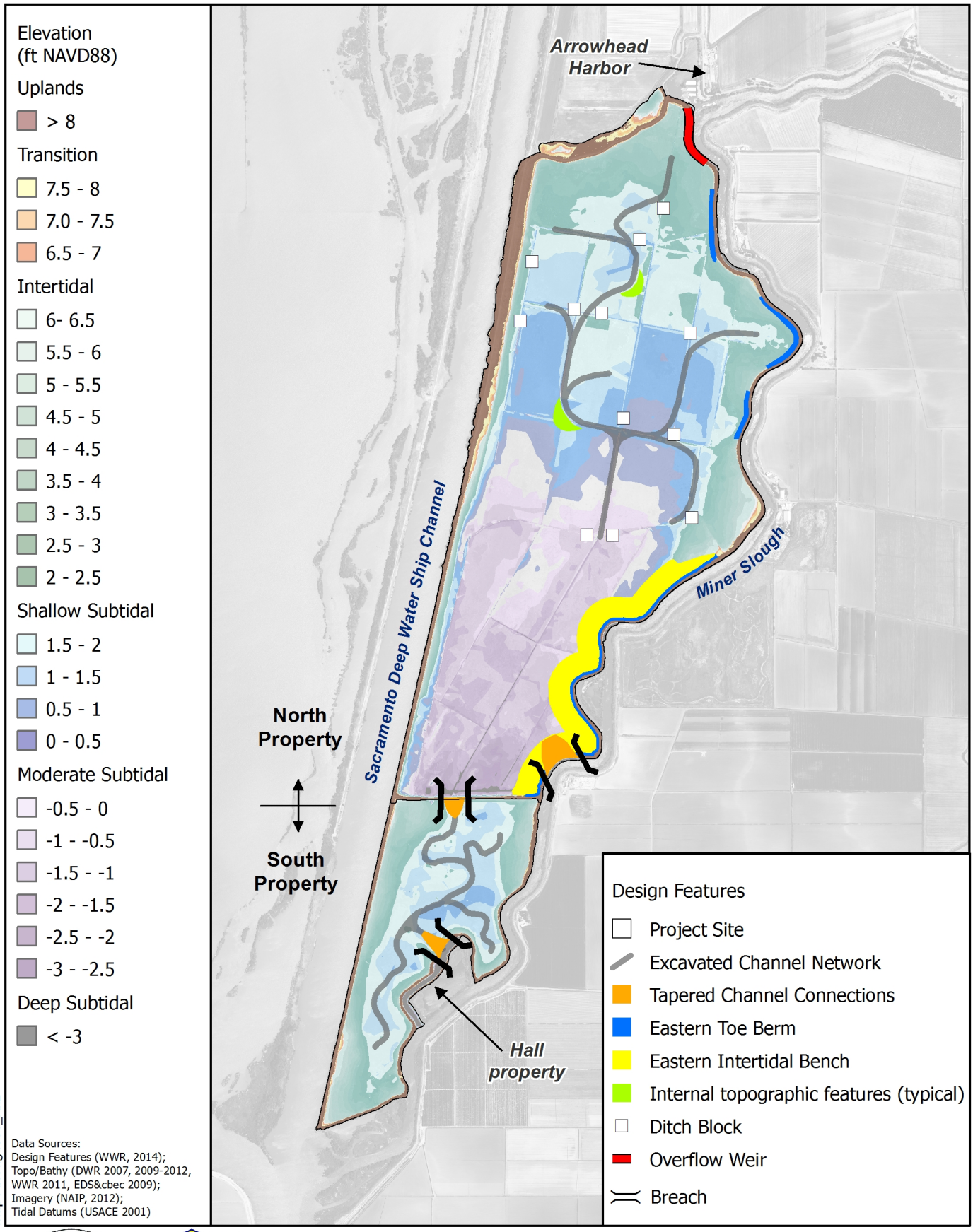
There would be no potential for short-term construction related cumulative effects under the No Project Alternative. There would be greater potential for cumulative impacts to wetland-associated sensitive and/or special-status species (e.g., plants, giant garter snake, western pond turtle) from fluctuating hydrology if other projects affect water levels compared with the Proposed Project; however, no planned projects or future restoration project opportunity areas listed in Table 3.19-1 have the potential to increase flows or velocities in Miner Slough. There would also be greater potential for residency of inasive aquatic plants and fish compared with the Proposed Project, although other projects listed in Table 3.19-1 would generally improve conditions and reduce potential for residency. There would be no cumulatively considerable impacts from the No Project Alternative.

4.5 Alternative 2: Two Breaches and Weir

4.5.1 Description

Under Alternative 2, two breaches would be created on the Miner Slough levee: one in the central portion of Prospect Island, just north of the existing internal cross-levee, and the second would be constructed at the location of the formerly repaired breach connecting the Miner Slough spur channel to the south property (Figure 4.5-1). The internal cross-levee separating the north and south properties would also be excavated under this alternative. In addition, a high stage overflow weir would be constructed prior to levee breaching, with a 7 ft NAVD 88 crest elevation near the entrance to Arrowhead Marina in the far northeast corner of

the island. Local levee elevations at the location of the proposed overflow weir are in the 18 ft NAVD 88 range, which would translate to approximately 11 ft of levee excavation. Based on physical and hydraulic site conditions at the weir location on an outside bend of Miner Slough, the weir would be approximately 1,000 ft in length. Rock slope protection would be placed on the exposed levee ends of the north breach and the exterior slope of the weir to provide protection from erosion. The rock slope protection would be imported using local barges and/or trucks, and would be placed from the levee crest down to the base of the slope in the water. Once breached, the north and south properties would be subject to daily tidal inundation, with periodic overtopping of the weir at high tide during spring tide conditions. The overflow weir would also function during flood flow conditions in Miner Slough. Natural communities that would be created under Alternative 2 are shown in Table 4.5-1.



Data Sources:
Design Features (WWR, 2014);
Topo/Bathy (DWR 2007, 2009-2012, WWR 2011, EDS&cbec 2009);
Imagery (NAIP, 2012);
Tidal Datums (USACE 2001)

Map File: fig4501_Alt2

1:31,680 (1 in = 0.5 miles at letter size)

0 0.25 0.5 Mi

0 0.5 1 Km

Figure 4.5-1

Restoration Alternative 2

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

Table 4.5-1. Prospect Island Natural Communities: Existing, As-Built, and Future Areas Of Habitat Communities for Alternative 2

Acres by Natural Community Type[1]			Existing	As-Built[2]	Future	Change in Area[3]
Aquatic	Non-tidal	Non-tidal perennial aquatic	339.8	0.0	0.0	-339.8
	Tidal	Tidal perennial aquatic[4]	10.3	1097.8	473.4	463.1
Wetlands	Non-tidal	Non-tidal freshwater perennial emergent wetland	1100.5	0.0	0.0	-1100.5
	Tidal	Tidal mudflat (graded areas of eastern intertidal bench and toe berm)	0.0	74.7	0.0	0.0
		Tidal freshwater emergent wetland (intertidal)	0.0	356.0	433.0	433.0
		Tidal freshwater emergent wetland (shallow subtidal)	0.0	0.0	623.4	623.4
Uplands		Valley/foothill riparian	145.2	52.5	104.2	-41.0
		Grassland	66.4	85.4	32.5	-33.8
		Agriculture	17.7	10.9	10.9	-6.8
Other		Developed	4.5	7.1	7.0	2.5

[1] Acreages are based on Natural Communities Data (ESA, SWS 2014). Summations may vary due to rounding.

[2] As-built acres are immediately after breaching of Miner Slough levee.

[3] Change calculated as future minus existing area estimates of natural community types.

[4] Although portions of the south property interior were designated as tidal Waters of the U.S. in the Preliminary Wetland Delineation (DWR 2014a), there is no fish passage through the degraded breach repair, and other habitat functions are similar to those in nontidal perennial aquatic habitats.

4.5.2 Environmental impacts

Hydrology

Phase 1 and Phase 2 hydrodynamic modeling completed during the Prospect Island habitat restoration conceptual planning phase included a variety of configurations, with varying numbers and locations of breaches along both Miner Slough and the Sacramento Deep Water Ship Channel (DWSC) (SWS and WWR 2012, WWR and SWS 2014). The Phase 1 model configuration most similar to Alternative 2 of this Environmental Impact Report (EIR) is Alternative 4 (although the weir was excluded in Phase 1). Modeling results indicate that potential hydrology impacts to agricultural water supply/drainage and flood conveyance under Alternative 2 would be the same as those described for the Proposed Project.

Phase 1 hydrodynamic modeling indicates that north of the central Miner Slough levee breach, Alternative 2 would result in lower in-channel velocities and reduced potential for bed scour as compared with the Proposed Project. In Miner Slough south of the central breach to the Cache Slough confluence, Alternative 2 would result in similar in-channel velocities as for the Proposed Project. The conclusion that the velocities for Alternative 2 would be largely below stability thresholds is confirmed by more recent detailed modeling of 100- and 200-year flood events (RMA, 2016). Modeling for Alternative 2 indicates that velocity increases relative to baseline conditions would be limited to <0.1 fps for both the 100- and 200-year flood events, with velocities decreased immediately downstream of the Miner Slough weir (RMA, 2016). Furthermore, modeled stage increases at peak flood in channels surrounding Prospect Island would be small, at most 0.01 ft. There would be a reduction in peak water surface elevation for Miner Slough upstream of Prospect Island (RMA, 2016).

As for the Proposed Project, elements, including the intertidal bench and toe berm on the interior side of the Prospect Island – Miner Slough levee (Figure 4.5-1), siting the northernmost breach at a right angle to the predominant wind direction, as well as armoring the exposed levee ends at this breach location, would serve to dissipate wave energy and prevent wind-wave erosion of the Prospect Island–Miner Slough levee. Thus wind-wave action on the interior of Prospect Island resulting from Alternative 2 would not erode the Miner Slough – Ryer Island levee.

As with the Proposed Project, existing data indicate that Alternative 2 would not result in groundwater seepage to adjacent areas, there would be no construction related impacts to groundwater supplies and third-party wells under Alternative 2.

Similar to the Proposed Project, Alternative 2 would have no impact on compliance with regional D-1641 flow requirements. This alternative also would have no impact on scour that could impact stability of nearby bridges, trestles, culverts or other structures, and it would not affect water rights due to surface water diversion.

Water quality

Construction-related water quality impacts

The shift in breach location under Alternative 2 would not appreciably alter short-term construction-related impacts to water quality compared to those of the Proposed Project. There would be no dredging under Alternative 2, which would eliminate short-term construction-related increases in turbidity and suspended sediment levels within Miner Slough and in downstream waters due to mechanical dredging of the spur channel. As with the Proposed Project, implementation of Mitigation Measures 3.2-1.1, 3.2-1.2, 3.2-1.3, 3.2-3.1 and 3.2-3.2 would reduce other short-term construction-related impacts of increased turbidity, pollutants, and herbicide use to *less than significant*.

Salinity and water temperature

Phase 1 modeling of dissolved organic carbon (DOC) and Phase 2 modeling of salinity and water temperature completed during the Prospect Island habitat restoration conceptual planning phase indicate that long-term impacts to salinity (*less than significant*, Impact 3.2-5) and water temperature (*beneficial*, Impact 3.2-6) under this alternative would be the same as those under the Proposed Project.

Salinity modeling has been undertaken for 2009 (dry water year) and 2010 (below normal water year) at 13 Water Rights Decision 1641 (D-1641) station intakes within the Sacramento-San Joaquin River Delta (Delta) (mapped on Figure 11 of RMA 2018), to estimate potential changes to salinity associated with Alternative 2 of this 2019 FEIR (Alternative 4 of the Phase 2 modeling) (RMA, 2017). This report includes modeling results for all four of Contra Costa Water District's (CCWD) intakes under Alternative 2 (described below). Alternative 2 incorporates two breaches of Miner Slough–one just north of the Prospect Island cross-levee and the second near the southern end of Prospect Island, as well as an overflow weir in the northeastern corner of the site. Under Alternative 2,

modeling results indicate that salinity would decrease in summer months, especially in the western Delta. In the fall, salinity would increase in central and south Delta locations, but generally decrease in the western Delta. Such changes would not result in non-compliance with D-1641 salinity standards, nor unreasonably affect beneficial uses of water (RMA, 2017). Furthermore, at some locations, such as the Mallard Slough intake, EC base levels are well above drinking water guidelines (RMA 2018), indicating that the intake would not be suitable for future use regardless of the restoration project.

Under Alternative 2, electrical conductivity (EC) at Rock Slough is modeled to increase by a maximum of 19.6 uS/cm, equating to a maximum and seasonal (Fall) 3% increase on top of Base EC (Table 5 of RMA 2018). The modeled change at Rock Slough has been quantified in terms of chloride as: an average decrease of 0.13 mg/L out of an existing average of 83 mg/L; and a maximum increase of 6 mg/L on top of an existing maximum of 200 mg/L.

Under Alternative 2, EC at Mallard Slough is modeled to decrease or remain unchanged from Base EC for all months except January and December of a below-normal water year hydrology, and in January and December the modeled increase is only 0.1% (Table 5 of RMA 2018). The modeled change at Mallard Slough has been quantified in terms of chloride as: an average decrease of 3.2 mg/L out of an existing average of 1980 mg/L; and a maximum chloride increase of 2 mg/L on top of an existing maximum of 4,075 mg/L.

At Old River, modeled change in EC with Alternative 2 ranged from 11.8 to 16.4 µS/cm (2−3%) in October to December 2009 (dry-year hydrology), but other months modeled showed a decline in EC or < 1% modeled increase (Table 5 of RMA 2018). The modeled change at Old River under Alternative 2 has been quantified in terms of chloride as: an average decrease of 0.00 mg/L on top of an existing average of 62 mg/L; and a maximum chloride increase of 5.1 mg/L on top of an existing maximum of 167 mg/L.

At Victoria Canal, modeled change in EC with Alternative 2 ranged from 10.1-11.5 µS/cm (2−3%) from October to December 2009, but other months in 2009 showed a decline in EC or negligible < 1% modeled increase (Table 5 of RMA 2018). The modeled change at Victoria Canal has been quantified in terms of chloride as: an average increase of 0.34 mg/L on top of 36 mg/L; and a maximum chloride increase of 3.6 mg/L on top of an existing maximum of 143 mg/L.

Dissolved organic carbon

With respect to the potential export of DOC (Impact 3.2-7), Alternative 2 would result in lower transport of DOC to surrounding waterways compared to the Proposed Project. Overall, the low level of DOC export to the Delta under Alternative 2 would not result in substantial adverse effects on beneficial uses of water, including effects to municipal drinking water supply at the Barker Slough Pumping Plant. This would be a *less than significant* impact.

Methylmercury

As with the Proposed Project, Alternative 2 would convert existing perennially flooded freshwater emergent marsh to tidal freshwater emergent marsh. This may affect the rate of methylmercury production, degree of bioaccumulation in higher trophic level organisms resident at the site, and result in subsequent transport of methylmercury to downstream waterbodies. If methylmercury production increases, and depending on the magnitude of the increase, this could result in adverse, few, or no effects on public health or environmental receptors due to elevated methylmercury concentrations in the tissue of fish, birds, mammals, and humans that consume contaminated organisms.

Factors controlling the production and bioaccumulation of methylmercury and its ability to be transported from tidal wetlands into downstream waterbodies are complex and not yet fully understood (see Impact 3.2-8). Based upon the CALFED Science Program Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) conceptual model of methylmercury production, habitat flooding frequency corresponds with a methylmercury gradient, from relatively low methylmercury concentrations in the overlying water column of perennially flooded habitats (e.g., open-water areas), low to moderate concentrations in habitats that flood frequently and do not fully dry between inundation events (e.g., low elevation tidal marsh), and potentially higher concentrations in areas that flood less frequently and dry out between inundation events (e.g., seasonal floodplains or wetlands and high elevation tidal marsh) (Alpers et al. 2008).

As with the Proposed Project, restoration of tidal action to the site under Alternative 2 would result in the conversion of existing perennially flooded emergent marsh (i.e., associated with low to moderate methylmercury concentrations) to open-water habitat (i.e., associated with low methylmercury concentrations). It is anticipated that the small increase in the area of infrequently flooded habitat between mean high water (MHW) and mean higher high water (MHHW) on the land-side of the perimeter levees would potentially result in

increased methylmercury production. Overall, the small increase in the area of infrequently flooded habitat associated with higher methylmercury production would be offset by a large increase in open-water habitat associated with lower methylmercury production.

With respect to the potential export of methylmercury, Alternative 2 would result in lower transport to surrounding waterways compared to the Proposed Project due to the shift in breach location and infrequent activation of the weir at the northern end of Prospect Island.

Given scientific uncertainty regarding the degree to which freshwater tidal wetlands contribute to Delta methylmercury loading now and in the future (see also Impact 3.2-8), ongoing California Department of Water Resources (DWR) and California Department of Fish and Wildlife (CDFW) mercury compliance control studies (see also Impact 3.2-8), and the small degree of anticipated production under Alternative 2, this would be a *less than significant* impact.

Groundwater Quality

As with the Proposed Project, Alternative 2 would have no impact on groundwater quality.

Aquatic biological resources

Under Alternative 2, the northern Miner Slough breach would be replaced with an overflow weir, a central Miner Slough breach would be located on the north property just past the internal cross-levee, and the south Miner Slough breach would be located at the end of the Miner Slough spur channel (Figure 4.5-1). The weir is designed to regularly overtop during high flow events thereby maintaining access for juvenile salmonids and other fish species (DWR and CDFW 2014). Overall, the acreage and quality of habitat would remain similar to the Proposed Project. Although higher than under existing conditions, the potential for food export to other habitat within the Cache Slough Complex would be somewhat lower than with the Proposed Project, and originate from a broader range of residence times associated with beneficial algal production (WWR-Stillwater Sciences 2014).

The weir would require approximately 1,000 linear ft of rock slope armoring on the Miner Slough side of the weir, as well as small amounts at the breach transitions into the interior of Prospect Island. This would be a relatively small portion of the 5.2 mi Miner Slough levee and would be self-mitigated by the

channel margin and shaded riverine aquatic habitat created by tidally connecting Prospect Island to Miner Slough.

Under Alternative 2, dredging of the Miner Slough spur channel would not be necessary, with similar potential for short-term impacts related to the temporary repair of the south property levee (Impact 3.3-1). Impact 3.3-5 would not occur, and Impacts 3.3-3, 3.3-4, and 3.3-6 would be reduced. Mitigation Measures 3.2-2.1 and 3.2-3.1 would still be necessary. Potential fish injury or mortality impacts due site dewatering and herbicide application (Impacts 3.3-7 and 3.3-8) would be the same as the Proposed Project. Implementation of the associated Mitigation Measures (3.3-7.1, 3.2-3.1, and 3.2-3.2) would reduce these impacts to *less than significant*.

There would be no additional impacts under Alternative 2 relative to the Proposed Project and impacts to aquatic biological resources would remain *less than significant*.

Wetland and terrestrial biological resources

Short-term impacts to perennial aquatic habitats and wetland communities from site preparation under Alternative 2 would be the same as those of the Proposed Project (see Impact 3.4-1). This impact would be *significant and unavoidable*. There would be no short-term impacts to tidal aquatic habitats and wetland communities in the Miner Slough spur channel (see Impact 3.4-2), since dredging of the spur channel would not occur under Alternative 2. There would be a small increase (approximately 1 ac) in riparian clearing at the weir location under Alternative 2, such that short-term loss of valley/foothill riparian habitat due to clearing would increase from 19 ac under the Proposed Project (see Impact 3.4-3) to approximately 20 ac under Alternative 2. Accordingly, short-term construction-related mortality or detrimental effects to sensitive plants would also increase slightly (see Impact 3.4-4). Implementation of Mitigation Measures 3.4-3.1 and 3.4-4.1 would reduce these impacts to *less than significant*.

Long-term conversion of perennial aquatic habitats and wetland communities to tidal habitat types under Alternative 2 would be similar to that of the Proposed Project. There would be permanent conversion of up to approximately 340 ac of non-tidal perennial aquatic (open-water) habitat, and up to approximately 1,100 ac of non-tidal freshwater perennial emergent wetland habitat, into 473 ac of perennial aquatic (open-water) habitat and a total of 1,056 ac of tidal (intertidal and shallow subtidal) freshwater emergent wetland types (see Impact 3.4-5). Overall, this would be an increase of approximately 123 ac of open-water

(aquatic) habitat, a decrease of approximately 44 ac of wetland habitats, and would be a *less than significant* impact. Similar to the Proposed Project (see Impact 3.4-6), Alternative 2 would result in the conversion of approximately 93 ac of existing valley/foothill riparian habitat below MHHW (6.5 ft [NAVD 88]) to tidal freshwater emergent wetland habitat. However, potential areas suitable for riparian planting such as the dredged materials placement area in the south property, as well as along the Miner Slough levee road, would not be available under Alternative 2 such that the total long-term loss of valley/foothill riparian habitat would be approximately 41 ac, or a 14 ac greater loss than the Proposed Project. As with the Proposed Project, potential long-term impacts to individual high value trees for nesting and roosting would be minimized through implementation of Mitigation Measure 3.4-3.1. Long-term reduction in available habitat for special-status plant species adapted to existing conditions would be the same under Alternative 2 as that of the Proposed Project (see Impact 3.4-7), and would be *less than significant*.

There is one elderberry shrub at the location of the proposed overflow weir for Alternative 2, and it would be removed as part of site preparation activities. In the short-term, removal of this shrub may impact valley elderberry longhorn beetle habitat, as for the Proposed Project.

In the long-term, similar to the Proposed Project, there would be no impact on habitat for valley elderberry longhorn beetle under Alternative 2 (see Impact 3.4-9).

Under Alternative 2, short-term construction-related impacts to giant garter snakes, western pond turtles, special-status and migratory birds, and western red bats (see Impacts 3.4-10, 3.4-12, 3.4-14, and 3.4-17) would be the same as those under the Proposed Project. Implementation of Mitigation Measures 3.4-10.1, 3.4-12.1, 3.4-14.1 and 3.4-17.1 would reduce these impacts to *less than significant*.

As with the Proposed Project, Alternative 2 would increase aquatic habitat for the western pond turtle in the long-term by creating tidal channels with adjacent basking habitat during the lower end of the tide cycle (see Impact 3.4-13). This would be beneficial. Compared with the Proposed Project, Alternative 2 would create approximately four additional acres (1,056 ac total) of intertidal and shallow subtidal freshwater emergent wetland habitat for foraging birds, and would also be *beneficial* (see Impact 3.4-16).

Compared to the Proposed Project, it is expected that Alternative 2 would provide approximately four additional acres (1,097 ac total) of giant garter snake foraging habitat in the long-term (see also Impact 3.4-11). Although this is similar to the Proposed Project, Alternative 2 would result in a decrease of 18 ac of upland basking and over-wintering habitat, and an increase of 156 ac of giant garter snake foraging habitat compared with existing conditions. As with the Proposed Project, conversion of marginal non-tidal perennial aquatic habitat and non-tidal freshwater perennial emergent wetland to tidal perennial aquatic and tidal freshwater emergent wetland habitats under Alternative 2 would be offset by the creation of a mosaic of habitats. The mosaic of habitats would include linear features that are consistent with the giant garter snake conservation strategy in the Bay Delta Conservation Plan (Chapter 12 in DWR and USBR 2016), and would increase the acreage and value of available aquatic foraging habitats for giant garter snake. This would be a *beneficial* effect.

Alternative 2 would result in the permanent loss of 44 ac of freshwater emergent wetland (1,056 ac of intertidal + shallow subtidal wetland habitat partially offsetting the loss of 1,100 ac non-tidal wetland habitat), which provides foraging habitat for nesting raptors, nesting and foraging migratory birds, and western red bats (see Impacts 3.4-15, 3.4-16, and 3.4-18). This would also result in an overall reduction of marginal foraging habitat for Swainson's Hawks. Other emergent wetland habitat exists nearby the project site for nesting; however, many of these species are territorial and reduction in available habitat may result in the displacement of nesting special-status birds in the vicinity of the site. Bats will also forage over open-water areas replacing the emergent marsh and on the emergent marsh fringe. Similar to the Proposed Project, there would also be a loss of roosting habitat for western red bats. As with the Proposed Project (see Impact 3.4-15), implementation of Mitigation Measure 3.4-3.1 would reduce these impacts to *less than significant*.

Geology and soils

Under Alternative 2, potential impacts to soils and geology would be the same as for the Proposed Project.

Hazards and hazardous materials

Under Alternative 2, potential impacts (and benefits) from hazards and hazardous materials would be the same as for the Proposed Project.

Air quality

The duration of the construction period under this Alternative and the volumes of cut and fill would be slightly less than for the Proposed Project, but the types and nature of construction activities would be similar to the Proposed Project. The slight decrease in construction activity is not large enough to change the significance of the air quality impacts; therefore, the air quality impacts of this alternative would be the same as those of the Proposed Project – *less than significant* or *less than significant with mitigation*. Mitigation Measures 3.7-1.1, 3.7-1.2, and 3.7-1.3 would also apply to this alternative.

Greenhouse gases

Dredging of the Miner Slough spur channel would not occur under Alternative 2, and thus any associated construction emissions would not occur. Additionally, the total volume of material to be excavated and re-used on-site would be lower under Alternative 2. Construction activities associated with overflow weir construction would be similar to the Proposed Project, and not large enough to offset the overall decrease in greenhouse gas (GHG) emissions due to omission of spur channel dredging. Therefore, construction-related GHG emissions for this alternative would be less than the Proposed Project. These emissions are covered by the DWR Greenhouse Gas Emissions Reduction Plan (GGERP).

Mineral resources

Under Alternative 2, no impacts to mineral rights would occur because there would be no changes to access to the gas fields underlying portions of the project site due to activities occurring on Prospect Island, and there are no other locally known mineral resources.

Noise

Construction under Alternative 2 would require the interior restoration efforts as described for the Proposed Project, plus construction of an overflow weir near Arrowhead Harbor Marina. This overflow weir would be located approximately 100 ft from the live-aboard residences and would entail dismantling the current levee buffering the residences from construction related noise impacts. Noise levels anticipated for the Arrowhead Harbor Marina residences would be similar to those described in Impact 3.10-1. As with the Proposed Project, construction-related noise impacts would be potentially significant and would be reduced to *less than significant* with implementation of Mitigation Measure 3.10-1.1.

Alternative 2 also would have no impact on sensitive receptors due to excessive construction-related ground-borne vibrations.

In the long-term, Alternative 2 would continue to require the same infrequent operations, maintenance, and monitoring activities within Prospect Island after construction as the Proposed Project (Impact 3.9-1). This would be *less than significant* impact on long-term ambient noise levels in the vicinity.

Aesthetics

This alternative would have visual impacts similar to those of the Proposed Project, except that the northern breach would be relocated and replaced with a weir. Although the weir would have a different appearance than the breach, the overall impacts would be similar.

Agricultural resources

As with the Proposed Project, impacts of Alternative 2 on agricultural lands would be *less than significant*. There is no land designated as Prime, Unique, or Important Agricultural Land, and the potential temporary conversion of 10.9 ac is only a very small portion of the approximately 1,600 ac site that has no other agricultural activity of any kind. As with the Proposed Project, Alternative 2 would not result in seepage to nearby farmland on adjacent islands, and there would be a *less than significant* impact on agricultural uses on those lands.

Cultural resources

Under Alternative 2, there would be no impacts to historical resources since the remaining buildings and levees to be demolished at the site do not qualify as historical resources. There would be no impacts to unknown archaeological resources and unknown human burials would be the same as for the Proposed Project. Implementation of Mitigation Measures 3.13-2.1, 3.13-3.1 and 3.13-4.1 would reduce these impacts to *less than significant*. As with the Proposed Project, there would be no impacts to paleontological resources.

Land use and planning/Population and housing

Under Alternative 2, land use impacts would be the same as those of the Proposed Project.

Public services

As with the Proposed Project, Alternative 2 would not result in new housing or commercial uses and thus would not generate additional demand for police or fire protection. The weir along the northern Miner Slough levee would be designed to permit passage by vehicles, except during periods when the weir is inundated. On an annual basis, the frequency of weir overtopping was analyzed using long-term flood frequency data for the Sacramento River at Freeport in comparison with stage measurements from Miner Slough at the Highway 84 Bridge (cbec and WWR 2012). The data were then re-analyzed by season to capture a range of tidal and flood flow conditions in two representative water year types using a design weir crest elevation of 7 ft NAVD 88 (Table 4.5-2).

Table 4.5-2. Analysis of Inundation Frequency and Duration for the Overflow Weir Under Alternative 2 Based on Stage Data from Miner Slough at Hwy 84 Bridge (USGS 11455165)

Year	Type	No. of Events	Inundation Event Depth			Inundation Event Duration		
			Avg (ft)	Min (ft)	Max (ft)	Avg (hr)	Min (hr)	Max (hr)
Events exceeding 7 ft NAVD 88 during January-June in representative WY Types								
2007	Dry	6	0.10	0.01	0.23	1.29	0.25	2.75
2008	Dry	15	0.29	0.01	1.18	2.57	0.50	7.75
2010	Wet*	27	0.56	0.01	2.16	9.07	0.50	114
2011	Wet*	80	1.90	0.01	4.52	12.72	0.00	642
Events exceeding 7 ft NAVD 88 during July-December in representative WY Types								
2007	Dry	6	0.14	0.01	0.38	1.13	0.25	2.25
2008	Dry	7	0.15	0.01	0.38	1.39	0.25	2.50
2010	Wet*	12	1.51	0.01	3.42	27.1	0.50	286
2011	Wet*	10	0.22	0.01	0.63	2.00	0.25	4.50

* Year included Yolo Bypass flood events.

Overall, tidal inundation of the weir would occur approximately once per month for a period of one hour at depths of less than 6 in (see July–December results for 2007–2008). At higher river stages during winter (January–June), inundation would occur more frequently, with 27–80 inundation events estimated to occur based on water year 2010-11 data. These high flow inundation events would prohibit vehicle passage for 13 hours on average, with the maximum duration estimated at 642 hour (27 days) based on January 2011 data; however, as for the Proposed Project, there are no private properties to which access would be impeded. Therefore, this impact would be *less than significant*.

Recreation

As with the Proposed Project, Alternative 2 would create short-term construction-related impacts to recreational boating due to limited or prohibited use of the Arrowhead Harbor Marina and Miner Slough. Implementation of Mitigation Measure 3.16-1.1 would reduce these impacts to *less than significant*.

Hydraulic changes induced close to the entrance to Arrowhead Harbor Marina would potentially impact recreational boating during flood flow conditions. The marina entrance, located just north of Prospect Island along Miner Slough, is immediately adjacent to the proposed location of the overflow weir to be built at an elevation of 7 ft. Thus, when water stage within Miner Slough exceeds 7 ft, changes to flow velocity and direction at the entrance to the marina would begin to occur. The magnitude of these changes would increase as stage and flow increase. Modeling results quantify these changes to both water velocity and flow direction near the entrance of Arrowhead Harbor Marina; flow direction would shift from a north-south orientation (in line with the harbor entrance) to a more east-west direction (orthogonal to the harbor entrance), and water velocity tangential to the marina's entrance would increases from approximately 1 fps to approximately 2.5 feet per second (fps) (WWR and SWS 2013). However, because velocities in excess of these levels occur within the main channel of Miner Slough during flood conditions, potential navigation risks related to current orientation at the mouth of the marina are comparable to those occurring along nearby meander bends. Further, little or no boat traffic is typically present during such conditions (J. Fonss, Arrowhead Harbor Marina, pers. comm., May 2014). Therefore, this would be a *less than significant* impact.

Long-term changes to water velocity in other areas of Miner Slough during high flow periods under Alternative 2 would be similar to, or only slightly higher than, described for the Proposed Project (Impact 3.16-2). As with the Proposed Project, little or no boat traffic is typically present during such conditions. Furthermore, high flow conditions and velocities would be within the range of such conditions in other nearby Delta channels, and thus navigation in other areas of Miner Slough under such conditions would not present challenges to boat operators that would not otherwise be typically encountered elsewhere in the Delta. Therefore, with the exception of the Arrowhead Harbor Marina entrance, there would be a *less than significant* impact on long-term changes to water velocity in Miner Slough under Alternative 2.

Transportation and traffic

Compared to the Proposed Project, short-term construction-related impacts would be similar to the Proposed Project, because barge-based or truck transportation requirements would be similar, and access could be temporarily impeded. Mitigation Measures 3.17-1.1 and 3.17-1.2 would reduce this impact to *less than significant*.

Alternative 2 would reduce long-term vehicle access impacts relative to the Proposed Project, because it would allow access via a road across the proposed Miner Slough levee weir, except for 27–80 inundation events lasting approximately 13 hours or more, depending on tide conditions and flood flows. The temporary loss of vehicle access to the northern portion of the Miner Slough levee during flood conditions would not be significant, because there are no privately-owned residences that the loss of access would impact. Because there is currently no land access to Hall Island from the Miner Slough levee and the property is flooded, there would be no potential conflicts with existing land uses on the property.

Utilities

Under Alternative 2, the solid waste disposal impacts (Impact 3.18-1) would be similar to the Proposed Project because the same amount of cleared materials may be hazardous (less than 100 cy) would need to be off-hauled to a landfill. As with the Proposed Project, local landfills could accommodate the disposal needs of Alternative 2 (e.g., debris, wooden electrical distribution poles, lead paint from old buildings, excavated soil contaminated with drilling fluids additives). Potential effects to easement holders (Impact 3.18-3) also would be the same as under the Proposed Project. Overall, solid waste disposal and potential effects to easement holders would be *less than significant*.

The potential for adverse effects on existing utilities (Impact 3.18-2) would be similar to the Proposed Project, because the PG&E distribution lines and poles within Prospect Island would be removed and it is possible that some unknown or unmarked subsurface utilities may exist on the site (i.e., old pipelines or septic tanks) that could be encountered during project grading. Mitigation Measure 3.18-2.1 would reduce this impact to *less than significant*.

Cumulative Effects

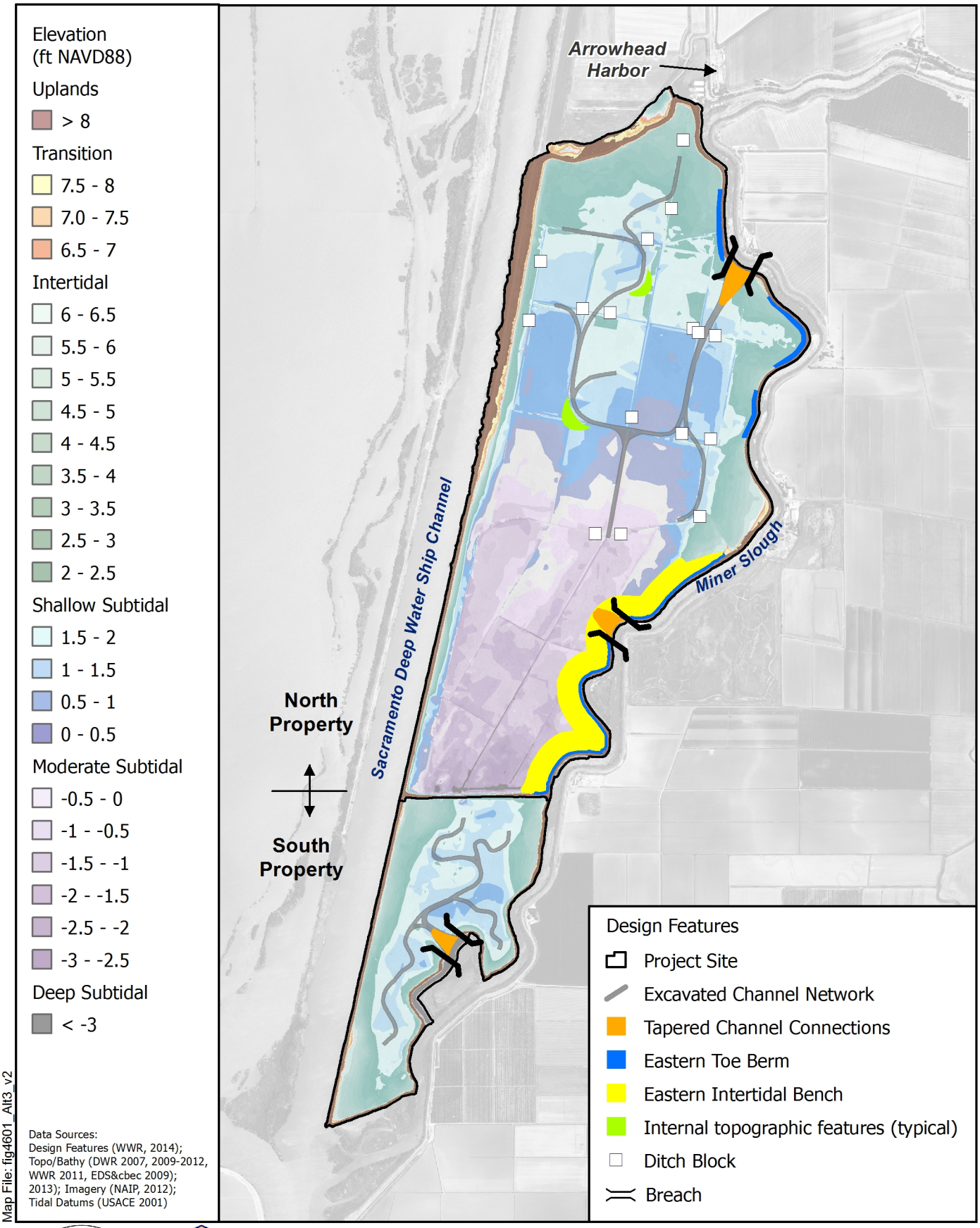
With Alternative 2, potential for cumulative impacts would be the same as for the Proposed Project. Although turbidity would be reduced due to the lack of

dredging, short-term cumulative turbidity impacts would still be *less than significant with mitigation*.

4.6 Alternative 3: Three Breaches

4.6.1 Description

Under Alternative 3, three breaches would be created on the Miner Slough levee: two in the north property, the first approximately 0.5 mi south of Arrowhead Harbor Marina, the second in the central portion of the Miner Slough levee. On the south property, the third breach would be constructed at the location of the formerly repaired breach connecting the Miner Slough spur channel to the south property (Figure 4.6-1). Under this alternative, the internal cross-levee separating the north and the south properties would remain intact, and the levee road and portions of the Miner Slough levee south of the central breach would be maintained. The DWR would protect the cross-levee from potential impacts by raising, reinforcing, and/or widening the 0.5 mi cross-levee on Prospect Island. Rock slope protection would be placed on the exposed levee ends of the north and central breach locations to provide protection from erosion. Because the north and south properties would not be hydraulically connected, except via tidal exchanges with Miner Slough, no dredging of the Miner Slough spur channel would be required under Alternative 3. Once the Miner Slough levee is breached, the north and south properties would be subject to daily tidal inundation.



Data Sources:
Design Features (WWR, 2014);
Topo/Bathy (DWR 2007, 2009-2012, WWR 2011, EDS&cbec 2009); 2013); Imagery (NAIP, 2012);
Tidal Datums (USACE 2001)

Map File: fig4601_Alt3_v2

1:31,680 (1 in = 0.5 miles at letter size)
0 0.25 0.5 Mi
0 0.5 1 Km

Figure 4.6-1
Restoration Alternative 3

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

4.6.2 Environmental impacts

Hydrology

Phase 1 and Phase 2 hydrodynamic modeling completed during the Prospect Island habitat restoration conceptual planning phase included a variety of configurations with varying numbers and locations of breaches along both Miner Slough and the Sacramento Deep Water Ship Channel (DWSC) (SWS and WWR 2012, WWR and SWS 2014). All of the modeled alternatives included hydraulic connection between the north and south properties. The overall change in the tidal prism would be similar to that of the Proposed Project. Thus, hydrologic impacts related to agricultural water supply and drainage, and the potential for erosion of the Miner Slough levee, would be the same as those described for the Proposed Project.

As with the Proposed Project, existing data indicate that Alternative 3 would not result in groundwater seepage to adjacent areas, there would be no construction related impacts to groundwater supplies and third-party wells under Alternative 3.

As with the Proposed Project, there would be no impact on flood conveyance or regional D-1641 flow requirements. This alternative also would have no impact on scour that could impact stability of nearby bridges, trestles, culverts or other structures, and it would not affect water rights due to surface water diversion.

Water quality

Under Alternative 3, short-term construction-related impacts to water quality would be less than those of the Proposed Project. There would be no dredging under Alternative 3, which would eliminate short-term construction-related increases in turbidity and suspended sediment levels within Miner Slough and in downstream waters due to mechanical dredging of the spur channel. However, there would be three levee breaches to Miner Slough totaling approximately 1,800 ft in length and 85,000 cy in volume (above and below MHHW) in order to reconnect the north and south properties to tidal action. Levee breaches would occur at the end of the restoration project in October of Year 2. On balance, Alternative 3 would result in decreased potential for turbidity and suspended sediment impacts as compared to the Proposed Project.

As with the Proposed Project, implementation of Mitigation Measures 3.2-1.1, 3.2-1.2, 3.2-1.3, 3.2-2.1, 3.2-3.1 and 3.2-3.2 would reduce the remaining short-term construction-related impacts of increased turbidity, pollutants, and herbicide use on water quality in the vicinity of Prospect Island to *less than significant*.

Long-term effects on salinity and water temperature (Impacts 3.2-5, 3.2-6) under Alternative 3 would be the same as the Proposed Project. These impacts would be *less than significant* for salinity, and *beneficial* for water temperature. The increased number of breaches along Miner Slough would potentially result in greater export of dissolved organic carbon (DOC) to adjacent waterways as compared to the Proposed Project (Impact 3.2-7). However, similar to the Proposed Project, DOC export would not result in substantial adverse effects on beneficial uses of water, in particular municipal drinking water supply at the Barker Slough Pumping Plant, and would be a *less than significant* effect on long-term DOC concentrations in the Sacramento-San Joaquin River Delta (Delta).

As with the Proposed Project, Alternative 3 would convert existing perennially flooded freshwater emergent marsh to tidal freshwater emergent marsh. This may affect the rate of methylmercury production and degree of bioaccumulation in higher trophic level organisms resident at the site, and may result in subsequent transport of methylmercury to downstream waterbodies. If methylmercury production increases, and depending on the magnitude of the increase, this could result in adverse, few, or no effects on public health or environmental receptors due to elevated methylmercury concentrations in the tissue of fish, birds, mammals, and humans that consume contaminated organisms.

Factors controlling the production and bioaccumulation of methylmercury and its ability to be transported from tidal wetlands into downstream waterbodies are complex and not yet fully understood (see Impact 3.2-8). Based upon the CALFED Science Program Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) conceptual model of methylmercury production, habitat flooding frequency corresponds with a methylmercury gradient, from relatively low methylmercury concentrations in the overlying water column of perennially flooded habitats (e.g., open-water areas), low to moderate concentrations in habitats that flood frequently and do not fully dry between inundation events (e.g., low elevation tidal marsh), and potentially higher concentrations in areas that flood less frequently and dry out between inundation events (e.g., seasonal floodplains or wetlands and high elevation tidal marsh) (Alpers et al. 2008).

As with the Proposed Project, restoration of tidal action to the site under Alternative 3 would result in the conversion of existing perennially flooded

emergent marsh (i.e., associated with low to moderate methylmercury concentrations) to open-water habitat (i.e., associated with low methylmercury concentrations). It is anticipated that the small increase in the area of infrequently flooded habitat between MHW and MHHW on the land-side of the perimeter levees would potentially result in increased methylmercury production. However, the increase in methylmercury production would be offset by the increases in open-water habitat associated with lower production and bioaccumulation potential. Under Alternative 3, there is potential for greater export of methylmercury as compared with the Proposed Project due to the additional breach along the Miner Slough levee. Despite this, given scientific uncertainty regarding the degree to which freshwater tidal wetlands contribute to Delta methylmercury loading now and in the future (see also Impact 3.2-8), ongoing DWR and CDFW mercury compliance control studies (see also Impact 3.2-8), and the small degree of anticipated production under Alternative 3, this would be a *less than significant* impact.

As with the Proposed Project, Alternative 3 would have *no impact* on groundwater quality.

Aquatic biological resources

Under Alternative 3, dredging of the Miner Slough spur channel would not be necessary with similar potential for short-term impacts related to the temporary repair of the south property levee (Impact 3.3-1). Impact 3.3-5 would not occur. Short-term impacts to fish species related to direct injury, impediment to migration, and impairment of essential fish behaviors (Impacts 3.3-3, 3.3-4, 3.3-6) would be potentially greater than those of the Proposed Project since there would be three levee breaches to Miner Slough. However, since there would be no dredging under Alternative 3, the degree of short-term impacts related to direct injury, impediment to migration, and impairment of essential fish behaviors (Impacts 3.3-3, 3.3-4, 3.3-6) would be reduced, as compared with the Proposed Project. Implementation of the associated Mitigation Measures (3.3-3.1, 3.3-3.2, 3.2-2.1) would reduce these impacts to *less than significant*. Further, the mitigation associated with Impact 3.3-6 would still be necessary. Lastly, potential fish injury or mortality impacts due site dewatering and herbicide application (Impacts 3.3-7 and 3.3-8) would be the same as the Proposed Project and implementation of the associated Mitigation Measures (3.3-7.1, 3.2-3.1, and 3.2-3.2) would reduce these impacts to *less than significant*.

Under Alternative 3, dredging of the Miner Slough spur channel would not be necessary with similar potential for short-term impacts related to the temporary

repair of the south property levee (Impact 3.3-1). Impact 3.3-5 would not occur, and impacts 3.3-3, 3.3-4, and 3.3-6 would be reduced. The mitigation associated with Impact 3.3-6 would still be necessary. Lastly, potential fish injury or mortality impacts due site dewatering and herbicide application (Impacts 3.3-7 and 3.3-8) would be the same as the Proposed Project and implementation of the associated Mitigation Measures (3.3-7.1, 3.2-3.1, and 3.2-3.2) would reduce these impacts to *less than significant*.

As with the Proposed Project, Alternative 3 would be beneficial with respect to long-term conversion and enhancement of aquatic habitat (Impact 3.3-2), and water temperatures (Impact 3.3-10). The addition of a third breach along Miner Slough would increase potential for food export to other habitats within the Cache Slough Complex relative to the Proposed Project (WWR-Stillwater Sciences 2014).

Under Alternative 3, the potential for establishment of Asian Clam at the site (Impact 3.3-11) and potential food web impacts due to increased levels of methylmercury bioaccumulation (Impact 3.3-12) would be *less than significant*, the same as for the Proposed Project.

Wetland and terrestrial biological resources

Short-term, construction-related impacts to wetland and terrestrial resources under Alternative 3 would be similar to those of the Proposed Project. Implementation of Mitigation Measures 3.4-4.1 through 3.4-17.1 would reduce these impacts to *less than significant*.

With respect to potential long-term effects, the addition of a third breach location along the Miner Slough levee would result in a slight reduction of tidal freshwater emergent wetland in the vicinity of the central breach location compared with the Proposed Project. This loss would be partially offset by increased amounts of shallow subtidal habitat in the vicinity of the internal cross-levee breach, where the latter is not part of Alternative 3. Compared with existing conditions, there would still be a long-term increase in freshwater emergent wetland at the site. This would be a beneficial effect.

With respect to long-term effects on valley/foothill riparian habitat, the addition of the third breach would result in a greater loss of this habitat type compared to the Proposed Project. This would represent an additional loss of up to 5 ac of valley/foothill riparian habitat compared to the Proposed Project. However, with implementation of design features (e.g., planting) as well as mitigation measures

detailed under the Proposed Project, potential impacts to riparian resources and riparian-associated species (e.g., plants, Swainson's Hawk, western red bat) would be reduced to *less than significant*.

Geology and soils

Under Alternative 3, beneficial effects on Miner Slough levee stability would be similar to those of the Proposed Project. Alternative 3 would also include raising, reinforcing, and/or widening the 0.5 mi cross-levee on Prospect Island separating the north and south properties. Thus, improved stability of the cross-levee would be a beneficial effect under Alternative 3.

As with the Proposed Project, Alternative 3 would support inorganic sediment accretion, help reverse existing land subsidence, offset future subsidence, and support system resiliency to mean sea level rise (see also Section 3.19.3 Summary of cumulative impacts – Geology and soils).

Hazards and hazardous materials

Under Alternative 3, potential impacts (and benefits) from hazards and hazardous materials would be the same as for the Proposed Project.

Air quality

The volumes of the imported and exported construction materials, the volumes of soil cut and fill, as well as other work load anticipated to complete this alternative, including the additional Miner Slough levee breach and improvements to the 0.5 mi cross-levee between the north and south properties, would be greater than the Proposed Project. The nature and timing of the construction of activities would be similar to the Proposed Project, and the larger work load for this project would generate greater air pollutant emissions. However, given Mitigation Measures 3.7-1.1, 3.7-1.2, and 3.7-1.3, which include offset mitigation for NO_x emissions, the air quality significance determinations of this alternative would be the same as those of the Proposed Project – *less than significant* or *less than significant with mitigation*.

Greenhouse gases

With the additional Miner Slough levee breach and improvements to the 0.5 mi cross-levee between the north and south properties under Alternative 3, the total volume of material to be excavated and re-used on-site would be greater

compared to the Proposed Project. Therefore, construction related GHG emissions for this alternative would be greater than the Proposed Project. However, as with the Proposed Project, the incremental contribution to the cumulative impact of increasing atmospheric levels of GHGs would be less than cumulatively considerable and, therefore, *less than significant*.

Mineral resources

Under Alternative 3, no impacts to mineral rights would occur because there would be no changes to access to the gas fields underlying portions of the Project site due to activities occurring on Prospect Island, and there are no other locally known mineral resources.

Noise

Impacts of Alternative 3 would be greater than the Proposed Project due to increased construction activities. Implementation of Mitigation Measure 3.10-1.1 would reduce these impacts to *less than significant*.

In the long-term, Alternative 3 would continue to require similar infrequent operations, maintenance, and monitoring activities as the Proposed Project within the north property only (Impact 3.9-1). This would be *less than significant* impact on long-term ambient noise levels in the vicinity.

Aesthetics

Under Alternative 3, an additional breach would be located in the central portion of the Miner Slough levee. However, overall visual impacts of this alternative would be similar to those of the Proposed Project.

Agricultural resources

As with the Proposed Project, impacts of Alternative 3 on agricultural lands would be *less than significant*. There is no land designated as Prime, Unique, or Important Agricultural Land, and the potential temporary conversion of 10.9 ac of currently farmed land is only a very small portion of approximately 1,600 ac that has no other agricultural activity of any kind. In addition, Alternative 3 would not result in substantial seepage to nearby farmland on adjacent islands, and there would be a *less than significant* impact on agricultural uses on those lands.

Cultural resources

Under Alternative 3, there would be *no impacts* to historical resources since the remaining buildings and levees to be demolished at the Project site do not qualify as historical resources. Under Alternative 3, the impacts to unknown archaeological resources and unknown human burials would be the same as for the Proposed Project. Implementation of Mitigation Measures 3.13-2.1, 3.13-3.1 and 3.14-4.1 would reduce these impacts to *less than significant*. As with the Proposed Project, there would be no impacts to paleontological resources.

Land use and planning/Population and housing

Under Alternative 3, land use impacts would be the same as those of the Proposed Project.

Public services

Alternative 3 would create three breaches on Miner Slough in the northern, central, and southern parts of the island while leaving the cross-levee intact. A section of the Miner Slough levee would still be rendered inaccessible after the breaches are constructed; however, given there are no affected residences, this impact would be considered *less than significant*.

Recreation

Under Alternative 3, short-term construction-related impacts would be the same as under the Proposed Project and would be reduced to *less than significant* with implementation of Mitigation Measure 3.16-1.1. All other impacts would be the same as under the Proposed Project.

Transportation and traffic

Alternative 3 would maintain the interior cross-levee, and breaches on the north property would be north of the formerly privately-owned parcel. A section of the Miner Slough levee would still be rendered inaccessible after the breaches are constructed; however, no residences would be affected.

This alternative would entail slightly more construction than the Proposed Project, including an additional breach in the Miner Slough levee, as well as improvements to the 0.5 mi cross-levee between the north and south properties. Therefore, traffic impacts during construction would be slightly greater than those

of the Proposed Project. However, implementation of Mitigation Measures 3.17-1.1 and 3.17-1.2 would reduce this impact to *less than significant*.

Utilities

Under Alternative 3, solid waste disposal and potential effects to easement holders would be *less than significant*, the same as for the Proposed Project.

The potential for adverse effects on existing utilities (Impact 3.18-2) would be similar to the Proposed Project, because the PG&E distribution lines and poles within Prospect Island would be removed, and it is possible that some unknown or unmarked subsurface utilities may exist on the site (i.e., old pipelines or septic tanks) that could be encountered during grading. Mitigation Measure 3.18-2.1 would reduce this impact to *less than significant*.

Cumulative Effects

With Alternative 3, potential for for cumulative impacts would be similar as for the Proposed Project. Although turbidity would be reduced due to the lack of dredging, short-term cumulative turbidity impacts would still be *less than significant with mitigation*.

4.7 Comparison of Alternatives and Identification of Environmentally Superior Alternative

The California Environmental Quality Act (*CEQA) Guidelines* (Sections 15126.6(d), 15126.6(e)) require that the EIR designate an environmentally superior alternative to the Proposed Project. If the alternative with the least environmental impact is the No Project Alternative, then one of the other remaining alternatives is to be designated as the environmentally superior alternative.

Table 4.7-1 presents a summary of effects of the Proposed Project to those of the alternatives using the analyses conducted by resource area. Each alternative is ranked in comparison to the Proposed Project as environmentally superior (“+” fewer impacts), potentially superior (“=/+”), the same as (“=”), potentially inferior (“=/-”), or inferior (“-“, more impacts or fewer benefits). On balance, this comparison shows that Alternative 1, the No Project Alternative, would have the least environmental impact. However, this is not unexpected, because the majority of short-term construction-related impacts under the Proposed Project would not occur under the No Project Alternative. However, maintaining existing

conditions at Prospect Island under this alternative would not meet any of the Project objectives, including: enhancement of primary productivity and food availability for fisheries in the Sacramento-San Joaquin River Delta (Delta); increasing the quantity and quality of salmonid rearing habitat and habitat for other listed species; enhancement of water quality, recreation and carbon sequestration in tidal marshes; promotion of habitat resiliency; and promote habitat conditions that support native species.

As noted above, CEQA requires that the Environmental Impact Report (EIR) identify an environmentally superior alternative other than the No Project Alternative. Alternatives 2 and 3 are both environmentally superior compared with the Proposed Project because neither would require dredging of the Miner Slough spur channel, resulting in reduced short-term construction-related impacts to water quality and aquatic species in Miner Slough. However, Alternative 2 is slightly more beneficial than Alternative 3 due to the replacement of the northern Miner Slough breach, which requires full excavation of the levee during construction, with a weir, which requires only partial excavation. The weir would result in slightly lower export of primary productivity to surrounding Delta waterways compared to a breach in this location under the Proposed Project and Alternative 3; this would be a reduced benefit. However, the weir would also result in lower potential export of water quality constituents of concern (e.g., DOC, methylmercury), to adjacent waterways (Section 4.6.2) relative to the Proposed Project and Alternative 3. Although Alternative 2 would result in the greatest potential impact to valley/foothill riparian habitat, increased amounts of freshwater tidal emergent marsh would be relatively more beneficial to wetland-associated species (e.g., giant garter snakes, western pond turtles, special-status and migratory birds, and western red bats) than the other alternatives.

Table 4.7-1. Comparison of Proposed Project Effects to Those Under the Alternatives

Impact No.	Impact Title	PP	Comparison to Proposed Project		
			Alt 1	Alt 2	Alt 3
	HYDROLOGY				
3.1-1	Potential changes in agricultural water supply and drainage due to changes in tidal range	LTS	=/+	=	=
3.1-2	Potential impacts to Sacramento River Flood Control Project and Yolo Bypass Floodway flood conveyance	NI	=	=	=
3.1-3	Groundwater seepage impacts from Prospect Island to adjacent areas	LTS	=/+	=	=
3.1-4	Potential wind-wave erosion of the interior side of Prospect Island levees	LTS	=	=	=
3.1-5	Potential toe-scour and erosion of Miner Slough levees affecting Ryer Island levee stability	LTS	=/+	=/+	=
3.1-6	Potential increase in seepage on adjacent lands due to Miner Slough bed scour	LTS	=/+	=	=
3.1-7	Potential impacts to regional flow resulting in non-compliance with D-1641 flow requirements on the Sacramento River at Rio Vista	NI	=	=	=
3.1-8	Potential scour impacting stability of nearby bridges, trestles, culverts or other structures	NI	=	=	=
3.1-9	Potential impacts to water rights from diversion of surface water	NI	=	=	=
3.1-10	Potential construction related impacts to groundwater supplies and third-party wells	NI	=	=	=
	WATER QUALITY				
3.2-1	Short-term construction-related water quality impacts	LTSM	+	=	=
3.2-2	Short-term construction-related increases in turbidity and/or mobilization of contaminants from dredging and excavation of levee breaches	LTSM	+	+	=/+
3.2-3	Short-term construction-related effects from application of aquatic herbicides	LTSM	+	=	=
3.2-4	Short-term construction-related effects on water temperature in adjacent waterbodies due to dewatering activities	NI	+	=	=
3.2-5	Long-term effects on salinity in waterbodies near Prospect Island	LTS	+	=	=
3.2-6	Long-term effects on water temperature within Prospect Island and in nearby waterbodies	B	-	=	=
3.2-7	Long-term effects on primary productivity and dissolved organic carbon (DOC) within and near Prospect Island	LTS	+	=/+	=/-
3.2-8	Long-term effects on methylmercury production, bioaccumulation, and export	LTS	=/+	=/+	=/-

Impact No.	Impact Title	PP	Comparison to Proposed Project		
			Alt 1	Alt 2	Alt 3
3.2-9	Long-term effects on groundwater quality	NI	=	=	=
	AQUATIC BIOLOGICAL RESOURCES				
3.3-1	Short-term loss and degradation of aquatic habitat from construction-related activities	LTS	+	=/+	=/+
3.3-2	Long-term conversion and enhancement of aquatic habitat	B	-	=/-	=/+
3.3-3	Short-term direct construction-related injury or mortality of fish	LTSM	+	=/+	=/+
3.3-4	Short-term construction-related noise impediments to fish migration	LTSM	+	=/+	=/+
3.3-5	Short-term impairment of essential fish behaviors due to potential increases in turbidity during underwater sediment sampling activities	Impact deleted (sediment sampling is complete)			
3.3-6	Short-term impairment of essential fish behaviors due to construction-related increases in turbidity	LTSM	+	=/+	=/+
3.3-7	Short-term fish injury or mortality due to dewatering	LTSM	+	=	=
3.3-8	Fish Injury or mortality due to herbicide application	NI	+	=	=
3.3-9	Post-construction increased predation on native fish	LTS	n/a	=	=
3.3-10	Long-term impacts to fish in Prospect Island and adjacent water bodies from changes in water temperature	B	-	=	=
3.3-11	Altered habitat and food web from invasion by Asian Clam	LTS	+	=	=
3.3-12	Food web impacts from increased levels of methylmercury bioaccumulation	LTS	+	=/+	=/-
	WETLAND AND TERRESTRIAL BIOLOGICAL RESOURCES				
3.4-1	Short-term impacts to perennial aquatic habitats and wetland communities from site preparation	SU	+	=	=
3.4-2	Short-term impacts to tidal aquatic habitats and wetland communities from dredging in the Miner Slough spur channel	NI	=	=	=
3.4-3	Short-term loss of valley/foothill riparian habitat	LTSM	+	=	=
3.4-4	Short-term construction-related mortality or detrimental effects to sensitive plants	LTSM	+	=	=
3.4-5	Long-term conversion of perennial aquatic habitats and wetland communities to tidal habitat types	LTS	=/-	=	=/-
3.4-6	Long-term loss of valley/foothill riparian habitat	LTSM	=/+	-	=/-
3.4-7	Reduction in available habitat for special-status plant species adapted to existing conditions	LTS	+	=	=/-
3.4-8	Short-term construction-related impacts to valley elderberry longhorn beetle	LTSM	=	=/-	=

Impact No.	Impact Title	PP	Comparison to Proposed Project		
			Alt 1	Alt 2	Alt 3
3.4-9	Long-term impacts to valley elderberry longhorn beetle	NI	=	=	=
3.4-10	Short-term construction-related injury or mortality and loss of habitat for giant garter snakes	LTSM	+	=	=
3.4-11	Long-term conversion of giant garter snake habitat	LTS	=/-	=	=
3.4-12	Short-term construction-related habitat loss and injury or mortality of individual western pond turtles	LTSM	+	=	=
3.4-13	Long-term conversion of western pond turtle habitat	B	-	=	=/-
3.4-14	Short-term, construction-related injury or mortality, take of nests, and loss of nesting and foraging habitat of special-status and migratory birds	LTSM	+	=	=
3.4-15	Long-term conversion of nesting and foraging habitat for special-status and migratory birds	LTSM	=/+	=/+	=/-
3.4-16	Post-construction conversion to tidal habitat suitable for foraging migratory birds	B	=/-	=/+	=/-
3.4-17	Short-term, construction-related injury or mortality and loss of roosting and foraging habitat for western red bats	LTSM	+	=	=
3.4-18	Long-term removal of western red bat roosting and foraging habitat	LTSM	=/+	=	=/-
GEOLOGY AND SOILS					
3.5-1	Long-term effect on exposure of people and structures to seismic- and landslide-related hazards	B	-	=	=
3.5-2	Long-term effect on sediment deposition and erosion in Prospect Island	B	-	=	=
HAZARDS AND HAZARDOUS MATERIALS					
3.6-1	Potential effects from abandoned gas wells	LTSM	+	=	=
3.6-2	Potential effects from contaminant migration via existing groundwater monitoring wells	LTSM	+	=	=
3.6-3	Potential mobilization of contaminants from levee breaching and/or sediment dredging and re-use	LTS	+	=	=/+
3.6-4	Hazards associated with the Prospect Island houses on the north property	B	-	=	=
3.6-5	Potential hazards associated with the abandoned house on the south property	B	-	=	=
3.6-6	Potential soil or water contamination from on-site equipment storage and fueling	LTSM	+	=	=
3.6-7	Potential effects on human health due to the short-term use of aquatic-approved herbicides prior to site construction	LTSM	+	=	=
3.6-8	Potential effects on human health due to changes in the extent of mosquito breeding habitat	B	-	=	=

Impact No.	Impact Title	PP	Comparison to Proposed Project		
			Alt 1	Alt 2	Alt 3
AIR QUALITY					
3.7-1	Generation of criteria pollutant emissions that contribute to air quality violations	LTSM	+	=	=/+
3.7-2	Conflict with or obstruct applicable general plans or regional air quality plans	LTSM	+	=	=/+
3.7-3	Expose sensitive receptors to air pollutants and cause higher health risks	LTS	=	=	=/+
3.7-4	Expose sensitive receptors to objectionable odors	LTS	+	=	=/+
GREENHOUSE GASES					
3.8-1	Proposed Project-related GHG emissions	LTS	+	+	=/+
MINERAL RESOURCES					
3.9-1	Loss of a known mineral resource that would be of value to the region and residents of the state	NI	=	=	=
3.9-2	Loss of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan	NI	=	=	=
NOISE					
3.10-1	Potential for short-term noise disturbance to nearby residents	LTSM	+	=	=/+
3.10-2	Potential for long-term increases in ambient noise levels in the Proposed Project vicinity	LTS	+	=	=
3.10-3	Potential for sensitive receptors to be exposed to excessive ground-borne vibrations during construction-related activities	NI	=	=	=/+
AESTHETICS					
3.11-1	Temporary change in views during construction	LTS	+	=	=
3.11-2	Long-term change in views from State Route 84	LTS	+	=	=
3.11-3	Long-term change in views from Arrowhead Harbor Marina	LTS	+	=	=
3.11-4	Long-term change in views from boats in Miner Slough	LTS	+	=	=
3.11-5	Long-term change in views from boats in the Deep Water Ship Channel	LTS	+	=	=
3.11-6	Long-term change in views from nearby residences	LTS	+	=	=
3.11-7	Long-term light and glare	NI	=	=	=

Impact No.	Impact Title	PP	Comparison to Proposed Project		
			Alt 1	Alt 2	Alt 3
AGRICULTURAL AND FORESTRY RESOURCES					
3.12-1	Loss or conversion of prime, unique, or important agricultural lands	LTS	=	=	=
3.12-2	Conflicts with Williamson Act contracted lands	NI	=	=	=
3.12-3	Potential effects to agricultural uses on adjacent lands	LTS	+	=	=
CULTURAL RESOURCES					
3.13-1	Impacts to historical resources on land	NI	=	=	=
3.13-2	Inadvertent discovery of a shipwreck during in-water construction	LTSM	+	=	=
3.13-3	Impacts to unknown archaeological resources	LTSM	+	=	=
3.13-4	Impacts to unknown human burials	LTSM	+	=	=
3.13-5	Impacts to paleontological resources	NI	=	=	=
LAND USE AND PLANNING/POPULATION AND HOUSING					
3.14-1	Potential conflicts with adjacent land uses	LTS	+	=	=
3.14-2	Potential conflict with plans and policies	NI	=	=	=
3.14-3	Population and housing effects	NI	=	=	=
PUBLIC SERVICES					
3.15-1	Potential conflict with existing police and fire protection services	LTSM	+	-/+	+
RECREATION					
3.16-1	Short-term construction-related impacts to recreational boating in Miner Slough and Arrowhead Harbor Marina	LTSM	+	=	=
3.16-2	Long-term impacts to recreational boating in Miner Slough and Arrowhead Harbor Marina	LTS	+	=	=
3.16-3	Long-term Impacts on recreational use of Prospect Island	NI	=	=	=
3.16-4	Consistency with existing plans	LTS	+	=	=
TRANSPORTATION AND TRAFFIC					
3.17-1	Potential traffic impacts during construction	LTSM	+	=	=
3.17-2	Potential long-term loss of access to Miner Slough levee	LTS	+	-/+	+

Impact No.	Impact Title	PP	Comparison to Proposed Project		
			Alt 1	Alt 2	Alt 3
UTILITIES					
3.18-1	Solid waste disposal impacts	LTS	+	=	=
3.18-2	Potential for adverse effects on existing utilities	LTSM	+	=	=
3.18-3	Potential for adverse effects to easement holders	LTS	+	=	=

Abbreviations: B = beneficial, LTS = less than significant, LTSM = less than significant with mitigation, NI = no impact, SU = significant and unavoidable. Each alternative is ranked in comparison to the Proposed Project as environmentally superior (“+” fewer impacts), potentially superior (“=/+”), the same as (“=”), potentially inferior (“=/-”), or inferior (“-“, more impacts or fewer benefits).

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6 REFERENCES

Adams, P. B., C. B. Grimes, S. T. Lindley, and M. L. Moser. 2002. Status review for North American green sturgeon, *Acipenser medirostris*. National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, CA and NMFS, Northwest Science Center, Seattle, WA.

Alpers, C., C. Eagles-Smith, C. Foe, S. Klasing, M. Marvin-DiPasquale, D. Slotton, and L. Winham-Myers. 2008. Mercury conceptual model. Sacramento-San Joaquin Delta Regional Ecosystem Restoration Implementation Plan. Sacramento, CA.

Annand, E. M., and F. R. Thompson, III. 1997. Forest bird response to regeneration practices in central hardwood forests. The Journal of Wildlife Management 61: 159-171. DOI: https://doi.org/10.2307/3802425

Armor, C., R. Baxter, W. Bennett, R. Breuer, M. Chotkowski, P. Coulston, D. Denton, B. Herbold, W. Kimmerer, K. Larsen, M. Nobriga, K. Rose, T. Sommer, and M. Stacey. 2005. Interagency Ecological Program synthesis of 2005 work to evaluate the pelagic organism decline (POD) in the upper San Francisco Estuary. Stockton, CA.

Arrowhead Harbor Marina. 2009. Arrowhead Harbor on Miner Slough. Clarksburg, CA. Website. http://arrowheadharbor.com/index.html (Accessed: July 2019).

Atwater, B. F. 1982. Geologic maps of the Sacramento-San Joaquin Delta, California. U.S. Geological Survey miscellaneous field studies map MF-1401. Scale 1:24,000. http://pubs.er.usgs.gov/publication/mf1401

Azat, J. 2014. GrandTab 2014.04.22 California Central Valley Chinook population report. California Department of Fish and Wildlife, Fisheries Branch. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84381&inline=1

BAAQMD (Bay Area Air Quality Management District). 2014. Meteorological Site: Rio Vista (Site ID: 8901). 1989-2014. Website. [no longer active].

Barrett, J. C., G. D. Grossmand, and J. Rosenfeld. 1992. Turbidity-induced changes in reactive distance of rainbow trout. Transactions of the American

Fisheries Society 121: 437–443. DOI: https://doi.org/10.1577/1548-8659(1992)121<0437:TICIRD>2.3.CO;2

BASF Corporation. 2014. Habitat herbicide. Material safety data sheet. 30235835/SDS_CPA_US/EN. BASF – the chemical company. http://www.cdms.net/LabelsMsds/LMDefault.aspx?pd=7136

Beamesderfer, R. P., and M. H. Webb. 2002. Green sturgeon status review information. Prepared for State Water Contractors by S. P. Cramer and Associates, Inc.

Bergamaschi, B. A., J. A. Fleck, B. D. Downing, E. Boss, B. Pellerin, N. K. Ganju, D. H. Schoellhamer, A. A. Byington, W. A. Heim, M. Stephenson, and R. Fujii. 2011. Methyl mercury dynamics in a tidal wetland quantified using in situ optical measurements. Limnology and Oceanography 56(4): 1344-1371. DOI: https://doi.org/10.4319/lo.2011.56.4.1355

Bergamaschi, B. A., J. A. Fleck, B. D. Downing, E. Boss, B. A. Pellerin, N. K. Ganju, D. H. Schoellhamer, A. A. Byington, W. A. Heim, M. Stephenson, and R. Fujii. 2012. Mercury dynamics in a San Francisco Estuary tidal wetland: assessing dynamics using in situ measurements. Estuaries and Coasts 35(4): 1036-1048. DOI: https://doi.org/10.1007/s12237-012-9501-3

Benoit, J., C. Gilmour, A. Heyes, R. P. Mason, and C. Miller. 2003. Geochemical and biological controls over methylmercury production and degradation in aquatic ecosystems. Pages 262-297 *in* Y. Chai and O. C. Braids, editors. Biogeochemistry of environmentally important trace elements. ACS Symposium Series No. 835. American Chemical Society, Washington, D. C. DOI: https://doi.org/10.1021/bk-2003-0835.ch019

Betchart, W. 2008. Delta levees – types, uses, and policy options. Prepared for Delta Vision, California Resources Agency. http://deltavision.ca.gov/ConsultantReports/Delta_VisionLeveesReport_Final_08-07-08.pdf

Bonds, C. L. 2014. Personal Communication. E-mail from C.L. Bonds (Senior Engineer, DWR) to T. Stevens (CDFW). June 5, 2014.

Brett, J. R., W. C. Clarke, and J. E. Shelbourn. 1982. Experiments on thermal requirements for growth and food conversion efficiency of juvenile chinook

salmon *Oncorhynchys tshawytscha*. Canadian Technical Report of Fisheries and Aquatic Sciences 1127.

Brode, J., and G. Hansen. 1992. Status and future management of the giant garter snake (*Thamnophis gigas*) within the southern American Basin, Sacramento and Sutter counties, California. California Department of Fish and Game, Inland Fisheries Division.

Brown, L. R., J. K. Thompson, K. Higgens, and L. V. Lucas. 2007. Population density, biomass, and age-class structure of the invasive clam *Corbicula fluminea* in rivers of the lower San Joaquin River watershed, California. Western North American Naturalist 67(4): 572-586. DOI: https://doi.org/10.3398/1527-0904(2007)67[572:PDBAAS]2.0.CO;2

Brown L. R, W. A. Bennett, R. W. Wagner, T. Morgan–King, N. Knowles, F. Feyrer, D. Schoellhamer, M. Stacey, and M. Dettinger. 2013. Implications for future survival of delta smelt from four climate change scenarios for the Sacramento–San Joaquin Delta, California. Estuaries Coasts 36:754–774. DOI: http://dx.doi.org/10.1007/s12237-013-9585-4.

Bruce, B. 2008. Cultural resource report for the Prospect Island Levee System, Excess Property Project, Solano County, CA. Northwest Information Center Report S-019945. U.S. Bureau of Reclamation, Mid-Pacific Region.

Bryan, K. 1923. Geology and groundwater resources of Sacramento Valley, California. U.S. Geological Survey Water-Supply Paper 495.

Bryant, W. A., and E. W. Hart. 2007. Fault-rupture hazard zones in California. Alquist-Priolo Earthquake Fault Zoning Act, with index to earthquake fault zones maps. California Geological Survey, Special Publication 42, interim revision 2007. ftp://ftp.consrv.ca.gov/pub/dmg/pubs/sp/Sp42.pdf

Burnett, R. D., and J. DeStaebler. 2003. Songbird monitoring of lower Clear Creek floodway restoration project: 2002 report. PRBO Conservation Science. Contribution # 1098. Stinson Beach, CA.

Cache Slough Landowners. 2019. Little Egbert Tract. Website. http://cacheslough.com/little-egbert-tract/ (Accessed: July 2019).

CAL FIRE (California Department of Forestry and Fire Prevention). 2007. Solano County Fire Hazard Severity Zone map. Website. [no longer active].

California Department of Conservation. 2012. Map of Solano County Important Farmland. ftp://ftp.consrv.ca.gov/pub/dlrp/FMMP/pdf/2012/sol12.pdf

California Department of Conservation. 2014. Map of California earthquake fault zones, and landslide and liquefaction zones. Website (Regulatory Maps Portal). http://www.quake.ca.gov/gmaps/WH/regulatorymaps.htm (Accessed: July 2019).

California EcoRestore. 2014. Lisbon Weir Modification Project. Yolo Bypass, CA. http://resources.ca.gov/docs/ecorestore/projects/Lisbon_Weir.pdf

California EcoRestore. 2017. Bradmoor Island Tidal Habitat Restoration Project. Suisun Marsh, CA. http://resources.ca.gov/docs/ecorestore/projects/Bradmoor_Island.pdf

California EcoRestore. 2019a. Goat Island Tidal Marsh Restoration. Suisun Marsh, CA. http://resources.ca.gov/docs/ecorestore/projects/Goat_Island.pdf

California EcoRestore. 2019b. Hill Slough Tidal Marsh Restoration Project. Suisun Marsh, CA. http://resources.ca.gov/docs/ecorestore/projects/Hill_Slough_Tidal_Restoration.pdf

California EcoRestore. 2019c. McCormack-Williamson Tract Restoration Project. Sacramento County, CA. http://resources.ca.gov/docs/ecorestore/projects/McCormack_Williamson_Tract_Project.pdf

California EcoRestore. 2019d. Tule Red Restoration Project. Suisun Marsh, CA. http://resources.ca.gov/docs/ecorestore/projects/Tule_Red_Restoration.pdf

California EcoRestore. 2019e. Wings Landing Tidal Habitat Restoration Project. Suisun Marsh, CA. http://resources.ca.gov/docs/ecorestore/projects/Wings-Landing-Project.pdf

California EcoRestore. 2019f. Winter Island Tidal Habitat Restoration Project. West Delta, CA.

http://resources.ca.gov/docs/ecorestore/projects/Winter_Island_Tidal_Habitat_Restoration.pdf

California EcoRestore. 2019g. Yolo Flyway Farms Tidal Habitat Restoration Project. Cache Slough Complex, CA. http://resources.ca.gov/docs/ecorestore/projects/Yolo-Flyaway-Farms-Tidal-Habitat-Restoration-Project.pdf

California EcoRestore. 2019h. Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project. Yolo Bypass, CA. http://resources.ca.gov/docs/ecorestore/projects/Yolo_Bypass_Salmonid_Habitat_Restoration_and_Fish_Passage_Project.pdf

California EcoRestore. 2019i. California EcoRestore Home. Website. http://resources.ca.gov/ecorestore/ (Accessed: July 2019).

CESA (California Endangered Species Act). 1984. Fish and Game Code, Division 3 – Fish and Game Generally, Chapter 1.5 – Endangered Species. https://leginfo.legislature.ca.gov/faces/codes_displayexpandedbranch.xhtml?tocCode=FGC&division=3.&title=&part=&chapter=&article= (Accessed: July 2019).

California Natural Resources Agency. 2019. Project: North Bay Aqueduct Alternative Intake Project. Website. http://bondaccountability.resources.ca.gov/Project.aspx?ProjectPK=9455&PropositionPK=4 (Accessed: July 2019).

California OPR (California Governor's Office of Planning and Research). 2019a. SCH Number 2016082013: Decker Island Restoration Project. Solano County, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/Project/2016082013 (Accessed: July 2019).

California OPR. 2019b. The Hill Slough Restoration Project. Solano County, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/2011052078 (Accessed: July 2019).

California OPR. 2019c. North Delta Improvements Project. Sacramento County, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/2003012112/3 (Accessed: July 2019).

California OPR. 2019d. Lookout Slough Restoration Project. Solano County, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/2019039136/2 (Accessed: July 2019).

California OPR. 2019e. Program Environmental Impact Report for the Lower Putah Creek Restoration Project – Upper Reach. Solano and Yolo Counties, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/2015022022/4 (Accessed: July 2019).

California OPR. 2019f. SCH Number 2003112039: Tule Red Tidal Restoration Project. Suisun Marsh, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/Project/2003112039 (Accessed: July 2019).

California OPR. 2019g. SCH Number 2018082025: Winter Island Tidal Habitat Restoration Project. West Delta, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/Project/2018082025 (Accessed: July 2019).

California OPR. 2019h. Lower Yolo Bypass Restoration Project. Yolo County, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/2011032001/3 (Accessed: July 2019).

California OPR. 2019i. Conaway Ranch Floodway Corridor and Habitat Enhancement Project NOE Description. Yolo County, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/2012128039 (Accessed: July 2019).

California OPR. 2019j. SCH Number 2014092063: Honker Bay Conservation Bank. Solano County, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/Project/2014092063 (Accessed: August 2019).

California OPR. 2019k. SCH Number 2010122078: Northern Liberty Island Fish Conservation Bank. Yolo Bypass, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/Project/2010122078 (Accessed: July 2019).

California OPR. 2019l. SCH Number 2017022012: Fremont Weir Adult Fish Passage Modification Project. Yolo Bypass, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/Project/2017022012 (Accessed: July 2019).

California OPR. 2019m. SCH Number 2017082031: Aquatic Invasive Plant Control Program (AIPCP). Sacramento – San Joaquin Delta, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/Project/2017082031 (Accessed: July 2019).

California OPR. 2019n. SCH Number 2015012062: Davis Woodland Water Supply Project (DWWSP), Aquifer Storage and Recovery Project Supplemental EIR. Woodland, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/Project/2015012062 (Accessed: August 2019).

California OPR. 2019o. Southport Sacramento River Early Implementation Project. Yolo County, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/2011082069/14 (Accessed: August 2019).

California OPR. 2019p. SCH Number 1987011307: Sacramento River Deep Water Ship Channel. Sacramento, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/Project/1987011307 (Accessed: July 2019).

California OPR. 2019q. SCH Number 2016032048: Decker Island Levee Repair Demonstration Project. Solano County, CA. CEQAnet Web Portal. https://ceqanet.opr.ca.gov/Project/2016032048 (Accessed: July 2019).

California State Parks Division of Boating and Water Ways. 2019. Public Notices for AIS Treatment. http://dbw.parks.ca.gov/?page_id=29465 (Accessed: July 2019).

California Trout Inc. 2019. Knaggs Ranch Agricultural Floodplain Study. Website. https://caltrout.org/our-work/steelhead-salmon/knaggs-ranch-agricultural-floodplain-study/ (Accessed: July 2019).

CalRecycle (California Department of Resources Recycling and Recovery). 2006. Targeted statewide waste characterization study: detailed characterization of commercial self-haul and drop-box waste. Sacramento. Prepared by Cascadia Consulting Group. Tiered Regulatory Placement Criteria.

CalTrans (California Department of Transportation). 2004. Transportation- and construction-induced vibration guidance manual. Prepared for California Department of Transportation Noise, Vibration, and Hazardous Waste Management Office by Jones & Stokes, Sacramento, CA. http://www.dot.ca.gov/hq/env/noise/pub/vibrationmanFINAL.pdf

CalTrans. 2009. Technical noise supplement. Prepared for California Department of Transportation Division of Environmental Analysis by ICF Jones & Stokes, Sacramento, CA. http://www.dot.ca.gov/hq/env/noise/pub/tens_complete.pdf

CalTrans. 2010. State Route 84 Corridor System Management Plan. CalTrans District 4, CA. https://dot.ca.gov/programs/transportation-planning/multi-modal-system-planning/system-plan

CalTrans. 2019. District 3 Current Projects. Website. https://dot.ca.gov/caltrans-near-me/district-3 (Accessed: July 2019).

CARB (California Air Resources Board). 2005. Air Quality and Land Use Handbook: A Community Health Perspective. California Environmental Protection Agency, California Air Resources Board, CA. https://ww3.arb.ca.gov/ch/handbook.pdf

CARB. 2013. National and California ambient air quality standards. CA. http://www.arb.ca.gov/research/aaqs/aaqs2.pdf

CARB. 2015. Aerometric data analysis and management. CA. http://www.arb.ca.gov/adam/

CARB. 2016. Ambient Air Quality Standards. CA. https://www.arb.ca.gov/research/aaqs/aaqs2.pdf

CARB. 2017. Area Designations (Activities and Maps). CA. https://www.arb.ca.gov/desig/changes.htm#summaries

Carlson, P. 2015. Personal Communication. E-mail from P. Carlson (Associate Right of Way Agent, DWR) to G. Benigno (Environmental Scientist, DWR). March 26, 2015.

Carpenter, R. S., J. F. Kitchell, and J. R. Hodgson. 1985. Cascading trophic interactions and lake productivity. BioScience 35: 634–639. DOI: https://doi.org/10.2307/1309989

Casper, B. M., A. N. Popper, F. Matthews, T. J. Carlson, and M. B. Halvorsen. 2012. Recovery of barotrauma injuries in Chinook salmon, *Oncorhynchus tshawytscha*, from exposure to pile driving sound. PLOS ONE 7(6): e39593. DOI: https://doi.org/10.1371/journal.pone.0039593

cbec and WWR (cbec and Wetlands and Water Resources). 2012. Prospect Island tidal habitat restoration project overflow weir design. Prepared for

California Department of Water Resources. Technical Memorandum. San Rafael, CA.

CCAA (California Clean Air Act). 1988. Division 26 Air Resources, Health and Safety Code. https://arb.ca.gov/bluebook/bb05/HEA[14]16/HEA_[14]_16.htm

CDFG (California Department of Fish and Game). 1977. Miner Slough Management Plan. CDFG Region 2. Solano County, CA.

CDFG. 1994. Staff report regarding mitigation for impacts to Swainson's Hawks (*Buteo swainsoni*) in the Central Valley of California. Memorandum to CDFG Division Chiefs and Regional Managers from R. Rempel. Sacramento, CA.

CDFG. 2005a. California Department of Fish and Game project review guidelines for delta smelt, winter-run Chinook salmon, and spring-run Chinook salmon protection in the Sacramento-San Joaquin Estuary. Prepared by California Department of Fish and Game, Central Valley Bay-Delta Branch, CA.

CDFG. 2005b. The status of rare, threatened, and endangered plants and animals of California 2000-2004. Species Accounts – Fishes. California Department of Fish and Game. https://www.dfg.ca.gov/wildlife/nongame/t_e_spp/new_te_rpt.html

CDFG and Yolo Basin Foundation. 2008. Yolo Bypass Wildlife Area Land Management Plan. Prepared in association with EDAW. Davis, CA.

CDFW (California Department of Fish and Wildlife). 2013. Lindsey Slough Tidal Marsh Wetland Enhancement Project. Initial study and mitigated negative declaration. Prepared by Life Science!

CDFW. 2014a. Striped Bass Study and Sturgeon Study. Website. https://www.wildlife.ca.gov/Regions/3 (Accessed April 2014 and July 2019).

CDFW. 2014b. Fall Midwater Trawl status and trends graph. Website. http://www.dfg.ca.gov/delta/data/fmwt/Indices/sld003.asp (Accessed July 2019).

CDFW. 2014c. California Natural Diversity Data Base. RareFind (computer application). Sacramento, CA. https://www.wildlife.ca.gov/Data/CNDDB (Accessed: July 2019).

CDFW. 2019. Hill Slough Restoration Project Phase I – Preliminary Restoration Design, Environmental Documentation and Permitting. Website. http://www.dfg.ca.gov/ERP/erp_proj_hill_slough.asp (Accessed: July 2019)

CDPH (California Department of Public Health). 2011. Western black-legged tick (*Ixodes pacificus)* collection locations, California. Vector borne disease section. CA.

CDPR (California Department of Pesticide Regulation). 2013. Pesticide Registration Chemical/Label Database, Sacramento, CA.

CGS (California Geological Survey). 2010a. Fault activity map of California. Compilation and interpretation by C. W. Jennings and W. A. Bryant, with assistance from G. Saucedo. California Geologic Data Map Series, Map No. 6. Scale 1:750,000. http://www.consrv.ca.gov/cgs/cgs_history/Pages/2010_faultmap.aspx.

CGS. 2010b. Geologic map of California. Original compilation by C. W. Jennings; updated by C. Gutierrez, W. Bryant, G. Saucedo, and C. Wills. California Geologic Data Map Series, Map No. 2. Scale 1:750,000. http://www.consrv.ca.gov/cgs/cgs_history/Pages/2010_geologicmap.aspx.

CGS. 2013. Probabilistic Seismic Hazards Assessment (PSHA), ground motion map. PSHA Model 2002, revised April 2003. http://redirect.conservation.ca.gov/cgs/rghm/pshamap/pshamap.asp

Choe, K.-Y., G. A. Gill, and R. Lehman. 2003. Distribution of particulate, colloidal, and dissolved mercury in San Francisco Bay estuary. 1. Total mercury. Limnology and Oceanography 48: 1535-1546. DOI: https://doi.org/10.4319/lo.2003.48.4.1535

Choe, K.-Y., and G. A. Gill. 2003. Distribution of particulate, colloidal, and dissolved mercury in San Francisco Bay estuary. 2. Monomethyl mercury. Limnology and Oceanography 48: 1547-1556. DOI: https://doi.org/10.4319/lo.2003.48.4.1547

City of West Sacramento. 2013. Port of West Sacramento business plan. March 2013. Sacramento, CA. http://www.cityofwestsacramento.org/documents/port/PortBusinessPlan.pdf

City of West Sacramento. 2019. Flood Protection. Website. https://www.cityofwestsacramento.org/government/departments/community-development/flood-protection (Accessed: July 2019).

Clarke, C. W., and J. E. Shelbourn. 1985. Growth and development of seawater adaptability by juvenile fall Chinook salmon (*Oncorhynchus tshawytscha*) in relation to temperature. Aquaculture 45: 21-31. DOI: https://doi.org/10.1016/0044-8486(85)90255-8

Clinkenbeard, J. P. 2012. Aggregate sustainability in California: fifty-year aggregate demand compared to permitted aggregate reserves. California Geological Survey Map Sheet 52. http://www.conservation.ca.gov/cgs/information/publications/ms/Documents/MS_52_2012.pdf

CNPS. 2014. Inventory of Rare and Endangered Plants. Online database. http://www.rareplants.cnps.org/ (Accessed: July 2019).

Coastal and Ocean Working Group of the California Climate Action Team. 2013. State of California sea-level rise guidance document. Report developed by the Coastal and Ocean Working Group of the California Climate Action Team with science support provided by the Ocean Protection Council's Science Advisory Team and the California Ocean Science Trust. March 2013 update. http://www.opc.ca.gov/webmaster/ftp/pdf/docs/2013_SLR_Guidance_Update_FINAL1.pdf

Comrack, L. A. 2008. Yellow-breasted chat (*Icteria virens*). Pages 351-358 *in* W. D. Shuford and T. Gardali, editors. California bird species of special concern: a ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of western birds no. 1. Western Field Ornithologists, Camarillo, CA and California Department of Fish and Game, Sacramento, CA.

Contra Costa County. 2019. Recycling. Website. http://www.co.contra-costa.ca.us/4911/Recycling (Accessed: July 2019).

Cramer, S. S., and D. B. Demko. 1996. The status of late-fall and spring chinook salmon in the Sacramento River basin regarding the Endangered Species Act. Special Report. Prepared on behalf of Association of California Water Agencies and California Urban Water Agencies. CA.

Crawford, H. S., R. G. Hooper, and R. W. Titterington. 1981. Song bird population response to silvicultural practices in central Appalachian hardwoods. Journal of Wildlife Management 45: 680–692. DOI: https://doi.org/10.2307/3808701

Cubasch, U., D. Wuebbles, D. Chen, M. C. Facchini, D. Frame, N. Mahowald, and J.-G. Winther. 2013. Introduction. Pages 119-158 *in* T. F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P. M. Midgley, editors. Climate change 2013: The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York.

Cummings, K. S and D. L. Graf. 2010. Mollusca: bivalvia. Pages 309-384 *in* J. H. Thorp, and A. P. Covich, editors. Ecology and classification of North American freshwater invertebrates. Academic Press, New York. DOI: https://doi.org/10.1016/B978-0-12-374855-3.00011-X

CVRWQCB (Central Valley Regional Water Quality Control Board). 2000. Salinity: A literature summary for developing water quality objectives (Draft). Central Valley Regional Water Quality Control Board, January. http://www.waterboards.ca.gov/centralvalley/water_issues/swamp/historic_reports_and_faq_sheets/info_supt_rec_guidelines/davis2000_salinity_litsum_ar07019.pdf

CVRWQCB 2011. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region. Fourth edition (revised October 2011). http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans

CVRWQCB (Central Valley Regional Water Quality Control Board), CDFW (California Department of Fish and Wildlife), and Delta Protection Commission. 2002. Delta dredging and reuse strategy. Volume I. Sacramento, CA.

Davis, J. N., and C. A. Niemela. 2008. Northern Harrier (*Circus cyaneus*). Pages 149-155 *in* W. D. Shuford and T. Gardali, editors. California bird species of special concern: a ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of

Western Birds 1. Western Field Ornithologists, Camarillo, CA, and California Department of Fish and Game, Sacramento, CA.

Dawson, T. E. 2009. Preliminary geologic map of the Lodi 30' x 60' quadrangle, California. California Geological Survey. Scale 1:100,000. ftp://ftp.consrv.ca.gov/pub/dmg/rgmp/Prelim_geo_pdf/Lodi_100K_prelim.pdf

Delta Protection Commission. 2010. Delta Land Use and Resource Management Plan for the primary zone of the Delta. Adopted February 25. CA.

Delta Research Station. 2019. Environmental Review Process for the Delta Research Station. Website. http://www.deltaresearchstation.com/Review.html (Accessed: July 2019).

Dettinger, M., J. Anderson, M. Anderson, L.R. Brown, D. Cayan, and E. Maurer. 2016. Climate Change and the Delta. San Francisco Estuary and Watershed Science, 14(3). DOI: https://doi.org/10.15447/sfews.2016v14iss3art5.

Deverel, S. J., and D. A. Leighton. 2010. Historic, recent and future subsidence, Sacramento-San Joaquin Delta, California, USA. San Francisco Estuary and Watershed Science 8(2). DOI: https://doi.org/10.15447/sfews.2010v8iss2art1

DOGGR (California Division of Oil, Gas, and Geothermal Resources). 1992. Penetration chart –gas fields of the Sacramento Valley. Publication No. TR44. California Resources Agency, Department of Conservation, Division of Oil, Gas, and Geothermal Resources.

DOGGR. 2007. Well review program: introduction and application. California Resources Agency, Department of Conservation, Division of Oil, Gas, and Geothermal Resources.

DOGGR. 2011. Development, regulation, and conservation of oil and gas resources. Chapter 4 *in* California Code of Regulations. California Resources Agency, Department of Conservation, Division of Oil, Gas, and Geothermal Resources. ftp://ftp.consrv.ca.gov/pub/oil/regulations/PRC04_January_11.pdf

DOGGR. 2014. Well Finder Web Viewer. California Resources Agency, Department of Conservation, Division of Oil, Gas, and Geothermal Resources. http://maps.conservation.ca.gov/doggr/index.html

Domagalski, J. L. 1998. Occurrence and transport of total mercury and methyl mercury in the Sacramento River Basin, California. Journal of Geochemical Exploration 64: 277–291. DOI: https://doi.org/10.1016/S0375-6742(98)00038-7

Domagalski, J. 2001. Mercury and methylmercury in water and sediment of the Sacramento River Basin, California. Applied Geochemistry 16: 1677-1691. DOI: https://doi.org/10.1016/S0883-2927(01)00068-3

DOT (U.S. Department of Transportation). 2006. Transit noise and vibration impact assessment. Federal Highway Administration. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Noise_and_Vibration_Manual.pdf

Downs, J. 2014. Personal Communication. Senior Environmental Scientist (CDFW). Prospect Island VELB Survey Report. June 17, 2014.

DPR (California Department of Parks and Recreation). 1976. California Inventory of Historic Resources. Sacramento, CA.

DPR. 2011. Recreation proposal for the Sacramento-San Joaquin Delta and Suisun Marsh. Sacramento, CA.

Drexler, J. Z. 2011. Peat formation processes through the millennia in tidal marshes of the Sacramento-San Joaquin Delta, California, USA. Estuaries and Coasts 34: 900–911. DOI: https://doi.org/10.1007/s12237-011-9393-7

DSC (Delta Stewardship Council). 2013. Protect and enhance the unique cultural, recreational, natural resource, and agricultural values of the California Delta as an evolving place. Chapter 5 *in* Delta Plan. Adopted May 16, 2013. Sacramento, CA. http://deltacouncil.ca.gov/sites/default/files/documents/files/CH_05_2013.pdf

DTSC (California Department of Toxic Substance Control) 2015. EnviroStor map of Prospect Island vicinity. http://www.envirostor.dtsc.ca.gov/public/ (Accessed: February 18, 2015).

Dunk, J. R. 1995. White-tailed Kite (*Elanus leucurus*). *In* A. Poole, editor. The Birds of North America Online. Cornell Lab or Ornithology, Ithaca. Retrieved from the Birds of North America: http://bna.birds.cornell.edu/bna/species/178. DOI: https://doi.org/10.2173/bna.178

DWR (California Department of Water Resources). 1996. Water quality conditions in the Sacramento-San Joaquin Delta 1970-1993. Report to the State Water Resources Control Board in Accordance with Water Rights Decision 1485, Order 4(f). Sacramento, CA.

DWR. 2003. California's Groundwater. Bulletin 118. http://www.water.ca.gov/groundwater/bulletin118/bulletin118update2003.cfm.

DWR. 2004. Methodology for flow and salinity estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. Twenty-Fifth Annual Progress Report to the State Water Resources Control Board. CA.

DWR. 2008. Mein's Landing habitat enhancement/mitigation. Interim Delta Actions, Sacramento, CA. https://water.ca.gov/LegacyFiles/deltainit/docs/6-16-08Meins.pdf

DWR. 2009. Prospect Island natural gas wells; evaluation of potential environmental threat. Memorandum. Brent Lamkin, Senior Engineering Geologist, DWR-DOE-Project Geology Section.

DWR. 2012a. Prospect Island chain of title. DWR Cadastral Unit.

DWR. 2012b. Status of levee heights for Delta islands. Memorandum prepared for the Delta Stewardship Council by Dave Mraz, DWR, Delta Levees and Environmental Engineering Branch. http://deltacouncil.ca.gov/delta-maps

DWR. 2012c. Initial study and draft negative declaration. California Department of Water Resources Draft Climate Action Plan Phase 1: Greenhouse Gas Emissions Reduction Plan.

DWR. 2013a. Notice of preparation of a draft environmental impact report, Prospect Island Tidal Habitat Restoration Project. Sacramento, CA.

DWR. 2013b. Site Characterization and Groundwater Monitoring Data Collection Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum Report. DWR, North Central Region Office.

DWR. 2014a. Preliminary Wetland Delineation for the Prospect Island Tidal Habitat Restoration Project, Solano County, California. Final Report August 2014. Prepared by Stillwater Sciences, Davis, CA. Contract No. 4200009291.

DWR. 2014b. Site Characterization and Groundwater Monitoring Data Analysis Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, CA. Memorandum Report. DWR, North Central Region Office.

DWR 2014c. Botanical Survey Report for the Prospect Island Tidal Habitat Restoration Project. Prepared by Lesley Hamamoto – Senior Environmental Scientist. Solano County, CA.

DWR. 2014d. Phase I Environmental Site Assessment. Fish Restoration Program Agreement – South Prospect Island Acquisition. Solano County, CA.

DWR. 2014e. Prospect Island Title Report Map. Exhibit Maps – Drawing Number K-9D-21 and K-9D-44.

DWR. 2015. Temporary Barriers Program Home. Temporary Barriers Project. South Delta Branch, Bay-Delta Office. http://baydeltaoffice.water.ca.gov/sdb/tbp/index_tbp.cfm

DWR. 2018. Prospect and Ryer Island Hydrologic Data Analysis, October 1, 2013 to April 1, 2017, Prospect Island Tidal Habitat Restoration Project, Solano County, CA. Memorandum Report. DWR, North Central Region Office.

DWR. 2019a. Delta Projects. Website. https://water.ca.gov/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects (Accessed: July 2019).

DWR. 2019b. Dutch Slough Tidal Restoration Project. Website. https://water.ca.gov/Programs/Integrated-Regional-Water-Management/Delta-Ecosystem-Enhancement-Program/Dutch-Slough-Tidal-Restoration-Project (Accessed: July 2019).

DWR. 2019c. Suisun Projects. Website. https://water.ca.gov/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Suisun-Projects (Accessed: July 2019).

DWR. 2019d. Lower Elkhorn Basin Levee Setback Project. Website. https://water.ca.gov/Programs/Flood-Management/Flood-Projects/Lower-Elkhorn-Basin (Accessed: July 2019).

DWR. 2019e. Delta Conveyance. Website. https://water.ca.gov/deltaconveyance (Accessed: July 2019).

DWR. 2019f. Central Valley Flood Protection Plan. Website. https://water.ca.gov/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan (Accessed: July 2019).

DWR. 2019g. WSIHIST (05/09/19 0746). Website. http://cdec.water.ca.gov/cgi-progs/iodir_ss/wsihist (Accessed: July 2019).

DWR. 2019h. Welcome to California Data Exchange Center. Website. http://cdec.water.ca.gov/ (Accessed: July 2019).

DWR. 2019i. Water Data Library. Website (web-based application). http://wdl.water.ca.gov/waterdatalibrary/ (Accessed: July 2019).

DWR. 2019j. Comparison of MCLs and PHGs for Regulated Contaminants in Drinking Water. Website. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/MCLsandPHGs.html (Accessed: July 2019).

DWR. 2019k. California Data Exchange Center: Miner Slough at HWY 84 Bridge. Website. http://cdec.water.ca.gov/dynamicapp/staMeta?station_id=HWB (Accessed: July 2019).

DWR. 2019l. Climate Change Program. Website. https://water.ca.gov/Programs/All-Programs/Climate-Change-Program (Accessed: July 2019).

DWR and California State Coastal Conservancy. 2008. Dutch Slough Tidal Marsh Restoration Project. Draft Environmental Impact Report. Prepared for DWR, Sacramento, CA, and the California State Coastal Conservancy, Oakland, CA. Prepared by Grassetti Environmental Consulting, Berkeley, CA. SCH# 2006042009. http://www.water.ca.gov/floodsafe/fessro/environmental/dee/docs/DS_DEIR_CoverExecSum.pdf

DWR and California State Coastal Conservancy. 2014. Dutch Slough Tidal Marsh Restoration Project. Final Supplemental Environmental Impact Report. Prepared for DWR, Sacramento, CA, and the California State Coastal Conservancy, Oakland, CA. Prepared by Grassetti Environmental Consulting, Berkeley, CA. SCH# 2006042009. http://www.water.ca.gov/floodsafe/fessro/environmental/dee/docs/DS_FinalSEIR_FullDoc.pdf

DWR and CDFG (California Department of Water Resources and California Department of Fish and Game). 2008. Risks and options to reduce risks to fishery and water supply uses of the Sacramento/San Joaquin Delta. A report pursuant to requirements of Assembly Bill 1200, Laird.

DWR and CDFW (California Department of Water Resources and California Department of Fish and Wildlife). 2014. Prospect Island Tidal Habitat Restoration Project: Conceptual Restoration Plan. Prepared by DWR and CDFW, Sacramento, CA, with assistance from Stillwater Sciences, Davis, CA and Wetlands and Water Resources, Inc., San Rafael, CA. Contract No. 4200009291.

DWR and USBR (California Department of Water Resources and U.S. Bureau of Reclamation). 2016. Final Environmental Impact Report/Environmental Impact Statement for the Bay Delta Conservation Plan/California WaterFix. Final EIR/EIS for the BDCP/California WaterFix. December. (DOE/EIS-0515.) (ICF 00139.14.) Prepared by ICF International, Sacramento, CA. http://baydeltaoffice.water.ca.gov/sdb/bdcp/index_bdcp.cfm

eBird. 2013. Online database for California. Audubon California, PRBO, and the Cornell Lab of Ornithology. https://ebird.org/home (Accessed: July 2019).

Eckerle, K. P., and C. F. Thompson. 2001. Yellow-breasted Chat (*Icteria virens*), *In* A. Poole, editor. The Birds of North America Online. Cornell Lab of Ornithology, Itheca, NY. DOI: https://doi.org/10.2173/bna.575

Eddleman, W. R., R. E. Flores, and M. L. Legare. 1994. Black Rail (*Laterallus jamaicensis*). *In* A. Poole and F. Gill, editors. The Birds of North America, No. 123. Philadelphia: The Academy of Natural Sciences, Philadelphia, Pennsylvania and The American Ornithologists' Union, Washington, D.C. DOI: https://doi.org/10.2173/bna.123

Ekstrom, J. A., and S. C. Moser. 2012. Climate change impacts, vulnerabilities, and adaptation in the San Francisco Bay area: a synthesis of PIER Program reports and other relevant research. Publication CEC-500-2012-071. California Energy Commission. http://www.energy.ca.gov/2012publications/CEC-500-2012-071/CEC-500-2012-071.pdf

ESA (Endangered Species Act). 1973. United States Code Title 16 – Conservation, Chapter 35 – Endangered Species, Section 15131 *et seq*. USFWS and NMFS. https://www.fws.gov/international/pdf/esa.pdf (Accessed: July 2019).

England, A. S., M. J. Bechard, and C. S. Houston. 1997. Swainson's Hawk (*Buteo swainsoni*) *in* A. Poole and F. Gill, editors. The birds of North America, No. 265. The American Ornithologists' Union, Washington, D.C. DOI: https://doi.org/10.2173/bna.265

FCAA (Federal Clean Air Act). 1963. United States Code Title 42 – The Public Health and Welfare, Chapter 85 – Air Pollution Prevention and Control. https://legcounsel.house.gov/Comps/Clean%20Air%20Act.pdf

Federal Interagency Committee on Noise. 1992. Federal agency review of selected airport noise analysis issues.

Feyrer, F., T. R. Sommer, and R. D. Baxter. 2005. Spatial-temporal distribution and habitat associations of age-0 splittail in the lower San Francisco Estuary watershed. Copeia 5: 159-168. DOI: https://doi.org/10.1643/CE-04-187R1

Fischenich, C. 2001. Stability thresholds for stream restoration materials. ERDC Technical Note EMRRP-SR-29. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Fisheries Hydroacoustic Working Group. 2008. Agreement in principle for interim criteria for injury to fish from pile driving activities. Memorandum.

Fitzgerald, W. F., D. R. Engstrom, R. P. Mason, and E. A. Nater. 1998. The case for atmospheric mercury contamination in remote areas. Environmental Science and Technology 32: 1-7. DOI: https://doi.org/10.1021/es970284w

Fonss, J. 2014. Personal communication. Owner, Arrowhead Harbor Marina. Conversation with Douglas Rischbieter, Senior Environmental Scientist, California Department of Water Resources.

Gardali, T. 2008. Song sparrow (*Melospiza melodia*) ("Modesto" population). Pages 400-404 *in* W. D. Shuford and T. Gardali, editors. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, CA, and California Department of Fish and Game, Sacramento, CA.

Garza, J. C., and D. E. Pearse. 2008. Population genetic structure of *Oncorhynchus mykiss* in the California Central Valley. Final Report for California Department of Fish and Game Contract PO485303.

Gilmour, C. C., E. A. Henry, and R. Mitchell. 1992. Sulfate stimulation of mercury methylation in freshwater sediments. Environmental Science and Technology 26: 2281–2287. DOI: https://doi.org/10.1021/es00035a029

Google Earth. 2014. Prospect Island (38° 16'10.35"N; 121° 39'11.76"W). June 1993 aerial imagery. (Accessed May 2014).

Graymer, R. W., B. C. Moring, G. J. Saucedo, C. M. Wentworth, E. E. Brabb, and K. L. Knudsen. 2006. Geologic map of the San Francisco Bay region. U.S. Geological Survey Scientific Investigations Map 2918. http://pubs.usgs.gov/sim/2006/2918/ DOI: https://doi.org/10.3133/sim2918

Grimaldo, L., and Z. Hymanson. 1999. What is the impact of the introduced Brazilian waterweed *Egeria densa* to the Delta ecosystem? Interagency Ecological Program for the San Francisco Estuary Newsletter 12(1).

Hagen, C. 2014. Personal Communication. Wildlife Habitat Supervisor (CDFW), Stockton. Conversation with Douglas Rischbieter, California Department of Water Resources. September 22, 2014.

Hagen, C. 2015. Personal communication. Wildlife Habitat Supervisor, California Department of Fish and Wildlife. Stockton. Conversation with Donald Guy, California Department of Water Resources. March 18, 2015.

Hanak, E., J. Lund, A. Dinar, B. Gray, R. Howitt, J. Mount, P. Moyle, and B. Thompson. 2011. Managing California's water: from conflict to reconciliation. Public Policy Institute of California, San Francisco. http://www.ppic.org/content/pubs/report/R_211EHR.pdf

Hansen, G. E. 1986. Status of the giant garter snake *Thamnophis couchii gigas* (Fitch) in the southern Sacramento Valley during 1986. Final report. Standard Agreement No. C-1433. Prepared for California Department of Fish and Game, Sacramento, CA.

Hansen, G. E. 1988. Review of the status of the giant garter snake (*Thamnophis couchi gigas*) and its supporting habitat during 1986-1987. Final report. Contract C-2060. Prepared for California Department of Fish and Game.

Hansen, G. E., and J. M. Brode. 1980. Status of the giant garter snake, *Thamnophis couchi gigas*. Special Publication Report No. 80-5. California Department of Fish and Game, Inland Fisheries Endangered Species Program.

Hansen, G. E., and J. M. Brode. 1993. Results of relocating canal habitat of the giant garter snake (*Thamnophis gigas*) during widening of SR 99/70 in Sacramento and Sutter Counties, California. Interagency Agreement 03E325 (FG7550) (FY 87/88-91-92). Final report for CalTrans.

Hanson, C. H. 1997. Acute temperature tolerance of juvenile Chinook salmon from the Mokelumne River. Hanson Environmental Inc.

Harden, D. R. 2004. California geology. Second edition. Pearson Education. Upper Saddle River, New Jersey.

Heath, S. 1998. Yellow Warbler (*Dendroica petechia*). *In* The riparian bird conservation plan: a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight. Point Reyes Bird Observatory, Stinson Beach, CA.

Heath, S. K. 2008. Yellow Warbler (*Dendroica petechia*). Pages 332-339 *in* W. D. Shuford and T. Gardali, editors. California bird species of special concern: a ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of western birds no. 1. Western Field Ornithologists, Camarilla, CA and California Department of Fish and Game, Sacramento, CA.

Helley, E. J., K. R. Lajoie, W. E. Spangle, and M. L. Blair. 1979. Flatland deposits of the San Francisco Bay region, California – their geology and engineering properties, and their importance to comprehensive planning. U.S. Geologic Survey Professional Paper 943. DOI: https://doi.org/10.3133/pp943

Hester, M. W., J. M. Willis, and T. M. Sloey. 2013. Insights into colonization and expansion dynamics of tule marsh at Liberty Island, California. Presentation. Final products meeting for Breach III: evaluating and predicting 'restoration thresholds' in evolving freshwater-tidal marshes. https://sites.google.com/a/uw.edu/breach-iii/emerging-products/presentations

Holland, R. F. 1994. The western pond turtle: habitat and history. Final Report DOE/BP-62137-1. Bonneville Power Administration and Oregon Department of Fish and Wildlife, Wildlife Diversity Program, Portland, OR.

Hopf, F. 2011. Levee Failures in the Sacramento San-Joaquin River Delta: Characteristics and perspectives. Doctoral dissertation. Geology Department, Texas A&M, College Station, TX.

Hussey, B. H., and W. E. Odum. 1992. Evapotranspiration in tidal marshes. Estuaries 15: 59-67. DOI: https://doi.org/10.2307/1352710

IEP TWM PWT (Interagency Ecological Program Tidal Wetlands Monitoring Project Work Team). 2017. Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary, Version 1.0. https://water.ca.gov/LegacyFiles/iep/docs/tidal_wetland_monitoring_framework_upper_sfe_v1.pdf (Accessed: July 2019).

Isaac, J. 2014. Personal communication. OES Office Assistant III, Solano County OES. Call from Michele King, Grassetti Environmental Consultants. March 5, 2014.

Jackson, Z. J., and J. P. Van Eenennaam. 2013. 2012 San Joaquin River sturgeon spawning survey. Final Annual Report. U. S. Fish and Wildlife Service, Stockton Fish and Wildlife Office, Anadromous Fish Restoration Program, Lodi.

Jaramillo, A. 2008. Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*). *In* D. Shuford and T. Gardali, editors. California bird species of special concern.

Studies of Western Birds No. 1. Western Field Ornithologists, Camarillo, CA and California Department of Fish and Game, Sacramento, CA.

Jassby, A. D., J. E. Cloern, and B. E. Cole. 2002. Annual primary production: patterns and mechanisms of change in a nutrient-rich tidal ecosystem. Limnology and Oceanography 47: 698-712. DOI: https://doi.org/10.4319/lo.2002.47.3.0698

Jennings, M. R., and M. P. Hayes. 1994. Amphibian and reptile Species of Special Concern in California. California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova.

Jennings, M. R., M. P. Hayes, and D. C. Holland. 1992. A petition to the U.S. Fish and Wildlife Service to place the California red-legged frog (*Rana aurora draytonii*) and the western pond turtle (*Clemmys marmorata*) on the list of endangered and threatened wildlife and plants. Department of Herpetology, California Academy of Science, San Francisco, California and Department of Biology, University of Southwestern Louisiana, Lafayette.

Junk, W. J., P. B. Bayley, and R. E. Sparks. 1989. The flood pulse concept in river-floodplain systems. *In* D. P. Dodge, editor. Proceedings of the international large river symposium. Canadian Special Publication of Fisheries and Aquatic Science 106: 110-127.

Katz, J., C. Jeffres., L. Conrad., T. Sommer., N. Corline., J. Martinez., S. Brumbaugh., L. Takata., N., Ikemiyagi., J. Kiernan., and P. Moyle. 2013. The Experimental Agricultural Floodplain Habitat Investigation at Knaggs Ranch on Yolo Bypass 2012-2013. Preliminary Report to US Bureau of Reclamation, October 1, 2013. CalTrout, Davis, CA, and California Department of Water Resources. In cooperation with landowner partners Cal Marsh and Farm Ventures, LLC and Knaggs Ranch, LLC, with additional support from the NOAA Southwest Fisheries Science Center and California Department of Fish and Wildlife. https://watershed.ucdavis.edu/files/biblio/Knaggs%202013%20final%20BOR%20report_0.pdf (Accessed: July 2019).

Kerin, E. J., C. C. Gilmour, E. Roden, M. T. Suziki, J. D. Coates, and R. P. Mason. 2006. Mercury methylation by dissimilatory iron-reducing bacteria. Applied and Environmental Microbiology 72: 7919-7921. DOI: https://doi.org/10.1128/AEM.01602-06

Kinnetic Laboratories, Inc. 2015. Sampling and Analysis Plan – Evaluation of Miner Slough Spur Channel Dredge Material, Prospect Island Tidal Habitat Restoration Project. Prepared for California Department of Water Resources. Contract No. C51464. Kinnetic Laboratories, Inc., Santa Cruz, CA.

Kinnetic Laboratories, Inc. 2016a. Sediment Testing Results for Prospect Island. Letter to Joseph Heavin, Hultgren-Tillis Engineers. Prepared by Kinnetic Laboratories, Inc., Santa Cruz, CA.

Kinnetic Laboratories, Inc. 2016b. Evaluation of Miner Slough Spur Channel Dredge Material, Prospect Island Tidal Habitat Restoration Project. Sampling and Analysis Report. Contract No. C51464. Kinnetic Laboratories, Inc., Santa Cruz, CA.

Klimley A. P., P. J. Allen, J. A. Israel, and J. T. Kelly. 2007. The green sturgeon and its environment: introduction. Environmental Biology of Fishes 79: 187-190. DOI: https://doi.org/10.1007/s10641-006-9155-8

Kramer-Wilt, E. 2010. Habitat preferences and interactions with macrobenthos of the non-indigenous Asian clam, *Corbicula fluminea*, in a restoring freshwater tidal marsh, Sacramento River delta. Doctoral dissertation. University of Washington, Seattle.

Kroodsma, R. L. 1982. Bird community ecology on power-line corridors in east Tennessee. Biological Conservation 23: 79-94. DOI: https://doi.org/10.1016/0006-3207(82)90032-5

Kus, B. 2004. Least Bell's Vireo (*Vireo bellii pusillus*). Pages 58–59 *in* T. Gardali, B. Rocco, K. Kreitinger, S. Scoggin, and V. Tonoilo, editors. The riparian bird conservation plan: a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/pdfs/riparian_v-2.pdf

L and D Landfill. 2019. L and D Landfill – Home. Website. https://www.landdlandfill.com (Accessed: July 2019).

Land Trust Alliance. 2019. For Land Trusts: Climate Change. Website. https://www.landtrustalliance.org/topics/climate-change (Accessed August 2019).

LaSalle, M., D. Clarke, J. Homziak, J. D. Lunz, and J. Fredette. 1991. A framework for assessing the need for seasonal restrictions on dredging and disposal operations. Technical Report D-91-1. Prepared for U.S. Army Corp of Engineers, Vicksburg, MS. DOI: https://doi.org/10.21236/ADA240567

Lee, P., D. Bosworth., J. Manning. 2015. Progress Report – Delta Mercury Control Program: methylmercury import and export studies of tidal wetlands in the Sacramento-San Joaquin Delta, Yolo Bypass, and Suisun Marsh. California Department of Water Resources. Sacramento, CA.

Li, H., and S. L. Yang. 2009. Trapping effect of tidal marsh vegetation on suspended sediment, Yangtze Delta. Journal of Coastal Research 25: 915-924. DOI: https://doi.org/10.2112/08-1010.1

Lopez, C. B., J. E. Cloern, T. S. Schraga, A. J. Little, L. V. Lucas, J. K. Thompson, and J. R. Burau. 2006. Ecological values of shallow-water habitats: implications for the restoration of disturbed ecosystems. Ecosystems 9: 422-440. DOI: https://doi.org/10.1007/s10021-005-0113-7

Lowther, P. E., C. Celada, N. K. Klein, C. C. Rimmer, and D. A. Spector. 1999. Yellow Warbler (*Dendroica petechia*). Account No. 26 *in* A. Poole and F. Gill, editors. The birds of North America. Academy of Natural Sciences, Philadelphia, PA, and American Ornithologists' Union, Washington, DC. DOI: https://doi.org/10.2173/bna.454

Lowther, P., A. F. Poole, J. P. Gibbs, S. Melvin, and F. A. Reid. 2009. American Bittern (*Botaurus lentiginosus*). *In* A. Poole, editor. The Birds of North America online. Ithaca: Cornell Lab of Ornithology, Ithaca, New York. http://bna.birds.cornell.edu/bna/species/018doi:10.2173/bna.18 DOI: https://doi.org/10.2173/bna.18

Lucas, L. V., and J. K. Thompson. 2012. Changing restoration rules: Exotic bivalves interact with residence time and depth to control phytoplankton productivity. Ecosphere 3(12): Article 117. DOI: https://doi.org/10.1890/ES12-00251.1

Lundvall, D., R. Svanback, L. Persson, and P. Bystrom. 1999. Size-dependent predation in piscivores: interactions between predator foraging and prey avoidance abilities. Canadian Journal of Fisheries and Aquatic Sciences 56: 1285-1292. DOI: https://doi.org/10.1139/cjfas-56-7-1285

MacWhirter, R. B., and K. L. Bildstein, 1996. Northern Harrier, *Circus cyaneus*. *In* A. Poole and F. Gill, editors. The birds of North America. Academy of Natural Sciences, Philadelphia, PA, and American Ornithologists' Union, Washington, DC. DOI: https://doi.org/10.2173/bna.210

MacWilliams M. L., and E. S. Gross. 2010. UnTRIM San Francisco Bay–Delta Model sea level rise scenario modeling report. Delta Conservation Plan. Prepared for Science Applications International Corporation and California Department of Water Resources. Final Report. 562 p.

Marshall, M. 2005. Delta juvenile fish monitoring project. Interagency Ecological Program Newsletter 18: 5-6.

Mattice, J. S., and L. L. Dye. 1975. Thermal tolerance of the adult Asiatic clam *Corbicula manilensis*. Oak Ridge National Laboratory, Environmental Sciences Division. CA.

Mecum, W. L. 2005. Neomysis and Zooplankton monitoring. Interagency Ecological Program Newsletter 18: 10-15.

Melhop, P., and J. F. Lynch. 1986. Bird/habitat relationships along a successional gradient in the Maryland Coastal Plain. American Midland Naturalist 116: 225-239. DOI: https://doi.org/10.2307/2425730

Melwani, A. R., S. N. Bezalel, J. L. Grenier, J. A. Hunt, A. H. Robinson, and J. A. Davis. 2007. The relationship between landscape features and sport fish mercury in the Sacramento–San Joaquin Delta watershed. SFEI Contribution 534. San Francisco Estuary Institute, Oakland, CA. http://www.sfei.org/sites/default/files/Final%20FMP%20Landscape%20Report.pdf

Mitchell, C. P. J., and C. C. Gilmour. 2008. Methylmercury production in a Chesapeake Bay salt marsh. Journal of Geophysical Research 113. G00C04. doi:10.1029/2008JG000765. DOI: https://doi.org/10.1029/2008JG000765

Mitchell, C. P. J., T. E. Jordan, A. Heyes, and C. C. Gilmour. 2012. Tidal exchange of total mercury and methylmercury between a salt marsh and a Chesapeake Bay sub-estuary. Biogeochemistry 111: 583-600. DOI: https://doi.org/10.1007/s10533-011-9691-y

Monsanto Company. 2012. AQUAMASTER® Herbicide. Material Safety Data Sheet. Version 3.1.

Morgan-King, T. L., and D. H. Schoellhamer. 2013. Suspended-sediment flux and retention in a backwater tidal slough complex near the landward boundary of an estuary. Estuaries and Coasts 36: 300–318. http://ca.water.usgs.gov/pubs/Morgan-KingSchoellhamer2012.pdf DOI: https://doi.org/10.1007/s12237-012-9574-z

Mount, J., and R. Twiss. 2005. Subsidence, sea level rise, and seismicity in the Sacramento–San Joaquin Delta. San Francisco Estuary and Watershed Science 3, Issue 1, Article 5. http://escholarship.org/uc/item/4k44725p. DOI: https://doi.org/10.15447/sfews.2005v3iss1art7

Moyle, P.B. 2002. Inland fishes of California. Revised and expanded. University of California Press, Berkeley and Los Angeles, CA.

Moyle, P. B., P. K. Crain, and K. Whitener. 2007. Patterns in the use of a restored California floodplain by native and alien fishes. San Francisco Estuary and Watershed Science 5(3). DOI: https://doi.org/10.15447/sfews.2007v5iss3art1

Moyle, P. B., R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. 1995. Fish species of special concern in California. Second edition. Prepared for California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, CA.

Myrick, C. A., and Cech, J. J., Jr. 2001. Temperature effects on Chinook salmon and steelhead: a review focusing on California's Central Valley populations. Bay Delta Modeling Forum Technical Publication 01(1).

National Audubon Society. 2013. Audubon Important Bird Areas. Sacramento-San Joaquin Delta Site Profile. http://netapp.audubon.org/iba/Site/229.

National Petroleum Council. 2011. Plugging and abandonment of oil and gas wells. Paper 2-25. Working document of the National Petroleum Council North American Resource Development Study. Prepared by Technology Subgroup of the Operations and Environment Task Group. http://www.npc.org/Prudent_Development-Topic_Papers/2-25_Well_Plugging_and_Abandonment_Paper.pdf

National Research Council. 2012. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. The National Academies Press. DOI: https://doi.org/10.17226/13389

NCSS (National Cooperative Soil Survey). 2012. Soil survey geographic (SSURGO) database. Google Earth-based mapping tool. http://casoilresource.lawr.ucdavis.edu/soilweb/

Newhart, K. 2013. Summary of new pesticide active ingredient use tracking for field monitoring in surface water from 2005-2010. CDPR, Environmental Monitoring Branch, Sacramento, CA.

NMFS (National Marine Fisheries Service). 1993. Designated critical habitat; Sacramento River winter-run Chinook salmon; Final Rule. Federal Register 58: 33213-33219.

NMFS. 1998. Essential fish habitat: new marine fish habitat conservation mandate for federal agencies. EFH Federal Agency Primer. NMFS, Northeast Region, Gloucester, MA.

NMFS. 1999. Endangered and threatened species: threatened status for two chinook salmon evolutionarily significant units (ESUs) in California, final rule. Federal Register 64: 50394-50415.

NMFS. 2005. Endangered and threatened species: designation of critical habitat for seven evolutionarily significant units of Pacific salmon and steelhead in California, final rule. Federal Register 70: 52488-52626.

NMFS. 2006a. Endangered and threatened species: final listing determination for 10 distinct population segments of West Coast steelhead, final rule. Federal Register 71: 834-862.

NMFS. 2006b. Endangered and threatened wildlife and plants: threatened status for the southern distinct population segment of North American green sturgeon, final rule. Federal Register 71: 17757-17766.

NMFS. 2009a. Biological opinion and conference opinion on the long-term operations of the Central Valley Project and the State Water Project. Prepared

for U.S. Bureau of Reclamation. National Marine Fisheries Service, Southwest Region, Long Beach, CA.

NMFS. 2009b. Endangered and threatened wildlife and plants: final rulemaking to designate critical habitat for the threatened southern distinct population segment of North American Green Sturgeon, final rule. Federal Register 74: 52300-52351.

NMFS. 2019. Long-Term Operations of the Central Valley Project and State Water Project. Website. https://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/ocap.html (Accessed: July 2019).

NOAA (National Oceanic and Atmospheric Administration). 2003. Computational techniques for tidal datums handbook. NOAA Special Publication NOS CO-OPS 2.

NOAA. 2014. Nautical chart 18662 California: Sacramento River Andrus Island to Sacramento, CA. http://www.charts.noaa.gov/OnLineViewer/18662.shtml

Nobriga, M. L., and F. Feyrer. 2007. Shallow-water piscivore-prey dynamics in California's Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science: 5(2). DOI: https://doi.org/10.15447/sfews.2007v5iss2art4

NPIC (National Pesticide Information Center). 2002. Triclopyr. General Fact Sheet. Oregon State University, Corvallis, OR. http://npic.orst.edu/factsheets/triclogen.pdf

NPS (National Park Service). 1997. Secretary of the Interior historic preservation professional qualifications standards. Federal Register 62: 33708-33723. U.S. Government Printing Office, Washington, D.C.

NRCS (Natural Resources Conservation Service). 2007. National Engineering Handbook Part 360: Hydrology. Chapter 7, Hydrologic soil groups. http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/?cid=stelprdb1043063

Nufarm Americas, Inc. 2012. POLARIS herbicide. Material Safety Data Sheet. http://www.cdms.net/LabelsMsds/LMDefault.aspx?pd=9189&t=

OHP (Office of Historic Preservation). 2012a. Archaeological determinations of eligibility. OHP, California Department of Parks and Recreation, Sacramento, CA.

OHP. 2012b. Historic property directory. OHP, California Department of Parks and Recreation, Sacramento, CA.

Oregon State University. 2002. Imazapyr pesticide fact sheet: forestry use. National Institute of Environmental Health Services. Corvallis, Oregon. Updated by W. Trevathan. http://cms.oregon.gov/ODF/privateforests/docs/imazapyr.pdf

Orr, M., S. Crooks, and P. Williams. 2003. Will restored tidal marshes be sustainable? San Francisco Estuary and Watershed Science 1(1). DOI: https://doi.org/10.15447/sfews.2003v1iss1art5

Orsi, J. J., and W. L. Mecum. 1996. Food limitations as the probable cause of a long-term decline in the abundance of *Neomysis mercedis* the opossum shrimp in the Sacramento-San Joaquin Estuary. Pages 375-401 *in* J. T. Hollibaugh, editor. San Francisco Bay: The ecosystem. San Francisco, California: Pacific Division, American Association for the Advancement of Science.

Palermo, M. R., J. Homziak, and A. M. Teeter. 1990. Evaluation of clamshell dredging and barge overflow, Military Ocean Terminal, Sunny Point, North Carolina. Technical Report D-90-6. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Parus Consulting. 2012. Cultural Resources Inventory and Effects Assessment for the Prospect Island Project, Solano County, CA. Northwest Information Center Report #S-039290. Prepared for Stillwater Sciences and California Department of Water Resources.

Parus Consulting. 2014. Shipwreck survey of a portion of Miner Slough for the Prospect Island Project, Solano County, CA. Prepared for California Department of Water Resources.

Perry, R. W., and J. R. Skalski. 2009. Migration and survival of juvenile Chinook salmon through the Sacramento–San Joaquin River Delta during the winter of 2007–2008. Technical Report. U.S. Fish and Wildlife Service, Stockton, CA. http://www.fws.gov/stockton/jfmp/datareports.asp

Perry, R. W., P. L. Brandes, J. R. Burau, A. P. Klimley, B. MacFarlane, C. Michel, and J. R. Skalski. 2013. Sensitivity of survival to migration routes used by juvenile Chinook salmon to negotiate the Sacramento-San Joaquin River Delta. Environmental Biology of Fishes 96: 381–392. DOI: https://doi.org/10.1007/s10641-012-9984-6

Pierson, E. D., W. E. Rainey, and C. Corben. 2006. Distribution and status of western red bats (*Lasiurus blossevillii*) in California. Species Conservation and Recovery Program Report 2006-04. California Department of Fish and Game, Habitat Conservation Planning Branch, Sacramento, CA.

Pimentel, D. 2005. Environmental and economic costs of the application of pesticides primarily in the United States. Environment, Development, and Sustainability 7: 229-252. DOI: https://doi.org/10.1007/s10668-005-7314-2

Pinto-Coelho, R.M. 1998. Effects of eutrophication on seasonal patterns of mesozooplankton in a tropical reservoir: a 4-year study in Pampulha Lake, Brazil. Freshwater Biology 40: 159-173. DOI: https://doi.org/10.1046/j.1365-2427.1998.00327.x

Poirier, P. 2015. Personal Communication. E-mail correspondence between P. Poirier (CDFW) and G. Benigno (DWR). February 5, 2015.

Putah Creek Council. 2016. Lower Putah Creek Restoration Project Draft Program EIR Released for Review and Public Comment Meeting Scheduled. Website. https://www.putahcreekcouncil.org/lower-putah-creek-restoration-project-draft-program-eir-released-review-and-public-comment-meeting (Accessed: July 2019).

Putah Creek Council. 2019. Lower Putah Creek Restoration Planning. Website. https://www.putahcreekcouncil.org/lower-putah-creek-restoration-planning (Accessed: July 2019).

Rabidoux, A. A. 2013. Personal Communication. E-mail correspondence between A. A. Rabidoux (Water Resources Engineer, SCWA) and M. Carter (Project Engineer, WWR). June 19, 2013.

Rankin, E. T. 1986. Habitat selection by smallmouth bass in response to physical characteristics in a natural stream. Transactions of the American Fisheries Society 115: 322-334. DOI:

https://doi.org/10.1577/1548-8659(1986)115<322:HSBSBI>2.0.CO;2

Reclamation District 108. 2019. Knights Landing Outfall Gates (KLOG). Website. http://www.rd108.org/klog/ (Accessed: July 2019).

Reclamation District 2093. 2009. Liberty Island conservation bank. Initial study/mitigated negative declaration. April 2009.

Ricketts, M., and B. Kus. 2000. Yellow-breasted Chat (*Icteria virens*). *In* The riparian bird conservation plan: a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight. Point Reyes Bird Observatory, Stinson Beach, CA.

Riordan, D. 2014. Personal Communication. Senior Environmental Scientist, Fish Restoration Program, DWR. West Sacramento, CA. July 7, 2014 --- e-mail correspondence with Nick Eide, Parus Consulting, Roseville, CA.

RMA (Resource Management Associates, Inc.). 2016a. Prospect Island Tidal Habitat Restoration Project, Hydrodynamic Modeling Analysis for 100-year and 200-year Flood Events. Technical Memorandum. Contract No. 4200009291. RMA, Davis, CA.

RMA. 2016b. Cumulative Salinity Modeling Analysis in Support of the Proposed Tule Red Tidal Marsh Restoration, Grizzly Island, California. Draft Technical Memorandum. Resource Management Associates, Davis, CA.

RMA. 2018. Prospect Island Tidal Restoration Project, Modeling Evaluation for Alternative 2 Flow and Salinity Changes. Technical Memorandum. Contract No. 4200009291. RMA, Davis, CA.

Roberson, D. 2008. Short-eared owl (*Asio flammeus*). Pages 242-248 *in* W. D. Shuford and T. Gardali, editors. California bird species of special concern. Studies of Western Birds No. 1. Western Field Ornithologists, Camarillo, CA and California Department of Fish and Game, Sacramento, CA.

Robinson, A., D. Slotton., S. Lowe., and J. Davis. 2014. North Bay Mercury Biosentinel Project. Contribution #738. San Francisco Estuary Institute and the Aquatic Science Center. Richmond, CA.

Robinson, A., A. Richey., D. Slotton., J. Collins., and J. Davis. 2018. North Bay Mercury Biosentinel Project 2016-2017. Contribution #868. San Francisco Estuary Institute and the Aquatic Science Center. Richmond, CA.

Rochlin, I., M.-J. James-Pirri, S. C. Adamowicz, R. J. Wolfe, P. Capotosto, M. E. Demsey, T. Iwanejko, and D. V. Ninivaggi. 2012. Integrated Marsh Management (IMM): a new perspective on mosquito control and best management practices for salt marsh restoration. Wetlands Ecology and Management 20: 219-232. http://link.springer.com/article/10.1007%2Fs11273-012-9251-9 DOI: https://doi.org/10.1007/s11273-012-9251-9

Rytuba, J. J. 2000. Mercury mine drainage and processes that control its environmental impact. The Science of the Total Environment 260: 57-71. DOI: https://doi.org/10.1016/S0048-9697(00)00541-6

Sacramento County. 2019. Planning Projects Viewer. Website application. https://planningdocuments.saccounty.net/ (Accessed: July 2019).

Schlorff, R., and P. H. Bloom. 1984. Importance of riparian systems to nesting Swainson's Hawks in the Central Valley of California. Pages 612–618 *in* R. E. Warner and K. M. Hendrix, editors. California riparian systems: ecology, conservation, and productive management. University of California Press, Berkeley, CA.

Schoellhamer, D.H. 2011. Sudden Clearing of Estuarine Waters Upon Crossing the Threshold from Transport to Supply Regulation of Sediment Transport as an Erodible Sediment Pool is Depleted: San Francisco Bay, 1999. Estuaries and Coasts 34(5): 885-899. DOI 10.1007/s12237-01109382-x. DOI: https://doi.org/10.1007/s12237-011-9382-x

Schoellhamer, D. H., S. A. Wright, and J. Z. Drexler. 2012. Conceptual Model of Sediment in the Sacramento-San Joaquin River Delta. San Francisco Estuary and Watershed Science 10(3). DOI: https://doi.org/10.15447/sfews.2012v10iss3art3

Schuette, J. 1998. Environmental fate of glyphosate. California Department of Pesticide Regulation, Environmental Monitoring and Pest Management, Sacramento, CA. http://www.cdpr.ca.gov/docs/emon/pubs/fatememo/glyphos.pdf

SERA (Syracuse Environmental Research Associates). 2007. Aminopyralid. Human Health and Ecological Risk Assessment. Final report. USDA Contract AG-3187-C-06-0010. Prepared by SERA, Manlius, New York for USDA Forest Service, Southern Region, Atlanta, GA.

SERA. 2011a. Glyphosate human health and ecological risk assessment. Final report. USDA Contract AG-3187-C-06-0010. Prepared by SERA, Manlius, New York for USDA Forest Service, Southern Region, Atlanta, GA.

SERA. 2011b. Imazapyr human health and ecological risk assessment. Final report. USDA Contract AG-3187-C-06-0010. Prepared by SERA, Manlius, New York for USDA Forest Service, Southern Region, Atlanta, GA. http://www.fs.fed.us/foresthealth/pesticide/pdfs/Imazapyr_TR-052-29-03a.pdf

SFCWA (State and Federal Contractors Water Agency). 2013. Lower Yolo Restoration Project. Final Environmental Impact Report.

SFEI (San Francisco Estuary Institute & The Aquatic Science Center). 2019. California Environmental Data Exchange Network (CEDEN). Website (web-based application). http://www.ceden.org (Accessed: July 2019).

Simenstad, C., J. Toft, H. Higgins, J. Cordell, M. Orr, P. Williams, L. Grimaldo, Z. Hymanson, and D. Reed. 2000. Sacramento/San Joaquin Delta Breached Levee Wetland Study (BREACH). Preliminary Report. Wetland Ecosystem Team, University of Washington, School of Fisheries, Seattle, WA.

Slotton, D. G., S. M. Ayers, T. H. Suchanek, R. D. Weyand, A. M. Liston, C. Asher, D. C. Nelson, and B. Johnson. 2002. The effects of wetland restoration on the production and bioaccumulation of methylmercury in the Sacramento-San Joaquin Delta, California. *In* An assessment of human health and ecological impacts of mercury in the Bay-Delta watershed. Final Report. CALFED Bay-Delta Program.

Solano County. 2015. West Nile Virus activity begins in Solano County. Solano County, CA. Website. http://www.solanocounty.com/news/displaynews.asp?NewsID=708&TargetID=1. (Accessed: March 12, 2015).

Solano County. 2019. Resource Management Documents. Website. http://www.solanocounty.com/depts/rm/documents/default.asp (Accessed: July 2019).

Solano County Board of Supervisors. 2008. Solano County General Plan. Adopted on August 5, 2008. http://www.co.solano.ca.us/depts/rm/planning/general_plan.asp

Solano County Water Agency. 2019. North Bay Aqueduct. Website. http://www.scwa2.com/water-supply/north-bay-aqueduct (Accessed: July 2019).

Sommer, T., B. Harrell, M. Nobriga, R. Brown, P. Moyle, W. Kimmerer, and L. Schemel. 2001a. California's Yolo Bypass: evidence that flood control can be compatible with fisheries, wetlands, wildlife, and agriculture. Fisheries 26: 6-16. DOI: https://doi.org/10.1577/1548-8446(2001)026<0006:CYB>2.0.CO;2

Sommer, T., M. L. Nobriga, B. Harrell, W. Batham, and W. J. Kimmerer. 2001b. Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58: 325-333. DOI: https://doi.org/10.1139/cjfas-58-2-325

Sommer, T. R., W. C. Harrell, M. L. Nobriga, and R. Kurth. 2003. Floodplain as habitat for native fish: lessons from California's Yolo Bypass. Pages 81-87 *in* P. M. Faber, editor. California riparian systems: Processes and floodplain management, ecology, and restoration. 2001 Riparian habitat and floodplains conference proceedings, Riparian Habitat Joint Venture, Sacramento, CA.

Sommer, T., and F. Mejia. 2013. A place to call home: a synthesis of delta smelt habitat in the upper San Francisco Estuary. San Francisco Estuary and Watershed Science 11. http://www.escholarship.org/uc/item/32c8t244 DOI: https://doi.org/10.15447/sfews.2013v11iss2art4

Sousa, R., C. Antunes, and L. Guilhermino. 2008. Ecology of the invasive Asian clam *Corbicula fluminea* in aquatic ecosystems: an overview. Annales de Limnologie 44(2): 85-94. DOI: https://doi.org/10.1051/limn:2008017

Strange, C. J. 2008. Troubling waters. BioScience 58(11): 1008-1113.DOI: https://doi.org/10.1641/B581103

SWRCB (State Water Resources Control Board). 2000. Revised Water Right Decision 1641. December 29, 1999. Revised March 15, 2000. http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649.shtml

SWRCB. 2006. Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Sacramento, CA.

SWS (Stillwater Sciences). 2014. Prospect Island Tidal Habitat Restoration Project Biological Surveys. Prepared by SWS, Berkeley, CA for California Department of Water Resources, Sacramento, CA.

SWS and WWR (Stillwater Sciences and Wetlands & Water Resources). 2012. Prospect Island Tidal Restoration: Synthesis of Phase 1 Screening-Level Modeling Evaluation of Conceptual Restoration Alternatives. Final Report. Prepared by Stillwater Sciences, Davis, CA, and Wetlands & Water Resources, Inc., San Rafael, CA, with assistance from Resource Management Associates, Fairfield, CA, and cbec eco-engineering, West Sacramento, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

SWS and WWR. 2013. Prospect Island Invasive Vegetation Existing Conditions Assessment. Prepared by Stillwater Sciences, Davis, and Wetlands & Water Resources, Inc., San Rafael, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

Systech Water Resources. 2011. Analytical Modeling of the Sacramento River. Task 3 Technical Memorandum. Prepared for California Urban Water Agencies (CUWA) and the Central Valley Drinking Water Policy Work Group. Prepared by Systech Water Resources, Inc., Walnut Creek, CA.

Torres, R. A., N. A. Abrahamson, F. N. Brovold, G. Cosio, M. W. Driller, L. F. Harder, N. D. Marachi, C. H. Neudeck, L. M. O'Leary, M. Robsbotham, R. B. Seed. 2000. Seismic vulnerability of the Sacramento-San Joaquin Delta levees. CALFED Bay-Delta Program.

Tucker, M. E., C. D. Martin, and P. D. Gaines. 2003. Spatial and temporal distribution of Sacramento pikeminnow and striped bass at the Red Bluff Diversion Complex, including the research pumping plant, Sacramento River, California: January 1997 to August 1998, Red Bluff Research Pumping Plant

Report Series, Vol. 10. U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation, Red Bluff, CA.

URS. 2013. Geomorphic Assessment and Surficial Mapping of Prospect and Ryer Island, California. Technical Memorandum. Prepared for DWR, Division of Integrated Regional Water Management, Non-Urban Levee Evaluations Project.

URS, Jack R. Benjamin & Associates, Inc., and Phillip Williams & Associates, Ltd. 2006. Delta Risk Management Strategy Initial Technical Framework Paper Windwaves. Prepared for Department of Water Resources.

USACE (U.S. Army Corps of Engineers). 1987. Confined disposal of dredged material, Engineer manual. EM 1110-2-5027. Washington, D.C. http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-5027.pdf

USACE. 2000. Design and construction of levees. EM-1110-2-1913. Washington, D.C.

USACE. 2003. Evaluation of dredged material proposed for disposal at island, nearshore, or upland confined disposal facilities—testing manual. Prepared by USACE, Vicksburg, MS.

USACE. 2006. Sacramento River Flood Control Project Levee and Channel Profiles Map, Sheet 2 of 4. http://cvfpb.ca.gov/docs/profiles-maps/sactoriverbasin2of4.pdf

USACE. 2007. Yolo Bypass 2-D hydraulic model development and calibration. Engineering Documentation Report. U.S. Army Corps of Engineers, Sacramento District.

USACE. 2019. Sacramento River Deep Water Ship Channel. Website. https://www.spn.usace.army.mil/Missions/Projects-and-Programs/Projects-A-Z/Sacramento-River-Deep-Water-Ship-Channel-C/Main/ (Accessed: July 2019).

USACE and DWR (U.S. Army Corps of Engineers and California Department of Water Resources). 2001. Prospect Island Ecosystem Restoration Project, Solano County, CA. Environmental Assessment/Initial Study.

USBR (U.S. Bureau of Reclamation). 2008. Phase I/II Environmental Site Assessment, Prospect Island. Sacramento, CA.

USBR. 2013. Delta Cross Channel. Fact sheet. Mid-Pacific Region. http://www.usbr.gov/mp/PA/docs/fact_sheets/Delta_Cross_Channel_Canal.pdf

USBR and DWR (U.S. Bureau of Reclamation and California Department of Water Resources). 2005. Water Quality. Chapter 5, Section 5.3 *in* South Delta Improvements Program Volume 1. Draft Environmental Impact Statement/ Environmental Impact Report. Prepared by Jones and Stokes. CA.

USBR and DWR. 2012. Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan: Long-Term Operation of the Central Valley Project and State Water Project Biological Opinion Reasonable and Prudent Alternative Actions I.6.1 and I.7. https://water.ca.gov/LegacyFiles/fishpassage/docs/yolo2.pdf

USBR, USFWS, and CDFG (U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and California Department of Fish and Game). 2011. Water quality. Chapter 5, Section 5.2 *in* Suisun Marsh habitat management, preservation, and restoration plan. Final Environmental Impact Statement/Environmental Impact Report.

USEPA (U.S. Environmental Protection Agency). 1971. Noise from construction equipment and operations, building equipment, and home appliances. NTID 300.1. https://nepis.epa.gov/Exe/tiff2png.cgi/9101NN3I.PNG?-r+75+-g+7+D%3A%5CZYFILES%5CINDEX%20DATA%5C70THRU75%5CTIFF%5C00003321%5C9101NN3I.TIF

USEPA. 2002. No Effect determination for Paraquat Dichloride for Pacific Anadramous Salmonids. Memorandum to Field and External Affairs Division from L. Turner, Washington D.C. http://www.epa.gov/espp/litstatus/effects/ne_paraquat.pdf

USEPA. 2003. Species profile: American Bittern. http://www.epa.gov/region1/ge/thesite/restofriver/reports/final_era/B%20-%20Focus%20Species%20Profiles/EcoRiskProfile_american_bittern.pdf

USEPA. 2006. Reregistration eligibility decision for imazapyr. Prevention, Pesticides and Toxic Substances (7508c). EPA 738-R-06-007. OPP-2005-0495. Case Number 3078. U.S.

USEPA. 2007. Risks of imazapyr use to federally threatened California red-legged frog (*Rana aurora draytonii*). Pesticide effects determination. USEPA, Environmental Fate and Effects Division, Office of Pesticide Programs, Washington, D.C. http://www.epa.gov/oppfead1/endanger/litstatus/effects/redleg-frog/imazapyr/analysis.pdf

USEPA. 2008. Risks of glyphosate use to federally threatened California red-legged frog (*Rana aurora draytonii*). Environmental Fate and Effects Division, Office of Pesticide Programs, Washington, D.C.

USEPA. 2014. Emission factors for greenhouse gas inventories. Last modified April 4. http://www.epa.gov/climateleadership/documents/emission-factors.pdf

USEPA. 2017. What are sensitive receptors? Website. https://www3.epa.gov/region1/eco/uep/sensitivereceptors.html (Accessed June 2019).

USEPA. 2019. Protecting endangered species from pesticides. Website. https://www.epa.gov/endangered-species (Accessed: July 2019).

USEPA and USACE (U.S. Environmental Protection Agency and U.S. Army Corps of Engineers). 1998. Evaluation of dredged material proposed for discharge in waters of the U.S.—testing manual. Inland Testing Manual. Prepared by USEPA and USACE, Washington, D.C.

USFWS (U.S. Fish and Wildlife Service). 1993a. Endangered and threatened wildlife and plants: determination of threatened status for the giant garter snake. Federal Register 58: 54053-54066.

USFWS. 1993b. Endangered and threatened wildlife and plants: determination of threatened status for the delta smelt, Final Rule. Federal Register 58: 12854-12864.

USFWS. 1994. Endangered and threatened wildlife and plants: critical habitat determination for the delta smelt, Final Rule. Federal Register 59: 65256-65279.

USFWS. 1999a. Conservation guidelines for the valley elderberry longhorn beetle. USFWS, Sacramento Fish and Wildlife Office, Sacramento, CA. http://www.fws.gov/sacramento/es/Survey-Protocols-Guidelines/Documents/velb_conservation.pdf

USFWS. 1999b. Draft recovery plan for the giant garter snake (*Thamnophis gigas*). USFWS, Portland, OR. http://www.fws.gov/ecos/ajax/docs/recovery_plan/990702b.pdf

USFWS. 2003. Endangered and threatened wildlife and plants; notice of remanded determination of status for the Sacramento Splittail (Pogonichthys macrolepidotus), Final Rule. Federal Register 68: 55140-55166.

USFWS. 2004. Final programmatic consultation on the issuance of section 10 and 404 permits for projects with relatively small effects on the delta smelt (*Hypomesus transpacificus*) and its critical habitat within the jurisdiction of the Sacramento Fish and Wildlife Office of the U.S. Fish and Wildlife Service, California. Document No. 1-1-04-F-0345. Prepared by USFWS, Sacramento Fish and Wildlife Office, Sacramento, CA. http://www.fws.gov/sfbaydelta/documents/coe_delta_smelt.pdf

USFWS. 2008. Formal Endangered Species Act consultation on the proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP). Biological opinion. Prepared by USFWS, California and Nevada Region, Sacramento, California for U.S. Bureau of Reclamation, Central Valley Operations Office, Sacramento, CA. http://www.fws.gov/sfbaydelta/cvp-swp/cvp-swp.cfm

USFWS. 2012. Giant garter snake (*Thamnophis gigas*) 5-year review: summary and evaluation. Sacramento, CA.

USFWS. 2013. U. S. Fish and Wildlife Service's Species List Generator. Website (web-based application). https://www.fws.gov/sacramento/es_species/Lists/ (Accessed: July 2019).

USFWS. 2019a. Central Valley Project Improvement Act (CVPIA) Project Implementation Division. Website. https://www.fws.gov/cno/fisheries/cvpia/AnadromFishScreen.cfm (Accessed: July 2019).

USFWS. 2019b. California WaterFix. Website. https://www.fws.gov/sfbaydelta/HabitatConservation/CalWaterFix/Index.htm (Accessed: July 2019).

USFWS. 2019c. Delta Juvenile Fish Monitoring Program. Website. https://www.fws.gov/Lodi/juvenile_fish_monitoring_program/jfmp_index.htm (Accessed: July 2019).

USGS (U.S. Geological Survey). 1999. Earthquake probabilities in the San Francisco bay region: 2000 to 2030—a summary of findings. Open-File Report 99-517. Prepared by: Working Group on California Earthquake Probabilities. http://geopubs.wr.usgs.gov/open-file/of99-517/

USGS. 2013. Mineral resources data system: coterminous U.S. Online spatial database http://mrdata.usgs.gov/mineral-resources/mrds-us.html

Videler, J. J., and C. S. Wardle. 1991. Fish swimming stride by stride: speed limits and endurance. Reviews in Fish Biology and Fisheries 1: 23-40. DOI: https://doi.org/10.1007/BF00042660

Vogel, D. A. 2008. Pilot study to evaluate acoustic-tagged juvenile Chinook salmon smolt migration in the northern Sacramento-San Joaquin Delta, 2006-2007. Prepared for California Department of Water Resources by Natural Resources Scientists, Inc.

Vogel, D. 2011. Insights into the problems, progress, and potential solutions for Sacramento River Basin native anadromous fish restoration. Prepared for Northern California Water Association and Sacramento Valley Water Users by Natural Resource Scientists, Inc.

Wagner, D. L., C. W. Jennings, T. L. Bedrossian, and E. J. Bortugno. 1981. Geologic map of the Sacramento quadrangle, California. California Geological Survey, Regional Geologic Map 1A. Scale 1:250,000. http://ngmdb.usgs.gov/Prodesc/proddesc_520.htm

Wagner, W, M. Stacey, and L. Brown, M. Dettinger. 2011. Statistical models of temperature in the Sacramento San Joaquin Delta under climate-change scenarios and ecological implications. Estuaries Coasts 34:544-556. DOI: http://dx.doi.org/10.1007/s12237-010-9369-z.

Walker, J. D., and J. W. Geissman. 2009. Geologic Time Scale. Geological Society of America. DOI: 10.1130/2009.CTS004R2C. http://www.geosociety.org/science/timescale/ DOI: https://doi.org/10.1130/2009.CTS004R2C

Weiner, J. G., C. C. Gilmour, and D. P. Krabbenhoft. 2003. Mercury strategy for the Bay-Delta ecosystem: a unifying framework for science, adaptive management, and ecological restoration. Final report to California Bay Delta Authority, Contract 4600001642 between Association of Bay Area Governments and University of Wisconsin-La Crosse.

Welch, P. 1998. An evaluation of historic houses at Prospect Island, Sacramento-San Joaquin Delta, California. Northwest Information Center Report #S-019945. U.S. Bureau of Reclamation, Mid-Pacific Region.

Welch, P. 2007. Archaeological survey for the repair of two levees at Prospect Island and rehabilitation of erosion damage at Stringer Island, Solano County, California. U.S. Bureau of Reclamation, Mid-Pacific Regional Office, Sacramento.

Western Bat Working Group. 2007. Western Bat Working Group Regional Bat Species Priority Matrix. http://www.wbwg.org/speciesinfo/species_matrix/spp_matrix.pdf

Whipple, A. A., R. M. Grossinger, D. Rankin, B. Stanford, and R. A. Askevold. 2012. Sacramento-San Joaquin Delta historical ecology investigation: exploring pattern and process. Prepared for California Department of Fish and Game and Ecosystem Restoration Program. SFEI-ASC Historical Ecology Program, Publication #672. San Francisco Estuary Institute, Aquatic Science Center, Richmond, CA. http://www.sfei.org/DeltaHEStudy

Wildlands. 2019a. Honker Bay Conservation Bank. Website. https://www.wildlandsinc.com/banks/honker-bay-conservation-bank-salm/ (Accessed: July 2019).

Wildlands. 2019b. Wildlands Receives Final Approval for Mitigation Banks. Website. https://www.wildlandsinc.com/wildlands-receives-final-approval-for-mitigation-banks/#sthash.3eR2q00Q.dpuf (Accessed: July 2019).

Windham-Myers, L., M. Marvin-DiPasquale, D. P. Krabbenhoft, J. L. Agee, M. H. Cox, P. Heredia-Middleton, C. Coates, and E. Kakouros. 2009. Experimental

removal of wetland emergent vegetation leads to decreased methylmercury production in surface sediments. Journal of Geophysical Research 114, G00C05, DOI: https://doi.org/10.1029/2008JG000815

Winters Express. 2018. Winters Putah Creek Nature Park Fate Finally Fixed. Website. https://www.wintersexpress.com/local-news/winters-putah-creek-nature-park-fate-finally-fixed/ (Accessed: July 2019).

Witzman, J. 2014. Personal Communication. Program Manager 1, DWR, Sacramento, CA. Jan. 16, 2014 e-mail correspondence with Megan Keever, Stillwater Sciences, Berkeley, CA.

Woodland-Davis Clean Water Agency. 2019. Project Overview. Website. https://www.wdcwa.com/project-overview (Accessed: July 2019).

Wright, S.A. and D.H. Schoelhammer. 2005. Estimating sediment budgets at the interface between rivers and estuaries with application to the Sacramento–San Joaquin River Delta. Water Resources Research (41) (W09428). DOI: https://doi.org/10.1029/2004WR003753

WWR and SWS (Wetlands & Water Resources and Stillwater Sciences). 2013. Prospect Island Tidal Restoration: Supplemental Phase 1 Screening-Level Modeling Results Memorandum. Prepared by Stillwater Sciences, Davis, CA and Wetlands & Water Resources, Inc., San Rafael, CA, with assistance from Resource Management Associates, Fairfield, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

WWR and SWS. 2014. Phase 2 Modeling Synthesis Report, Prospect Island Tidal Habitat Restoration Project. Final Report. Prepared by Wetlands and Water Resources, Inc., San Rafael, CA and Stillwater Sciences, Davis, CA, with assistance from Resource Management Associates, Fairfield, CA and Delta Modeling Associates, San Francisco, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

Wylie, G. D., and L. L. Martin. 2005. Surveys for giant garter snakes in Solano County: 2005 report. USGS, BRD, WERC Dixon Field Station.

Yolo County. 2019a. Current Projects. Website. https://www.yolocounty.org/community-services/planning-public-works/planning-division/current-projects (Accessed: July 2019).

Yolo County. 2019b. Yolo County Central Landfill. Website. https://www.yolocounty.org/community-services/planning-public-works/integrated-waste-management-division/central-landfill (Accessed: July 2019).

Yolo Habitat Conservancy. 2019. Benefits of the Yolo Habitat Conservation Plan / Natural Community Conservation Plan. Website. https://www.yolohabitatconservancy.org/about (Accessed: July 2019).

Yolo Natural Heritage Program. 2009. Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*). Draft Species Accounts. Technology Associates.

YSAQMD (Yolo-Solano Air Quality Management District). 2007. Handbook for assessing and mitigating air quality impacts. Appendix A. Davis, CA. http://www.ysaqmd.org/documents/CEQAHandbook2007.pdf

YSAQMD. 2016a. 2015 Triennial Assessment and Plan Update. 07-13-2016. Prepared for California Air Resources Board. http://www.ysaqmd.org/wp-content/uploads/Planning/Final-2015-Triennial-Plan.pdf

YSAQMD. 2016b. Ambient Air Quality Standards Attainment Status. http://www.ysaqmd.org/wp-content/uploads/Graphics/Attainment_Status.png

YSAQMD. 2019. Attainment Status. Website. https://www.ysaqmd.org/plans-data/attainment/ (Accessed: July 2019).

Zeiner, D. C., W. F. Laudenslayer Jr., K. E. Mayer, and M. White, editor. 1988a. California's wildlife. Volume I. Amphibians and reptiles. California Statewide Habitat Relationships System. California Department of Fish and Game.

Zeiner, D. C., W. F. Laudenslayer Jr., K. E. Mayer, and M. White, editor. 1990a. California's wildlife. Volume II. Birds. California Statewide Habitat Relationships System. California Department of Fish and Game.

Zeiner, D. C., W. F. Laudenslayer Jr., K. E. Mayer, and M. White, editor. 1990b. California's wildlife. Volume III. Mammals. California Statewide Habitat Relationships System. California Department of Fish and Game.

Zhang, M., and R. Goodhue. 2010. Agricultural pesticide best management practices report. Final report for Central Valley Regional Water Quality Control Board. University of California, Davis Agricultural GIS Laboratory.

Zucker, E. 1985. Hazard Evaluation Division - Standard Evaluation Procedure - Acute toxicity test for freshwater fish. U.S. EPA Publication 540/9-85-006. [cited in USEPA 2002: http://www.epa.gov/espp/litstatus/effects/ne_paraquat.pdf]

Appendices

Appendix A

Summary of Technical Terms

Acre-foot: A common water industry unit of measurement. An acre-foot is 325,851 gallons, or the amount of water needed to cover one acre with water one foot deep. An acre-foot serves the annual water needs of two typical California families.

Ammocoetes: Larval phase of lampreys.

Anadromous fish: Fishes, such as Chinook salmon, steelhead, and lampreys, that are born in freshwater, eventually migrate to the ocean to grow into adults, and then finally return to freshwater to spawn.

Aqueduct: A man-made canal or pipeline used to transport water.

Aquifer: An underground geologic formation of rock or soil that is naturally saturated with water; an aquifer stores groundwater.

Attainment (air quality context): An air basin is considered to be in attainment for a particular air pollutant criteria if it meets federal and/or state standards set for that pollutant.

Backfill: Material used in refilling excavation, or the process of such refilling; also, material used to fill an excavated trench.

Basin Plan: Basin Plans (also called Water Quality Control Plans) provide the basis for protecting water quality in California, as mandated by both the federal Clean Water Act and the state Porter-Cologne Water Quality Act. These plans are designed to preserve and enhance water quality and protect the beneficial uses of all regional waters. Basin Plans typically:

1. Designate beneficial uses of all regional waters.
2. Establish narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses and conform to the state's anti-degradation policy.
3. Describe implementation programs to protect the beneficial uses of all waters in the region.
4. Describe surveillance and monitoring activities to evaluate the effectiveness of the Basin Plans.

Bay-Delta: The Sacramento-San Joaquin Bay-Delta is a unique natural resource of local, state, and national significance. The Delta is home to more than 500,000 people; contains 500,000 acres of agriculture; provides habitat for 700 native

plant and animal species; provides water for more than 25 million Californians and 3 million acres of agriculture; is traversed by energy, communications and transportation facilities vital to the economic health of California; and supports a $400 billion economy. This region comprises the entire estuary system of the San Francisco Bay, Sacramento and San Joaquin rivers, and the delta formed by those two rivers.

Bay Delta Conservation Plan: A conservation plan prepared to meet the requirements of the federal and state Endangered Species Acts and/or the Natural Community Conservation Plan Act to meet the State of California's co-equal goals of a more reliable water supply in California and a comprehensive restoration program for the Bay-Delta region.

Beneficial use: "Beneficial uses" of the waters of the State of California that may be protected against water quality degradation include, but are not necessarily limited to, domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

Benthic: This term refers to the bottom of rivers, lakes, or oceans.

Berm: A horizontal strip or shelf built into an embankment or cut to break the continuity of the slope, usually for the purpose of reducing erosion or to increase the thickness of the embankment at a point of change in a slope or defined water surface elevation.

Best management practices: An engineered structure or construction management activity, or combination of these, that eliminates or reduces the project's potentially adverse environmental impacts.

Bioaccumulation: The intake and retention of nonfood substances by a living organism from its environment, resulting in a build-up of the substances in the organism.

Biological opinion: Document issued under the authority of the federal Endangered Species Act stating the U.S. Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Service (NMFS) finding as to whether a federal action is likely to jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of designated critical habitat. As part of the biological opinion, the federal agencies

prepare reasonable and prudent alternatives (RPAs) that direct the lead agency or project applicant to implement specific actions to reduce effects that may threaten or endanger listed species.

Brackish: This type of water is a mixture of freshwater and saltwater.

California Endangered Species Act: The California Endangered Species Act of 1985 (CESA; Fish and Game Code § 2050 *et seq.*) is implemented by the California Department of Fish and Wildlife (CDFW). CESA prohibits the "take" of listed threatened and endangered species. Take under CESA is restricted to the direct killing of a listed species and does not prohibit indirect harm by way of habitat modification.

California Environmental Quality Act (CEQA): This state environmental law requires state and local public agencies to document and consider the environmental impacts of their actions. CEQA also requires an agency to identify ways to avoid or reduce significant environmental damage and to implement those mitigation measures where feasible. In addition, it provides opportunities for public participation in the decision-making process. See Public Resources Code §§ 21001.1, 21002, 21080; *State CEQA Guidelines* (California Code of Regulations [CCR]) § 15002(c).

California Native Plant Society: This society is a non-profit organization that seeks to increase understanding of California's native flora and to preserve that flora.

Canal: This structure is an artificial channel or ditch filled with water and designed for navigation or irrigating, i.e., to move water from one location to another.

Candidate species: Any species being considered by the U.S. Secretary of the Interior or U.S. Secretary of Commerce for listing as an endangered or threatened species, but not yet the subject of a proposed rule (see 50 Code of Federal Regulations [CFR] 424.02), or any species accepted as a candidate species by the CDFW pursuant to Fish and Game Code § 2074.2.

Carbon dioxide: A colorless, odorless gas that occurs naturally in the earth's atmosphere; substantial quantities are also emitted into the air by fossil fuel combustion.

Carbon monoxide: A colorless, odorless gas that is generated in the urban environment, primarily by the incomplete combustion of fossil fuels in motor vehicles.

Central Valley Project: California's federally-owned and operated water project, consisting of 20 dams and reservoirs and 500 miles of canals that deliver eight million acre-feet of water each year, primarily to Central Valley farmers.

CEQA Lead Agency: Under CEQA, a Lead Agency is the local or state governmental agency that has the principal responsibility for carrying out or approving the proposed activity.

Channel: This feature is either a natural or artificial watercourse, with a defined bed and banks that allows continuously or periodically restricted flowing water.

Clearing: The removal of all vegetation such as trees, shrubs, brush, stumps, exposed roots, down timber, branches, grass, and weeds.

Climate change: Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity.

Community: All members of a specified group of species present in a specific area at a certain time.

Compaction: An activity to make soil dense by mechanical action, which increases the density by reducing the voids or empty spaces in a material.

Confluence: The flowing together of two or more streams; the place of meeting of two streams.

Contaminant: Any substance or property preventing the use or reducing the usability of water for ordinary purposes such as drinking, bathing, recreation and cooling. It is generally considered synonymous with pollutant.

Contiguous: Actual contact with; also, near or adjacent to.

Contour: A line of constant elevation.

Cubic feet per second: A measurement of water flow equivalent to one cubic foot of water passing a given point in a second. One cubic foot is approximately 7.5 gallons.

Cultural resource: An aspect of a cultural system that is valued by or significantly representative of a culture or that contains substantial information about a culture. Properties such as landscapes or districts, sites, buildings, structures, objects, or cultural practices that are usually greater than 50 years of age and possess architectural, historic, scientific, or other technical value are identified as cultural resources.

Culvert: A pipe or small bridge for drainage under a highway, railroad, canal, or other embankment.

Cumulative impact: For CEQA purposes, defined as the change in the physical environment that results from the incremental impact of the project when added to other, closely related past, present and reasonably foreseeable future projects.

Dam: A barrier built across a river or stream to hold water.

Decibels: Units of measurement that express the intensity of sound; degree of loudness.

Delta: The site where rivers empty; an outlet from land to ocean, also where rivers deposit sediment they carry forming landforms.

Delta islands: Islands in the Sacramento-San Joaquin River Delta protected by levees. Delta Islands provide space for numerous functions, including agriculture, communities, and important infrastructure such as transmission lines, pipelines, and roadways.

Delta smelt: A small, slender-bodied fish with a typical adult size of two to three inches that is found only in the Sacramento-San Joaquin River Delta estuary.

Designated critical habitat: As defined by the federal Endangered Species Act, a specific geographic area(s) containing features essential for the conservation of a threatened or endangered species and that may require special management and protection.

Dewatering: A method used to eliminate water from a lake, river, stream, reservoir, or containment that allows construction activities to proceed as intended.

Discharge: Volume of water that passes a designated point within a given period of time. Any spilling, leaking, pumping, pouring, emitting, emptying, or dumping not including permitted activities in compliance with § 402 of the federal Clean Water Act.

Dissolved organic carbon: DOC is used to describe the thousands of dissolved compounds found in water that derive from organic materials (such as decomposed plant matter).

Disturbance: A discrete event, either natural or human induced, that causes a change in the condition of an ecological system.

Dredge: To dig, gather, or remove bottom materials (e.g., soil, rocks, sediments, etc.) to deepen waterways.

Duripan: A geologic term for a horizon in mineral soil characterized by cementation by silica.

Easement: An interest in land owned by another individual or organization that entitles its holder to a specific limited use and/or access.

Ecosystem: Where living and non-living things interact (coexist) in order to survive. An ecosystem consists of the biological community that occurs in some locale and the physical and chemical factors that make up its non-living or abiotic environment.

Electrical conductivity: A measure of the salt content of water.

Elevation: The height of a point above a plane of reference. Generally, the height above sea level.

Endangered species: Any species or subspecies of bird, mammal, fish, amphibian, reptile, or plant that is in serious danger of becoming extinct throughout all or a significant portion of its range, in compliance with the federal Endangered Species Act (ESA). Official federal designations of endangered

species are made by the USFWS or NMFS and published in the *Federal Register*. Species are also listed under CESA by the CDFW.

Environmental Impact Report: A detailed document prepared by a state or local public agency to comply with CEQA. The EIR describes and analyzes significant or potentially significant effects by a project on the physical environment and discusses actions and strategies to avoid or substantially lessen those effects.

Estuary: A body of water where freshwater meets saltwater.

Evolutionarily Significant Unit: This categorization of Pacific salmon is considered to be a distinct population segment and thus a species under the federal ESA (FESA).

Exotic species: A non-native species that is introduced into an area.

Extinct: No longer in existence; i.e., died out leaving no living representatives.

Farmland of Statewide Importance: Farmland of Statewide Importance is land other than Prime Farmland which has a good combination of physical and chemical characteristics for the production of crops. It must have been used to produce irrigated crops at some time during the two 'update' cycles prior to the mapping date. It does not include publicly owned lands for which there is an adopted policy preventing agricultural use.

Feasible: A term used to indicate that an alternative or mitigation measure is capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors.

Fill: Manmade deposits of natural soils or rock products and waste materials designed and installed in such a manner as to provide drainage yet prevent the movement of soil particles due to flowing water. This type of soil has no value, except as bulk.

Flap gate: A gate hinged along one edge, usually either the top or bottom edge. Examples of bottom-hinged flap gates are tilting gates and fish belly gates – so called from their shape in the cross-section.

Flood: A flood event is a temporary rise in water levels resulting in inundation of areas not normally covered by water.

Flood bypass: A region of land or a large man-made structure that is designed to convey excess flood waters from a river or stream in order to reduce the risk of flooding on the natural river or stream near a key point of interest, such as a city. For example, Yolo Bypass in Yolo County.

Floodplain: Any land area susceptible to inundation by floodwaters from any source.

Flora: All plant life associated with a particular habitat.

Flow: Volume of water that passes a specific point within a given period of time.

Footprint: Area of the ground surface affected by construction activities.

Forage: Vegetation used for animal consumption.

Freshwater: Water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids.

Front loader: A tractor loader used in construction that both digs and dumps in front.

Fry: Salmon that have emerged from gravel, completed yolk absorption, remained in freshwater streams, and are less than a few months old.

Fyke trap: Long, bag-shaped fishing net held open by hoops used to catch eels. The hoops can be constructed from cane, aluminum, or fiberglass over which the netting is secured.

Gate: A movable device/watertight barrier that controls the flow in a conduit, pipe, or tunnel without obstructing any portion of the waterway (e.g., a canal or ditch) when in the fully open position.

Gage: A device that registers water level, discharge, velocity, pressure, etc.

General plan: A planning document, usually at the city or county level that encapsulates policies for land use and development over a specified period of

time. A general plan may be supplemented by specific plans that address land use and development policies for specific portions of a planning jurisdiction, such as historic districts or areas slated for redevelopment.

Generator: A machine that converts mechanical energy into electrical energy.

Geomorphology: A scientific branch of geology that studies the characteristics, configuration, and evolution of rocks and landforms on the earth's surface.

Grade: The inclination or slope of a pipeline, conduit, stream channel, or natural ground surface; usually expressed in terms of the ratio or percentage of the number of units of vertical rise or fall per unit of horizontal distance ("rise over run").

Gradient: General slope or rate of change in vertical elevation per unit of horizontal distance of water surface of a flowing stream. Slope along a specific route, such as of a road surface, channel or pipe.

Grading: Altering a land surface by cutting, filling and/or smoothing during construction to meet a designated form and function.

Groundwater: Water that has percolated into natural, underground aquifers; water in the ground, not water that remains on the ground.

Groundwater table: The upper surface of the zone of saturation (all pores of subsoil filled with water), except where the surface is formed by an impermeable body.

Growing season: The period, often the frost-free period, during which the climate is such that crops can be produced.

Grubbing: This is the process of removing stumps, roots, and vegetable matter from the ground surface after clearing and prior to excavation.

Habitat: The location where a particular taxon of plant or animal lives and its surroundings, both living and non-living; the term includes the presence of a group of particular environmental conditions surrounding an organism including air, water, soil, mineral elements, moisture, temperature, and topography.

Habitat conservation plan: Planning document that is a mandatory component of an incidental take permit application under the FESA. The plan specifies, among other things, the impacts that are likely to result from take and the measures that the permit applicant will undertake to minimize and mitigate such impacts.

Harassment: Defined in regulations implementing the FESA promulgated by the Department of the Interior as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, and sheltering." (50 CFR 17.3)

Harm: Defined in regulations implementing the FESA promulgated by the Department of the Interior as an act "which actually kills or injures" listed wildlife; harm may include "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." (50 CFR 17.3)

Hazardous materials: Materials that are toxic, flammable, explosive, corrosive, combinations of these, or otherwise injurious to life and health.

Herbicide: This type of compound, usually a man-made organic chemical, is used to kill or control plant growth.

Hydrology: This is the scientific study of water in nature: its properties, distribution, and behavior. It also examines the occurrence, circulation properties, and distribution of the waters of the earth and their reaction to the environment.

Important farmland: As defined by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), Important Farmlands include Prime Farmland, Unique Farmland, Farmland of Statewide Importance, and Farmland of Local Importance. The categorization of farmland is based upon a soil classification system, which accounts for the physical and chemical characteristics of the land and suitability of the land for producing crops.

Incidental take permit: Permit issued by the USFWS that authorizes the incidental take of a listed species. The permit does not authorize the activities that result in take. The permit is submitted with a habitat conservation plan.

Intermittent stream: An ephemeral stream that flows part of the time, usually after a rainstorm, during wet weather, or for only part of the year.

Intertidal: The zone between high and low tide.

Inundate: To cover with impounded waters or floodwaters.

Invertebrate: Any animal that lacks a backbone or spinal column.

Irrigation: Applying water to crops, lawns or other plants using pumps, pipes, hoses, and/or sprinklers.

Jurisdiction: Boundary of authorization for a government agency. A term used to describe the level of responsibility a public entity has for a specific geographic area using its rules and regulations.

Juvenile: An early life stage of fish that are older than one year but not yet capable of reproduction.

Lead: A stable element that persists and accumulates both in the physical environment and in humans and animals that can lead to toxic effects.

Levee: A natural or man-made barrier that prevents rivers from overflowing their banks.

Listed: For the purposes of this section, 'listed' is defined as any species that is identified as candidate, threatened, or endangered pursuant to CESA and/or listed as threatened or endangered under FESA.

Macro-invertebrate: An animal without a backbone that is visible without the aid of a microscope, such as a crayfish in the aquatic environment.

Maximum contaminant level: The highest drinking water contaminant concentration allowed under federal and state Safe Drinking Water Act regulations. This threshold is set by USEPA for a regulated substance in drinking water.

Microorganism: An animal or plant that is microscopic in size.

Mitigation: Actions taken to avoid or substantially lessen significant environmental impacts when a project is carried out. Mitigation measures shall:

1. Avoid the impact altogether by not taking a certain action or parts of an action.
2. Minimize impacts by limiting the degree or magnitude of the action and its implementation.
3. Rectify the impact by repairing, rehabilitating, or restoring the affected environment.
4. Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action.
5. Compensate for the impact by replacing or providing substitute resources or environments.

National Pollutant Discharge Elimination System: A permitting program under § 402 of the federal CWA required for all point sources discharging pollutants into waters of the United States. The purpose of the NPDES program is to protect human health and the environment.

National Register of Historic Places: A federally-maintained register of districts, sites, buildings, structures, architecture, archeology, and culture worthy of preservation.

Natural Community Conservation Plan: A conservation plan created to meet the requirements of the California Fish and Game Code, § 2800, *et seq*.

NAVD88: North American Vertical Datum 1988. This is the vertical control datum established in 1991 by the minimum-constraint adjustment of the Canadian-Mexican-United States leveling observations. It held fixed the height of the primary tidal benchmark, referenced to the new International Great Lakes Datum of 1985 local mean sea level height value, at Father Point/Rimouski, Quebec, Canada (NGS 2014).

Nitrogen oxides: A class of pollutant compounds that include nitrogen dioxide (NO2) and nitric oxide (NO), both of which are emitted by motor vehicles.

Nonattainment: An air basin is considered to be in nonattainment for a particular air criteria pollutant if it is exceeding federal or state standards for that pollutant.

Non-native species: Also called introduced or exotic species, these kinds of species of plants or animals originate elsewhere and are brought/arrive into a new area.

Non-point source pollution: Pollution that is so general or covers such a wide area that no single, localized source of the pollution can be identified. These are forms of diffuse pollution caused by sediment, nutrients, organic and toxic substances originating from land use activities, which are carried to lakes and streams by surface runoff.

Notice of Preparation: The notice issued by a CEQA Lead Agency, and to a lesser extent a CEQA Responsible Agency, to publicly announce its intention to analyze a proposed project and write an environmental impact report pursuant to CEQA.

Nutrients: Animal, vegetable, or mineral substances, which sustain individual organisms and ecosystems.

Organism: Any individual form of life, such as a plant, animal or bacterium.

Outflow: The amount of water passing a specified point downstream of a structure, expressed in acre-feet per day or cubic feet per second.

Overtopping: Flow of water over the top of a dam or embankment.

Ozone: A photochemical oxidant that is a major cause of lung and eye irritation in urban environments.

Particulate matter: Liquid and solid particles of a wide range of sizes and compositions; of particular concern for air quality are particles smaller than or equal to 10 microns and 2.5 microns (PM_{10} and $PM_{2.5}$, respectively).

Peat: Soil formed of dead, but not fully decayed, plants found in bog areas.

Pelagic species: Fishes that spend most of their lives swimming in the water column with little contact with or dependency on the bottom. Adult spawning usually occurs in open water, often near the surface.

pH: A measurement of solution acidity with a relative scale, from 0 to 14. pH indicates how acidic or basic (alkaline) a solution is, where a pH of 7 is neutral,

and smaller readings become increasingly acid. Natural waters usually have a pH between 6.5 and 8.5.

Piscivorous: A carnivorous diet consisting largely of fish.

Plankton: Tiny, usually microscopic, plants (phytoplankton) and animals (zooplankton) with limited powers of locomotion, usually living free (i.e., floating) in the water away from substrates. Plankton is often a major source of nutrition for larger aquatic life forms.

Pollutant: Any inorganic or organic substance that contaminates air, water, or soil. Generally, any substance introduced into the environment that adversely affects the usefulness of a resource.

Population: Total number of individuals occupying an area.

Porter-Cologne Water Quality Control Act: Also referred to as the 'Porter-Cologne Act', it is contained in the California Water Code, Division 7, § 13000 *et seq*. It is the principal law governing water quality regulation in California and directs the SWRCB to formulate and adopt state policies for controlling water quality.

Prime Farmland: Prime Farmland is land that has the best combination of physical and chemical characteristics for the production of crops. It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops when treated and managed, including water management, according to current farming methods. Prime Farmland must have been used for the production of irrigated crops at some time during the two update cycles prior to the mapping date. It does not include publicly-owned lands for which there is an adopted policy preventing agricultural use.

Pumping plant: This type of facility lifts water up and over hills.

Qualitative: Descriptive term of kind, type or direction, as opposed to size, magnitude or degree.

Quantitative: Descriptive term of having to do with quantity, and/or capable of being measured.

Range: Geographic region in which a given plant or animal normally lives or grows.

Raptor: A bird species in the order Falconiformes (such as hawks, eagles, kites, and falcons) or Strigiformes (owls).

Reach: Any specified length of stream, channel, or other water course.

Rhizome: A horizontal underground stem that sends out roots and shoots from its nodes.

Riparian area: The land adjacent to a natural watercourse such as a river or a stream. Riparian areas support vegetation that provides important wildlife habitat, as well as important fish habitat when sufficient to overhang the bank and enter the water.

Ruderal: Weedy vegetation that is dominated by introduced species and is characteristic of areas where native vegetation has been disturbed or removed.

Runoff: Water that travels over the surface of the Earth, moving downward due to gravity.

Sacramento-San Joaquin River Delta: The legal Bay-Delta, as described in the California Water Code § 12220, generally extends from Sacramento to the north, Tracy to the south, Interstate 5 to the east, and Collinsville to the west. The Bay-Delta covers approximately 738,000 acres.

Salinity: Generally, the concentration of mineral salts dissolved in water. Salinity may be measured by weight (total dissolved solids - TDS), electrical conductivity, or osmotic pressure. Where seawater is known to be the major source of salt, salinity is often used to refer to the concentration of chlorides in the water.

Salmonid: Family of fish that includes salmon and steelhead.

Scour: Erosion in a stream bed, particularly if caused or increased by channel changes.

Sediment: Unconsolidated solid material that comes from weathering of rock and is carried by, suspended in, or deposited by water or wind.

Sediment concentration: The quantity of sediment relative to the quantity of transporting fluid, or fluid sediment moisture.

Sediment discharge: Rate at which sediment passes a stream cross-section in a given period of time, expressed in millions of tons per day.

Sediment load: Mass of sediment passing through a stream cross-section in a specified period of time, expressed in millions of tons.

Sedimentation: The phenomenon of sediment or other fine particulates entering a water body, or being disturbed from the bottom such that they move downstream and settle on the substrate in other aquatic areas.

Sequestration: CO_2 sequestration is the storage of CO_2 (usually captured from the atmosphere) in a solid material through biological or physical processes. Wetlands can provide carbon capture and storage.

Shallow water: Water with just enough depth to allow for sunlight penetration, plant growth, and the development of small organisms that function as fish food. Such habitats serve as spawning areas for the delta smelt.

Slope: Change in elevation per unit of horizontal distance. Also, a slope can be characterized as the inclined face of a cut, canal, or embankment.

Slough: A muddy or marshy area; a secondary channel of a river delta, usually flushed by the tide.

Smolt: A juvenile salmonid migrating to the ocean and undergoing physiological changes (called smoltification) to adapt from a freshwater to a saltwater environment.

Spawn: To lay eggs, refers mostly to fish.

Special-status species: Species that are in at least one of the following categories: listed as threatened or endangered under the FESA; proposed for federal listing under the FESA; federal candidates under ESA; listed as threatened or endangered under the CESA; candidates under CESA; plants listed as rare under the California Native Plant Protection Act; California fully protected species or specified birds under various sections of the California Fish

and Game Code; California species of special concern; or California Native Plant Society List 1A, 1B, 2, or 3 species.

Species: Basic category of biological classification for a single kind of animal or plant.

Stability: Tendency of systems, especially ecosystems, to persist, relatively unchanged, through time; also, persistence of a component of a system.

Stable: A term for not changing or fluctuating; firmly established.

Staging area: Location where construction equipment and materials may be stored prior to use.

Storm flow: Surface flow originating from precipitation and runoff, which has not percolated to an underground basin.

State Water Project: California's largest water supply project operated and maintained by the California Department of Water Resources that stores surplus water during wet periods and later distributes it to areas of need in the San Francisco Bay area, northern California, San Joaquin Valley, and Southern California. SWP facilities include 23 dams and reservoirs, 18 pumping plants, four generating-pumping plants, five hydroelectric power plants, and approximately 600 miles of canals and pipelines.

Stockpile: A storage pile of materials, such as soils.

Stormwater: Untreated surface runoff into a body of water during periods of precipitation.

Capacity (stream context): Total volume of water that a stream can carry within the normal high-water channel.

Subsidence: A decrease in ground surface elevation in the Bay-Delta region, which results primarily from peat soil being converted into gas, wind erosion, and compaction.

Substrate: A surface on which an organism grows or is attached.

Surface water: An open body of water, such as a river, stream or lake, and all springs, wells, or other collectors, which are directly influenced by surface water.

Suspended: The term applies to the state of floating in water.

Swale: A low place in a tract of land, such as a wide, shallow ditch, usually grassed or paved.

Take: Defined in the FESA as "…harass, harm pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct" on special-status species covered under FESA or CESA.

Terrestrial species: Types of species of animals and plants that live on or grow from the land.

Threatened species: Legal status afforded to plant or animal species that are likely to become endangered within the foreseeable future throughout all or a significant portion of the range, as determined by the USFWS or NMFS for federal species and by the CDFW for state species.

Toe drain: Open-jointed tile or perforated pipe located at the toe of a dam used in conjunction with horizontal drainage blankets to collect seepage from the embankment and foundation and convey the seepage to a location downstream from the dam.

Topographic map: A map indicating surface elevation and slope, e.g., U.S. Geological Survey (USGS) quadrangle series maps showing the shape of the earth's surface by contours. Topographic maps also show control data, boundaries, roads, buildings, watercourses, lakes and reservoirs, and other land features. The 7.5-minute series is appropriate for doing inundation mapping.

Topography: Physical shape of the ground surface, especially the relief and contour of the land.

Topsoil: The topmost layer of soil, usually containing organic matter, which is capable of supporting plant growth.

Total maximum daily loads: Estimates of the amount of specific pollutants that a body of water can safely take without threatening beneficial uses.

Transmission line: Facility for transmitting electrical energy at high voltage from one point to another point. Transmission line voltages are normally 115 kilovolt or larger.

Tributary: River or stream flowing into a larger river or stream.

Trihalomethanes: Any of several synthetic organic compounds formed when chlorine or bromine combine with organic materials in water.

Trophic level: Ranking of an animal within the food chain.

Turbidity: A measure of the cloudiness of water caused by the presence of suspended matter.

Unique Farmland: Unique Farmland is land which does not meet the criteria for Prime Farmland or Farmland of Statewide Importance, that has been used for the production of specific high economic value crops at some time during the two 'update' cycles prior to the mapping date. It has the special combination of soil quality, location, growing season, and moisture supply needed to produce sustained high quality and/or high yields of a specific crop when treated and managed according to current farming methods. Examples of such crops may include oranges, olives, avocados, rice, grapes, and cut flowers. It does not include publicly-owned lands for which there is an adopted policy preventing agricultural use.

Vernal pool: Seasonally-ponded landscape depressions in which water accumulates because of limitations to subsurface drainage and that support a distinct association of plants and animals.

Water column: A section of water extending from the surface of a body of water to its bottom.

Water quality: The condition of water as it relates to impurities.

Water rights: A legally protected right to take possession of water occurring in a natural waterway and to divert that water for beneficial use.

Waters of the United States: As defined in the Clean Water Act §404, waters of the U.S. are only surface waters, rivers, lakes, estuaries, coastal waters, and wetlands. Not all surface waters are legally waters of the United States.

Generally, those waters include interstate waters and tributaries, intrastate waters and tributaries used in interstate and/or foreign commerce, territorial seas at the cyclical high-tide mark, and wetlands adjacent to the above.

Watershed: A region or area where water ultimately drains or flows to a river, stream, lake or other body of water.

Water table: The groundwater level in an unconfined aquifer.

Weir: An overflow structure built across an open channel to raise the upstream water level and/or to measure the flow of water.

Well: A hole or shaft drilled into the earth to get water or other underground substances.

Wetland: A zone that is periodically or continuously submerged or has high soil moisture, has aquatic and/or riparian vegetation components, and is maintained by water supplies significantly in excess of those otherwise available through local precipitation. Lands including swamps, marshes, bogs, and similar areas such as wet meadows, river overflows, mudflats, and ponds.

Wildlife corridor: A belt of habitat that is essentially free of physical barriers such as fences, walls, and development, and connects two or more larger areas of habitat, allowing wildlife to move between physically separate areas.

Williamson Act: The California Land Conservation Act of 1965, commonly known as the Williamson Act, enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use for ten years. In return, landowners receive property tax assessments that are based on farming and open space uses as opposed to full market value.

Appendix B

List of Technical Reports

Technical documents for the Prospect Island Tidal Habitat Restoration Project are available from the California Department of Water Resources (DWR) (mailto:FRPA@water.ca.gov) on request:

Reports that informed the 2016 Draft Environmental Impact Report (DEIR):

Site Characterization and Groundwater Monitoring Data Collection Summary (DWR 2013):

DWR (California Department of Water Resources). 2013. Site Characterization and Groundwater Monitoring Data Collection Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum Report. DWR, North Central Region Office.

Preliminary Wetland Delineation (DWR 2014a):

DWR. 2014a. Preliminary Wetland Delineation for the Prospect Island Tidal Habitat Restoration Project, Solano County, California. Final Report August 2014. Prepared by Stillwater Sciences, Davis, CA. Contract No. 4200009291.

Site Characterization and Groundwater Monitoring Data Analysis Summary (DWR 2014b):

DWR. 2014b. Site Characterization and Groundwater Monitoring Data Analysis Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, CA. Memorandum Report. DWR, North Central Region Office.

Botanical Surveys (DWR 2014c):

DWR 2014c. Botanical Survey Report for the Prospect Island Tidal Habitat Restoration Project. Prepared by Lesley Hamamoto – Senior Environmental Scientist. Solano County, CA.

Phase 1 Environmental Site Assessment (DWR 2014d):

DWR. 2014d. Phase I Environmental Site Assessment. Fish Restoration Program Agreement – South Prospect Island Acquisition. Solano County, CA.

Title Report Map (DWR 2014e):

DWR. 2014e. Prospect Island Title Report Map. Exhibit Maps – Drawing Number K-9D-21 and K-9D-44.

Conceptual Restoration Plan (DWR and CDFW 2014):

DWR and CDFW (California Department of Water Resources and California Department of Fish and Wildlife). 2014. Prospect Island Tidal Habitat Restoration

Project: Conceptual Restoration Plan. Prepared by DWR and CDFW, Sacramento, CA, with assistance from Stillwater Sciences, Davis, CA and Wetlands and Water Resources, Inc., San Rafael, CA. Contract No. 4200009291.

Sampling and Analysis Plan (Kinnetic Laboratories 2015):

Kinnetic Laboratories, Inc. 2015. Sampling and Analysis Plan – Evaluation of Miner Slough Spur Channel Dredge Material, Prospect Island Tidal Habitat Restoration Project. Prepared for California Department of Water Resources. Contract No. C51464. Kinnetic Laboratories, Inc., Santa Cruz, CA.

Biological Surveys (SWS 2014):

SWS (Stillwater Sciences). 2014. Prospect Island Tidal Habitat Restoration Project Biological Surveys. Prepared by SWS, Berkeley, CA for California Department of Water Resources, Sacramento, CA.

Phase 1 Modeling Results Synthesis Final Report 2012 (SWS and WWR 2012):

SWS and WWR (Stillwater Sciences and Wetlands & Water Resources). 2012. Prospect Island Tidal Restoration: Synthesis of Phase 1 Screening-Level Modeling Evaluation of Conceptual Restoration Alternatives. Final Report. Prepared by Stillwater Sciences, Davis, CA, and Wetlands & Water Resources, Inc., San Rafael, CA, with assistance from Resource Management Associates, Fairfield, CA, and cbec eco-engineering, West Sacramento, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

Invasive Vegetation Existing Conditions Assessment (SWS and WWR 2013):

SWS and WWR. 2013. Prospect Island Invasive Vegetation Existing Conditions Assessment. Prepared by Stillwater Sciences, Davis, and Wetlands & Water Resources, Inc., San Rafael, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

Supplemental Phase 1 Screening-Level Modeling Results Memorandum (WWR and SWS 2013):

WWR and SWS (Wetlands & Water Resources and Stillwater Sciences). 2013. Prospect Island Tidal Restoration: Supplemental Phase 1 Screening-Level Modeling Results Memorandum. Prepared by Stillwater Sciences, Davis, CA and Wetlands & Water Resources, Inc., San Rafael, CA, with assistance from Resource Management Associates, Fairfield, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

Phase 2 Modeling Synthesis Final Report 2014 (WWR and SWS 2014):

WWR and SWS. 2014. Phase 2 Modeling Synthesis Report, Prospect Island Tidal Habitat Restoration Project. Final Report. Prepared by Wetlands and Water Resources, Inc., San Rafael, CA and Stillwater Sciences, Davis, CA, with assistance from Resource Management Associates, Fairfield, CA and Delta Modeling Associates, San Francisco, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

Reports prepared after circulation of the 2016 DEIR, including reports that informed the 2019 Partial Recirculated DEIR:

Prospect and Ryer Island Hydrologic Data Analysis October 1, 2013 to April 1, 2017 (DWR 2018a):

DWR. 2018a. Prospect and Ryer Island Hydrologic Data Analysis, October 1, 2013 to April 1, 2017, Prospect Island Tidal Habitat Restoration Project, Solano County, CA. Memorandum Report. DWR, North Central Region Office, CA.

Review of ENGEO's Seepage Impact Analysis, Prospect and Ryer Islands (DWR 2018b):

DWR 2018b. Review of ENGEO's Seepage Impact Analysis, Reclamation District 501, Prospect and Ryer Islands, Solano County, California, July 14, 2015, ENGEO Incorporated. Memorandum.

Response to RD 501 Comments on the February 2018 DWR Hydrologic Data Analysis (DWR 2019):

DWR. 2019. Response to RD 501 Comments on the February 2018 DWR Hydrologic Data Analysis Report, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum.

Sediment Sampling and Analysis Reports (Kinnetic Laboratories 2016a,b):

Kinnetic Laboratories, Inc. 2016a. Sediment Testing Results for Prospect Island. Letter to Joseph Heavin, Hultgren-Tillis Engineers. Prepared by Kinnetic Laboratories, Inc., Santa Cruz, CA.

Kinnetic Laboratories, Inc. 2016b. Evaluation of Miner Slough Spur Channel Dredge Material, Prospect Island Tidal Habitat Restoration Project. Sampling and Analysis Report. Contract No. C51464. Kinnetic Laboratories, Inc., Santa Cruz, CA.

Hydrodynamic Modeling Analysis for 100-year and 200-year Flood Events (RMA 2016):

RMA (Resource Management Associates, Inc.). 2016. Prospect Island Tidal Habitat Restoration Project, Hydrodynamic Modeling Analysis for 100-year and 200-year Flood Events. Technical Memorandum. Contract No. 4200009291. RMA, Davis, CA.

Note: this report relates to Alternative 2 of the FEIR, and Alternative 4 of the Phase 1 and 2 Modeling.

Prospect Island Tidal Restoration Project Modeling Evaluation for Alternative 2 Flow and Salinity Changes Technical Memorandum (RMA 2018):

RMA. 2018. Prospect Island Tidal Restoration Project, Modeling Evaluation for Alternative 2 Flow and Salinity Changes. Technical Memorandum. Contract No. 4200009291. RMA, Davis, CA.

Note: this report relates to Alternative 2 of the FEIR, and Alternative 4 of the Phase 1 and 2 Modeling.

Appendix C

Notice of Preparation and Scoping Report

CEQA Scoping Report

Prospect Island Tidal Habitat Restoration Project

Environmental Impact Report

Lead Agency/Project Sponsor:

California Department of Water Resources

Fish Restoration Program Agreement

August 2013

TABLE OF CONTENTS

1. INTRODUCTION 1
1.1. ORGANIZATION OF THE SCOPING REPORT 1
1.2. PROJECT BACKGROUND 1
1.3. SCOPING MEETING NOTIFICATION 2
1.4. SCOPING MEETING 2
1.5. OTHER PUBLIC INVOLVEMENT STRATEGIES 3
2. PUBLIC COMMENTS RECEIVED THROUGH SCOPING 4
2.1. GENERAL 4
2.2. AESTHETICS 4
2.3. AIR QUALITY AND GREENHOUSE GAS 4
2.4. BIOLOGICAL RESOURCES 5
2.5. COLLABORATION, CONSULTATION, COORDINATION 6
2.6. CULTURAL RESOURCES 7
2.7. GEOLOGY AND SOILS 7
2.8. HYDROLOGY AND WATER QUALITY 8
2.9. LAND USE/PLANNING 10
2.10. NOISE 11
2.11. OPERATIONS AND MAINTENANCE 11
2.12. PERMITTING AND ENFORCEMENT 11
2.13. PUBLIC SERVICES 11
2.14. RECREATION 11
2.15. TRANSPORTATION/TRAFFIC 12
3. COMMENTERS 13
APPENDIX A: MEETING NOTICE MATERIALS .....
APPENDIX B: SCOPING MEETING MATERIALS .....
APPENDIX C: WRITTEN & ORAL COMMENTS .....
APPENDIX D: ABBREVIATIONS .....

1. INTRODUCTION

The California Department of Water Resources (DWR), the lead agency implementing the California Environmental Quality Act (CEQA), and the California Department of Fish & Wildlife (CDFW) have initiated environmental compliance documentation for the Prospect Island Tidal Habitat Restoration Project (project), a component of the Fish Restoration Program Agreement (FRPA), in Solano County, California. This includes the preparation of a Draft Environmental Impact Report (DEIR), which will be prepared in compliance with CEQA (Public Resources Code Section 21000 et seq.) and the CEQA Guidelines (California Code of Regulations Title 14, Chapter 3, Sections 15000 and 15387). The DEIR will evaluate the environmental effects of restoring tidal freshwater emergent marsh wetland and open water habitats on Prospect Island.

Under CEQA, scoping is an early and open process for determining the scope of issues to be addressed in the DEIR. During the scoping process, the CEQA lead agency is required to invite potentially affected federal, state, local agencies, potentially affected Indian tribes, and other interested persons to provide input on the scope of the environmental analyses to be conducted for the project. The CEQA lead agency is also required to hold at least one public scoping meeting for projects of statewide, regional, or area-wide significance.

DWR initiated the CEQA process by issuing a Notice of Preparation (NOP) on May 17, 2013 to solicit input and comments on the scope of the DEIR. Stakeholders were provided over 30 days from the date of receiving the NOP to comment on the NOP and inform the scope of the DEIR. The review period of the NOP began May 17, 2013, and ended June 21, 2013. DWR received comments from 14 entities including federal and state agencies, local interest groups, local residents, farmers, and landowners. DWR held a public scoping meeting on June 10, 2013 to identify public concerns and comments on the DEIR scope.

This CEQA Scoping Report summarizes the scoping process conducted for this project, as well as the oral and written comments received during the formal public scoping comment period.

1.1. Organization of the Scoping Report

This document is organized in three sections. Section 1 describes the project and the scoping process. Section 2 describes the comments received during the scoping process, either at the public scoping meeting or as formal comment letters submitted via the project website, e-mail, fax, and mail. Both oral and written comments are documented in Section 2. Most responses included more than one comment, and comments are grouped together by issue topics. Section 3 lists the individuals and agencies that provided written and oral scoping comments. Appendix A includes materials used to notify the public of the scoping meeting. Appendix B contains the meeting materials. Appendix C includes the written comments received during the scoping period. Appendix D includes a list of the abbreviations used in this document.

1.2. Project Background

The Fish Restoration Program Agreement (FRPA) between the California Department of Water Resources (DWR) and the California Department of Fish and Wildlife (CDFW) addresses specific habitat restoration requirements of the US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions (BiOps) for State Water Project (SWP) and Central Valley Project operations. FRPA also addresses the habitat requirements of the CDFW Longfin Smelt Incidental Take Permit for SWP Sacramento-San Joaquin Delta operations.

The primary objective of FRPA is to implement the fish habitat restoration requirements and related actions of the BiOps and the ITP in the Delta, Suisun Marsh, and Yolo Bypass. FRPA is focused on restoring 8,000 acres of intertidal and associated subtidal habitat in the Delta and Suisun Marsh to benefit delta smelt, 800 acres of mesohaline habitat to benefit longfin smelt, and a number of related actions for salmonids. Habitat restoration actions implemented in compliance with the USFWS BiOp may also meet the habitat restoration requirements of the ITP.

The project is the proposed restoration of an approximately 1,600-acre property located in Solano County in the northern portion of the Sacramento-San Joaquin River Delta to tidal wetland habitat. The project is intended to partially fulfill the requirements stated above.

1.3. Scoping Meeting Notification

DWR noticed stakeholders about the NOP and the scoping period and meeting through the following methods:

- Posting in the State Clearinghouse
- Paid advertisements in the Sacramento Bee and the Rio Vista Beacon
- Certified mailing of the NOP to a list of 34 interested and affected stakeholders
- Email notice of the NOP with a link to access it online was sent to FRPA's listserv of 150 recipients, including agencies, organizations, and individuals that have shown interest in the project
- Information was posted on the FRPA program website
- Communications during previously scheduled stakeholder outreach and coordination meetings

Copies of advertisements and meeting notice materials are included in Appendix A.

1.4. Scoping Meeting

DWR conducted one scoping meeting, on June 10, 2013 from 7:00 – 9:00 p.m. in West Sacramento, CA, to solicit comments and input on the scope of the DEIR.

The scoping meeting began with a 15-minute "open-house" activity where participants were invited to browse project maps and ask questions and discuss specific issues of concern with agency and program staff.

The open house was followed by presentations made by DWR and program staff and consultants. The presentations provided information on: the meeting process and how to provide public comment; the CEQA process, scoping process, and compliance with CEQA regulations; and FRPA and the Prospect Island project. Copies of the meeting materials are included in Appendix B.

A public comment session was held after the presentations, during which meeting attendees were invited to provide formal oral comments. These comments are summarized in Section 2 below. During the scoping meeting, participants also were encouraged to submit written comments, or to take home comment forms to submit by mail, e-mail, or fax before close of the comment period on June 21, 2013. Four individuals attended the scoping meeting. These written comments are also summarized as part of this report and are included in their entirety in Appendix C.

1.5. Other Public Involvement Strategies

In addition to soliciting and collecting comments on the project during the scoping period, DWR and CDFW engaged with key stakeholders and the general public prior to the scoping period in a variety of ways as outlined by the Prospect Island Communications and Engagement Plan. This plan outlines several public involvement strategies to be undertaken throughout the project's CEQA process to inform and involve all levels of leaders, managers, stakeholders, and the general public about project activities, progress, actions, and documents. The strategies include: informational briefings through existing stakeholder engagement venues, with local governments and agencies, and with other interested stakeholders; engaging landowners and other potentially affected stakeholders to inform project design; periodic and timely presentations; partnerships with local organizations to reach out and involve constituents; information dissemination on the project website and through the project listserv; publications including fact sheets and newsletters; and frequent and ongoing stakeholder coordination.

The following stakeholder and public outreach meetings were held prior to the scoping period.

Date	Venue/Stakeholder Group	Format
8/21/12	BDCP Management Team Meeting	Interagency Coordination
10/16/12	Bay Delta Science Conference	Conference Presentation
10/24-25/12	DRERIP Evaluation	Expert Panel Review
11/14/12	Delta Conservancy All-Delta Public Meeting	Public Presentation
1/10/13	US Army Corps Operations Branch and Port of West Sacramento	Coordination Meeting
1/17/13	Delta Conservancy Board	Public Presentation
1/17/13	Delta Independent Science Board	Public Presentation
2/1/13	Arrowhead Marina	Coordination Meeting
2/14/13	Solano County Water Agency	Coordination Meeting
2/26/13	Port of West Sacramento and Bar Pilots Association	Coordination Meeting
3/4/13	Solano County Department of Resource Management	Coordination Meeting
3/7/13	RD 2068 and North Delta Water Agency	Coordination Meeting
3/28/13	Delta Protection Commission	Public Presentation
4/4/13	RD 501	Coordination Meeting
4/18/13	US Army Corps Operations Branch and Central Valley Flood Protection Board	Interagency Coordination
4/24/13	IEP-CWEMF Joint Conference	Conference Presentation and Poster
4/30/13	U.S. Army Corps of Engineers	Interagency Coordination
5/21/13	Lorraine Stringer	Coordination Meeting
5/23/13	Yolo Bypass Working Group	Public Presentation
6/5/13	North Delta Water Agency	Coordination Meeting

2. PUBLIC COMMENTS RECEIVED THROUGH SCOPING

This section summarizes the range of scoping comments received through the scoping period. These comments raised issues that will be taken into consideration by the FRPA agencies, and may require further coordination with the commenter or the relevant organization. The summary of comments presented in this section is organized by topic area and arranged in alphabetical order. This organization does not represent a relative importance among comments or topic areas, but rather is intended to facilitate presentation of comments in an orderly manner.

In total, 14 entities provided written and/or oral comments through the scoping process.

2.1. General

Two comments stated that a thorough and complete project description (including a description of all phases of the Project, equipment to be used, access roads, staging areas, construction procedures, construction schedule, and long-term monitoring of mitigated lands and biological resources) should be included in the EIR in order to facilitate meaningful environmental review of potential impacts, mitigation measures, and alternatives. One of these comments stated that this project description should be precise in describing project details related to the California State Lands Commission allowable activities in order to inform the Commission's analysis of the work to be performed at the site.

Another comment stated that the EIR should include a cumulative impacts section to determine all past, present, and probable future projects in the area that may contribute to a greater level of environmental impacts. This analysis should define the cumulative impacts "study area" boundary, show the locations of other projects included in the analysis, and explain how those projects and the proposed project may interact. The comment indicated that if potentially significant cumulative impacts are identified, the EIR should propose feasible mitigation measures to minimize those potential impacts.

An additional comment indicated that in order to avoid the improper deferral of mitigation, mitigation measures should either be presented as specific, feasible, or enforceable obligations, or should be presented as formulas containing "performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way" (according to State CEQA Guidelines).

2.2. Aesthetics

One comment expressed concern about vegetation removal along the road on the north side of Prospect Island, close to Arrowhead Marina, and stated that these aesthetic impacts should be evaluated.

2.3. Air Quality and Greenhouse Gas

Two comments stated that the effect of global warming and associated potential rise in sea levels along the California coast and associated effects on local hydrology, water quality, and perimeter levee stability should be studied in the EIR. The comments indicated that the project area and facilities/infrastructure could be affected under the common range of sea level rise scenarios.

One comment stated that a greenhouse gas emission (GHG) analysis that is consistent with the California Global Warming Solutions Act should be developed. The comment stated that the EIR should list all expected equipment and vehicles to be used as well as their duration of use and their GHG emissions rate, identify a threshold of significance for GHG emissions, calculate the level of GHGs that will be emitted as a result of construction and ultimate build-out of the project, and determine significance of the impacts and those emissions. If impacts are significant, the comment stated that mitigation measures that would reduce the impacts to the extent feasible be should identified in the EIR.

2.4. Biological Resources

A comment indicated that DWR should work closely with CDFW, USFWS, and National Marine Fisheries Service (NMFS) during development of the EIR to identify any special-status plants or wildlife species occurring in the project area that may be affected by the project. The comment indicated that although the project may result in cumulative positive impacts to target species, project construction could result in temporary impacts to species that are not the beneficiaries of the restored tidal marsh. As such, the EIR should analyze the potential for the project to impact all sensitive species in the project area, and to identify all feasible mitigation if impacts to these species are found to be significant.

Another comment expressed concern that if new habitat for endangered species is created, Reclamation District operations could be negatively impacted.

Another comment expressed that the potential for bass to enter the restoration area is a possibility and suggested that this be studied. The comment also noted that there are currently fishes on Prospect Island, especially visible at night.

One comment stated that DWR should verify that the state objectives in the NOP are consistent with Delta Plan Policy ER R2, which calls for restoring habitats at appropriate elevations and in a manner consistent with Section III of the CDFW's *Draft Conservation Strategy for the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Region* (DFG 2011).

One comment stated that DWR should verify in its environmental analysis that the project is consistent with Delta Plan Policy EP P5 (23 CCR Section 5009), which states that the potential for new introductions of, or improved habitat conditions for, nonnative invasive species, striped bass, or bass must be fully considered and avoided or mitigated in a way that appropriately protects the ecosystem. Another comment stated that the EIR should examine whether elements of the project would favor non-native fish with the Sacramento-San Joaquin River Delta.

One comment indicated that Delta Plan Recommendation ER R2 states that the project should ensure connections between areas being restored and existing habitat areas and other elements of the landscape needed for the full life cycle of the species that will benefit from the restoration project. The comment also indicated that ER R2 recommends enhancing the ability of the Yolo Bypass to flood more frequently to provide more opportunities for migrating fish, especially Chinook salmon, to use this system as a migration corridor that is rich in cover and food.

One comment indicated that project-level activities related to habitat restoration and management should be done in coordination with local and regional Habitat Conservation Plans, and stated that the project should coordinate with Caltrans in instances where DWR and

Caltrans programs share stewardship responsibilities for habitats, species, and/or migration routes.

One comment stated that the EIR should consider the project's potential to encourage the establishment or proliferation of aquatic invasive species such as the quagga mussel, or other nonindigenous, invasive species including aquatic and terrestrial plants. The comment indicated that these species could be brought in from construction boats and barges via biofouling, wherein marine and aquatic organism attach to and accumulate on the hull and other submerged parts of a vessel. If the environmental analysis finds potential impacts, possible mitigation could include contracting vessels and barges from nearby, or requiring hull cleaning from contractors.

One comment stated that the EIR should include a complete assessment of the habitats, flora and fauna within and adjacent to the project area, including endangered, threatened, and locally unique species and sensitive habitats. In addition, this comment urged planners to consider direct and indirect changes (temporary and permanent) that may occur with implementation of the project, including changes downstream of the project. This comment also stated that rare, threatened, and endangered species should be addressed according to CEQA Guidelines 15380.

One comment indicated that a California Endangered Species Act (CESA) permit is recommended if the project has the potential to result in take of species of plants or animals listed under CESA, and encouraged early consultation.

One comment indicated that because the project's intent is to create rearing habitat for endangered or threatened species, the EIR should consider the potential for additional safeguards to reduce the risk of harm from intake pumps used to divert surface water for irrigation on adjacent islands. The comment noted that some safeguards are costly or can interfere with pumping operations and stated that those issues should be addressed as well.

One comment expressed concern about beavers in the project area.

2.5. Collaboration, Consultation, Coordination

One comment suggested that public transparency be included in the intentions of the project, and reflected that some members of the community are concerned about the potential link between the Prospect Island project and other DWR initiatives such as the Peripheral Canal proposal. Clear communications about the project and its link to other projects could increase public support.

A comment noted that the Central Valley Flood Protection Board (CVFPB) is responsible for flood safety within California's Central Valley and maintains the integrity of existing flood control systems, regulated streams and designated floodways through its regulatory authority, and has provided assurances to the U.S. Army Corps of Engineers (USACE) to operate and maintain federal-state facilities of the State Plan of Flood Control, including Miner Slough and the east levee of the Sacramento Deep Water Ship Channel. CVFPB has assigned the operations and maintenance responsibility of Miner Slough and project levees along Miner Slough and the DWSC to Reclamation District 501. The comment stated that a permit is required prior to any work defined under California Code of Regulations, Title 23, Section 6, because those facilities could be impacted by the project.

A comment noted that the project could be a "covered action" under the Delta Reform Act, established as a certification process for compliance with the Delta Plan, in which case DWR must certify that the covered action is consistent with the Delta Plan and must file a certificate of consistency with the Delta Stewardship Council (DSC) that includes detailed findings. The comment noted that not all actions that occur in whole or in part in the Delta are covered actions, but specified that the definition of a covered action is provided in California Water Code Section 85057.5(a). The comment stated that project staff should engage in early consultation with DSC staff to determine whether the project is a covered action.

One comment stated that DWR and CDFW should adhere to the policy set forth in the FRPA Implementation Plan to develop an adaptive management plan consistent with the framework described in the Delta Plan in the environmental analysis and evaluation of alternatives. In addition, one comment stated that Delta Policy G P1 (23 CCR Section 5002) specifies what must be addressed in a Certification of Consistency filed by a state of local public agency with regard to a covered action, and stated that all covered actions need to document the use of best available science.

One comment noted that ecosystem restoration covered actions must include adequate provisions, appropriate to the scope of the covered action, to assure continued implementation of adaptive management, satisfied through an adaptive management plan that describes the approach to be taken, consistent with the adaptive management framework in the Delta Plan regulations.

One comment indicated that the Port of Sacramento may require the Prospect Island property as mitigation acreage for the Deep Water Ship Channel deepening project. The comment noted that the Port would like to coordinate with DWR to ensure that the habitat project is consistent with USACE mitigation requirements related to dredging, as well as coordinate on any planning, design, or construction activities related to the project, in order to mitigate impacts to navigation of the channel.

2.6. Cultural Resources

One comment stated that the cultural resource assessment that has already been prepared for the property should be further discussed in the EIR and that the findings of this assessment be attached as an appendix to the EIR, excluding or redacting confidential sensitive site information as appropriate.

One comment stated that the EIR should evaluate potential impacts to submerged cultural resources in the project area. The California State Lands Commission (CSLC) maintains a shipwrecks database that can assist with the analysis, and the comment stated that DWR should contact CSLC to obtain shipwrecks data from the database, as submerged archaeological sites or submerged historic resources that have remained in State waters for more than 50 years are presumed to be significant.

One comment stated that the EIR should mention that the title to all abandoned shipwrecks, archaeological sites, and historic or cultural resources on or in the tide and submerged lands of California is vested in the State and under the jurisdiction of the CSLC.

2.7. Geology and Soils

One comment indicated that the north levee of Prospect Island and the southeast levee on Little Holland are limited height levees, and the project would need to follow the height specifications

of these and other project levees. In addition, the comment indicated that all levees need to have protection against water and wave action on both the water and land sides.

One comment expressed that the project should protect the Prospect Island levees to enable other levees to protect neighboring properties from wave effects of to the prevailing west wind.

Two comments observed that in the past when Prospect Island has been inundated, Ryer Island also usually becomes saturated, purportedly due to the presence of horizontal sand lenses that run beneath both islands. As a result, the comments stated that the EIR should examine the geologic and hydrologic structure of Prospect Island, identify potential linkages with surrounding areas with shared sand lenses, and consider the effects that permanent flooding of Prospect Island would have on surrounding areas, in an effort to decrease the potential for increase of overall head pressure on sand lenses and avoid greater soil saturation and groundwater seepage on Ryer Island.

Another comment addressed the potential for seepage with excavation of channels, and stated that the results of the Ryer Island seepage analysis and any hydraulic influences for Prospect Island should be included in the environmental analysis.

One comment stated that the EIR should include an analysis of the off-site source locations for the sediment to be imported to the project site.

One comment expressed a concern about the potential increase of sedimentation and erosion within the Sacramento River Bank Protection Project. The comment stated that impacts on maintenance work (including erosion, vegetation management, and sediment removal; and associated financial costs) should be addressed under the cumulative effects analysis for the project. The comment also stated that mitigation measures and project design alternatives should avoid potential adverse impacts to the facilities and design flood carrying capacities of the project.

One comment indicated that since the proposed project is in the Sacramento-San Joaquin River Delta, sediment quality and suitability should be tested. The comment stated that the EIR should include avoidance and mitigation measures to reduce potential release of mercury/methylmercury and other toxins from project activities into waterways and onto state lands underlying those waterways.

2.8. Hydrology and Water Quality

The primary concerns that commenters expressed during the scoping period were related to hydrology. Comments stated that any significant impacts to water quality should be identified in the environmental documentation.

One comment indicated that because the Central Valley Regional Water Quality Control Board (CVRWQCB) identified the CSLC as a nonpoint source discharger of methylmercury, any action taken that might result in mercury/methylmercury suspension within the Sacramento-San Joaquin Delta Estuary may affect the CSLC's efforts to comply with the CVRWQCB's Total Maximum Daily Load.

These comments states that the effects of flood events on water levels and water rising and draining in the case of flood events should be studied. Several comments raised concern about trapping tidal water on the island in cases of tidal fluctuations, and would like water to move with tidal fluctuations rather than having Prospect Island serve as a water storage site.

One comment indicated that some project-level activities may affect riparian flow patterns upstream of bridges, trestles, culverts, or other structures for which Caltrans hold responsibility, and as a result, the EIR should include hydrological studies to determine whether such impacts will occur and identify appropriate mitigation measures.

Several comments stated that the project should reduce, or at least not increase, flood risk.

One comment stated that the DEIR should examine the circumstances under which Prospect Island would flood, and the water depths needed for flooding parts of Prospect Island that have varying depths.

One comment expressed concern about the quality of water entering reclamation ditches, and stated that the effects of stagnant water on reclamation ditches should be studied.

A comment stated that potential changes in Delta salinity and increased seawater intrusion should be examined in the EIR to ensure that appropriate avoidance or mitigation measures are developed if necessary. This comment indicated that hydrodynamic modeling has shown that tidal marsh restoration in the Delta has the potential to increase seawater intrusion into the Delta. Other potential impacts that the comment stated should be evaluated in the EIR include: changes in salinity at drinking water intakes in the Delta, including bromide and chloride concentrations and other increases in salinity that could "otherwise substantially degrade water quality" in the absence of standards violations (per California Code of Regulations, Division 6, Chapter 3, Article 20, Appendix G); changes in compliance with water quality objectives set by the State Water Resource Control Board's Decision 1641; changes in the position of the 2 parts per thousand isohaline on the Sacramento River (X2 position); and changes in upstream reservoir releases needed to meet water quality objectives.

One comment stated that the project should avoid lowering water quality or water levels during irrigation season.

Another comment stated that the EIR should evaluate the feasibility of designing operable overflow weirs that can limit the number of Prospect Island flood events and have a positive flood effect by flooding the Island in the instance of high water with high tides, as the controlled flooding of Prospect Island can lower water elevation during flood flows and high tides.

One comment indicated that the project may require a Lakebed and Streambed Alteration Agreement, pursuant to CDFW Code Section 1600 for project activities within or near Miner Slough and the Sacramento Deep Water Ship Channel that will: divert or obstruct the natural flow; change the bed, channel or bank including associated riparian or wetland/marsh resources; use material from the steam/channel bed; or substantially adversely affect fish and wildlife resources.

A similar comment indicated that consideration should be made early on to provide maximum flexibility to sustain the project area's primary flood control purpose and avoid adverse cumulative impacts to facilities of the State Plan of Flood Control and the Sacramento River Flood Control Project. It was stated that any activity that encroaches on Miner Slough or the east levee of the Deep Water Ship Channel should not adversely impact flood system integrity, conveyance, design water surface elevation, or operations and maintenance.

Several comments stated that the potential for scouring damage to neighboring levees should be studied in the EIR. Two comments expressed concern about the potential for scour effects caused by changed diversion and pumping practices on a restored wetland (i.e., Prospect

Island) and stated that the EIR should also examine the scour effects that could be caused by potential levee breaches, changes in surface water flow related to the location, method, and quantity of surface water diversions, as well as the location, method and quantity of surface water releases from Prospect Island into the surrounding waterways. Other comments stated that the EIR should consider how scour effects will be impacted under a variety of river conditions such as high flows from upstream reservoir releases, and how a rise in river level from upstream reservoir releases will be monitored and managed to prevent scouring of surrounding levees.

One comment expressed concern about how diversions of surface water onto and return flows from Prospect Island will be monitored and managed, as surface water diversions are subject to restrictions in time, quantity, and location, according to water rights.

One comment stated that the EIR should study the effects of water transfers involving Delta water supply and of altering existing flow patterns due to levee breaches on local water salinity level. The comment stated that the EIR should also incorporate continued monitoring of local water salinity levels, with respect to the changes incurred from proposed levee breaches under current and future conditions as a result of cross-regional water transfer agreements.

One comment stated that the EIR should consider Delta Plan Recommendation WQ R1 (stating that water quality in the Delta should be maintained at a level that supports, enhances, and protects beneficial uses identified in the applicable State Water Resources Control Board or regional water quality control board water quality control plans).

One comment raised a concern about the potential adverse effects of the project on adjacent land, such as increases in Ryer Island groundwater levels, increased scour on the Ryer Island Miner Slough levee, and increased flood risk. The comment stated that the EIR should address these concerns in a manner consistent with Delta Plan Policy P2 (23 CCR Section 5011).

2.9. Land Use/Planning

One comment indicated that the use of Prospect Island as a wetland habitat involves different use of water as compared to its historic agricultural activities, and stated that the EIR should consider how use of water on Prospect Island will be monitored and managed to ensure that consumptive use remains within the limit of existing Prospect Island water rights, and that the interests of other water rights holders are not injured.

One comment indicated that because the project is located entirely on public land, it is consistent with the part of Delta Plan Policy DP P2, which calls for ecosystem restoration plans to pursue sites on existing public lands before purchasing privately owned sites.

One comment indicated that the California State Lands Commission has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable waterways, as well as certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions. All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the projects of the Common Law Public Trust.

One comment indicated that the portion of the project in Miner Slough is located on lands under the jurisdiction of the California State Lands Commission (CSLC). As a result, a lease from CSLC will be required and the comment stated that the environmental review should determine the extent or location of the project on CSLC lands and if needed, submit detailed maps and/or

engineering designs to CSLC to determine the exact components of the project that will require a lease.

2.10. Noise

One comment stated that the EIR should evaluate noise and vibration impacts on fish and birds from construction, restoration, or flood control activities in the water, on the levees, and for land-side supporting structures. The EIR should describe weir installation in detail and evaluate whether any activities necessary for the weir installation could generate noise and underwater acoustic impacts that could affect species in the project vicinity. The comment indicated that mitigation measures could include species-specific periods when work would not negatively impact species, as defined by CDFW, USFWS, and NMFS.

2.11. Operations and Maintenance

One comment stated that levee maintenance and operations (e.g., levee patrols in high water events) should have an agency assigned to the task as well as dedicated long-term funding.

Two comments stated that the EIR should address the perpetual, ongoing maintenance of the Prospect Island levees that will not be breached, identify where responsibility for maintenance rests, and describe approaches for conducting maintenance in light of potentially flooded and ecologically sensitive surroundings, given that Prospect Island levees are critical to providing fetch length across the water and provide protection for surrounding area levees.

2.12. Permitting and Enforcement

One comment pointed out that waterways involved in the project are subject to a public navigational easement, which provides that the public has the right to navigate and exercise the incidences of navigation in a lawful manner on state waters that are capable of being physically navigated by oar or motor-propelled small craft. The activities completed under the project must not restrict or impede the easement right of the public.

2.13. Public Services

One comment indicated that the Delta “as place” should be protected, and that the project should contribute to protecting and enhancing the unique cultural, recreational, natural resource, and agricultural values of the Delta, as well as enhance opportunities for visitor-serving businesses according to Delta Plan Recommendation DP R17.

2.14. Recreation

One comment addressed the potential for Prospect Island to be accessible and navigable by boat and expressed concern about the associated potential for increased recreation access by duck hunters.

One comment indicated that Delta Plan Recommendation DP R11 calls for water management and ecosystem restoration agencies to provide recreation opportunities, including visitor-serving business opportunities, at new facilities and habitat areas whenever feasible. This same comment indicated that Recommendation DP R14 calls on the CDFW, in cooperation with other public agencies, to collaborate with nonprofits, private landowners, and business partners to expand wildlife viewing, angling and hunting opportunities; and that Recommendation DP R16

states that public agencies owning land should increase opportunities, where feasible, for bank fishing, hunting, levee-top trails, and environmental education.

One comment stated that the scope of the EIR should be expanded to include other recreational activities beyond hunting and fishing that are considered public trust uses or values, such as kayaking, boating, bird watching, swimming, and others. The comment also stated that during construction, public notification measures should be implemented to notify the public of possible closures to the Sacramento-San Joaquin River Delta and identify alternate access points for use areas with appropriate rerouting directions.

2.15. Transportation/Traffic

One comment also indicated that activities involving demolition, reinforcement, or rehabilitation of dikes or levees on which transportation facilities are built may potentially affect state transportation facilities. Built features on top of dikes and levees may contribute additional engineering considerations related to weight loading or compaction, and the comment stated that these factors should be addressed through geotechnical and hydrological studies conducted in coordination with Caltrans at the project level.

One comment indicated that any work or traffic control that encroaches on the State Right of Way requires an encroachment permit that is issued by Caltrans, and that traffic-related mitigation measures should be evaluated in the environmental review process and incorporated into the construction plans prior to the encroachment permit process.

No comments were received that pertained directly to Agricultural Resources, Utilities/Service Systems, Population and Housing, Mineral Resources, or Hazards and Hazardous Materials.

3. COMMENTERS

Agencies, organizations, and individuals providing oral or written scoping comments are listed in the tables below. Table 3.1. lists those individuals who provided oral comments during the scoping meeting. Table 3.2. lists the agencies and organizations that provided written comments during the scoping period outside of the scoping meeting. Written comments received are included in Appendix C. The transcript of the scoping meeting is also included in Appendix C.

Table 3.1. Oral Comments Received During Scoping Meeting

Oral Comments Received During Scoping Meeting in West Sacramento, California, June 10, 2013	
Name	**Affiliation**
Dave Stringer	Individual
Tom Hester	Individual - Ryer Island, Incorporated
John and Kathy Brimmer	Individuals - Ryer Island Ranch

Table 3.2. Written Comments Received During the Scoping Period

Comments Received During Scoping		
Agency/Affiliation	**Name**	**Type of Organization**
California Department of Fish & Wildlife	Scott Wilson	State Agency
Central Valley Flood Protection Board	Jay S. Punia	State Agency
Delta Stewardship Council	Cindy Messer	State Agency
California State Lands Commission	Cy R. Oggins	State Agency
California Department of Transportation	Erik Alm	State Agency
Contra Costa Water Agency	Leah Orloff	Local Agency
On behalf of Reclamation District 501	Hanson Bridgett LLP	Local Agency
Reclamation District 999	John Webber	Local Agency
Port of Sacramento	Rick Toft	Local Agency
On behalf of Islands Inc.	Hanson Bridgett LLP	Organization

APPENDIX A: MEETING NOTICE MATERIALS

- Notice of Preparation
- Display Advertisement (from Sacramento Bee and Rio Vista Beacon)
- Notification Email to the FRPA Listserv (5/20)
- State Clearinghouse Summary of Postings

NOTICE OF PREPARATION OF A DRAFT ENVIRONMENTAL IMPACT REPORT

TO: Agencies and Interested Parties

FROM: California Department of Water Resources

DATE: **May 17, 2013**

SUBJECT: Announcement of:

1) Notice of Preparation of an Environmental Impact Report on the Prospect Island Tidal Habitat Restoration Project
2) Public Scoping meeting to be held on **Monday June 10, 2013**
3) Scoping comments due by **June 21, 2013**

LEAD AGENCY: California Department of Water Resources (DWR)

PROJECT NAME: Prospect Island Tidal Habitat Restoration Project

PROJECT AREA: Prospect Island (Sacramento - San Joaquin River Delta)

The Department of Water Resources (DWR), lead agency implementing the California Environmental Quality Act (CEQA) (Public Resources Code Section 2100 et seq.), will prepare an Environmental Impact Report (EIR) for the Prospect Island Tidal Habitat Restoration Project. We need to know the views of your agency as to the scope and content of the environmental information that is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency may need to use this EIR when considering your permit or other approvals for the project. We are also seeking input from the public on the scope and content of the EIR.

The project description, location, and the potential environmental effects are contained in the attached materials. A copy of the Initial Study is not attached.

Due to time limits mandated by State law, your response must be submitted at the earliest possible date, but **no later than June 21, 2013**. We will need the name of a contact person in your agency. Please send your response to

Dan Riordan
Department of Water Resources, P.O. Box 942836, Sacramento, CA 94236
Fax: 916-376-9688, Email: dan.riordan@water.ca.gov

May 17, 2013
Date

Dean F. Messer
Chief, Division of Environmental Services
California Department of Water Resources
(916) 376-9700

NOTICE OF PREPARATION
for the Prospect Island Tidal Habitat Restoration Project
Environmental Impact Report

INTRODUCTION

The Department of Water Resources (DWR) will prepare an Environmental Impact Report (EIR) for the Prospect Island Restoration Project (project) in Solano County, California. The EIR will be prepared in compliance with the California Environmental Quality Act (CEQA)(Public Resources Code Section 21000 et seq.) and the CEQA Guidelines (California Code of Regulations Title 14, Chapter 3, Sections 15000-15387), as amended. DWR will be the lead agency under CEQA. In accordance with CEQA, the lead agency is responsible for the scope, content, and legal adequacy of the document. The EIR will evaluate the environmental effects of implementing a plan to restore tidal freshwater emergent marsh wetland and open water habitats on Prospect Island. The project description, location, and anticipated environmental issues are presented below.

Purpose of the Notice of Preparation: The purpose of a notice of preparation (NOP) is to notify responsible and trustee agencies, Federal agencies involved in approving or funding a project, and interested parties that an EIR will be prepared.

The NOP is an important step in the environmental scoping process, which is designed to determine the range of issues to be addressed in the EIR. The objectives of scoping include:

- Ensuring agency and public involvement in the environmental review process,
- Determining which specific impacts must be evaluated in the EIR,
- Establishing a reasonable range of alternatives, and
- Identifying the scope of issues that must be discussed in order to adequately and accurately address the potential impacts of the project as they relate to permitting and approval authority.

The Draft EIR (DEIR) will incorporate public concerns associated with the project and associated project alternatives, and will be sent out for a 45-day public review period, during which time both written and verbal comments regarding the adequacy of the document will be solicited.

The Final EIR (FEIR) will address the comments received on the DEIR during the public review period. The FEIR will be furnished to all who commented on the DEIR, and made available to anyone who requests a copy during the public comment period. The draft and final EIRs must: (1) provide a full and fair discussion of the project's significant environmental impacts, and (2) inform decision-makers and the public of the feasibility and potential impacts of a reasonable range of alternatives that could avoid or minimize adverse impacts.

The final step in the CEQA process for the EIR is certification of the FEIR and adoption of a series of Findings and a Mitigation Monitoring and Reporting Plan. A certified EIR indicates that the environmental document has been completed in compliance with CEQA. The CEQA Findings indicate that the decision-making body of the lead agency reviewed and considered the FEIR prior to approving the project, and that the FEIR reflects the lead agency's independent judgment and analysis.

Project Location

The Prospect Island Tidal Habitat Restoration Project site is an approximately 1600-acre property located in Solano County, in the northern portion of the Sacramento - San Joaquin River Delta (see Figure 1). Prospect Island falls under two ownerships: the majority of the island (northern 1,300 acres) is owned by DWR, and the southern, 300-acre portion is owned by the Port of West Sacramento (Port). Prospect Island is located immediately east of, and technically is still an element of, the southern end of the Yolo Bypass. The Island became separated from the Bypass with construction of the Sacramento Deep Water Ship Channel (DWSC) in the 1960s. The site is bounded on the east by Miner Slough, on the west by the DWSC, on the south by the confluence of the DWSC and Miner Slough, and on the north by an east-west levee that runs from Arrowhead Harbor to the DWSC.

Project Objectives

The project is intended to partially fulfill the 8,000-acre tidal habitat restoration obligations of DWR, contained within the Reasonable and Prudent Alternative (RPA) of the U.S. Fish and Wildlife Service Delta Smelt Biological Opinion (USFWS 2008) and referenced in the National Marine Fisheries Service Salmonid Biological Opinion (NMFS 2009), for long-term coordinated operations of the State Water Project (SWP) and the federal Central Valley Project (CVP). The project also could serve as partial habitat fulfillment of tidal restoration objectives under the proposed Bay Delta Conservation Plan (BDCP), upon its approval.

The objectives of the wetlands restoration at Prospect Island, in meeting the tidal restoration obligations described above, are to:

1) Enhance primary and secondary productivity and food availability for native fishes within Prospect Island and surrounding Delta waterways;
2) Increase the quantity and quality of salmonid rearing habitat within and in the areas surrounding Prospect Island;
3) Increase the amount and quality of habitats to support other listed species, to the extent they can be supported by site conditions and natural processes;
4) Provide other ecosystem benefits associated with increased Delta freshwater tidal marsh habitat, including water quality enhancement, recreation, and carbon sequestration;
5) To the greatest extent practical, promote habitat resiliency to changes in future Delta conditions, such as land use conversions, climate change, sea level rise, and invasive species; and

6) Avoid promoting conditions adverse to project biological objectives, such as those which would favor establishment or spread of invasive exotic species.

PROJECT DESCRIPTION

Background

Historically, the project area was tidal marshland, with Prospect Slough to the west and north, and Miner Slough to the east and south. Levees were constructed during the later 19th century and the land was converted to agricultural uses. Prospect Island is part of the Yolo Bypass floodplain; however construction of the DWSC in the 1960s isolated Prospect Island from the main reach of the Yolo Bypass.

The 1,300-acre northern portion of Prospect Island was purchased by the U.S. Bureau of Reclamation (USBR) in 1994 to be part of a proposed North Delta National Wildlife Refuge. Agriculture on the island ceased, but efforts to establish a refuge were not successful. Without near-term implementation of a restoration project that had been planned by the USACE and DWR, USBR initiated the process to transfer or sell the island to another entity. DWR acquired the northern portion of Prospect Island from USBR in January 2010. The DWR land is currently inundated, due to a broken flap gate which allows limited water exchange between Prospect Island and Miner Slough.

The southern, Port-owned portion of Prospect Island is subject to a greater, yet still limited, tidal exchange through a levee breach that was repaired with very large rock (about 3- to 5-foot diameter), and remains permeable but not navigable. The internal cross levee that separates the two parcels is currently intact.

Proposed Restoration Actions

The project would entail restoration of emergent wetlands and subtidal habitats on both properties comprising the approximately 1600-acre Prospect Island. The EIR will evaluate individual and cumulative impacts of up to five alternatives, as well as the 'no project' alternative, in accordance with CEQA. These alternatives have not yet been defined.

The design elements from which restoration alternatives will be developed are illustrated in Figure 2, and include the following. Individual alternatives may draw upon some or all of these design elements:

1) Breaching of perimeter levees in one or more locations on Miner Slough and/or breaching into the California Department of Fish and Wildlife Miner Slough Wildlife Area, for the purpose of restoring tidal connectivity;

2) Breaching of the cross levee between the northern DWR and southern Port properties, for the purpose of promoting target ecological functions;

3) Installation of a fixed or variable-height weir at the northeastern corner of the project site, for the purpose of providing winter high-flow connectivity to Miner Slough and upstream sloughs that connect to the Sacramento River;

4) Excavation of subtidal-elevation tidal slough channels within Prospect Island, for the purpose of facilitating internal tidal circulation and external connectivity;

5) Placement of the soils excavated in creation of internal subtidal channels to locations elsewhere within Prospect Island, for the purpose of raising subsided site elevations and/or for improving erosion protection of levees retained on the site;

6) Import of clean, suitable sediment from off-site sources, for the purpose of raising subsided site elevations, and/or for improving erosion protection of levees retained on the site;

7) Provision of physical access to adjacent properties currently accessed via existing Prospect Island levees.

PROPOSED SCOPE OF EIR

The EIR will analyze, describe, and evaluate all potential environmental impacts of the range of alternatives presented in the document. Individual and cumulative impacts, to be identified following completion of the scoping comment period, in accordance with CEQA, will be evaluated. The range of alternatives may be refined, revised, or expanded as a result of the scoping process.

For each issue listed below, the EIR will include a discussion of the parameters used in evaluating impacts; potential impacts from the various alternatives; and, if applicable, recommended mitigation to reduce the impacts to below a level of significance. Impact analyses will include discussion of direct and indirect impacts, short and long-term impacts, and cumulative impacts. In addition, each impact discussion will identify any areas of known controversy. Finally, the EIR will identify any unavoidable adverse impacts that would result from project implementation.

The issues presented below are preliminary in both scope and topic. Additional issues may be identified during the scoping process.

Air Quality and Greenhouse Gas

The EIR will evaluate potential effects that the proposed project could have on short-term air quality including greenhouse gases (GHGs) due to emissions resulting from construction operations including earthmoving, dredging, and/or filling and from post-construction adaptive management activities.

Agricultural Resources

Although the project site has been flooded for a number of years, the project will remove agriculturally mapped lands from future agricultural use. The EIR will describe site soils, the history of agricultural uses and flooding on the site, its land type mapping by the California Department of Conservation, and assess any project effects on loss of agricultural resources, including any prime agricultural soils and Williamson Act issues.

Biological Resources

Aquatic Biological Resources

One of the primary objectives of the Prospect Island Tidal Habitat Restoration Project is to enhance rearing habitat, foraging habitat, and food availability for native fishes. By increasing tidal open water and edge habitats, tidal circulation, and aquatic productivity, the proposed project is expected to benefit Chinook salmon, steelhead, delta smelt, green sturgeon, Sacramento splittail, and other Delta-dependent aquatic species. However, the EIR will evaluate potential effects on existing habitat for listed fish species that could result from breaching Prospect Island levees, and whether conditions that may be harmful to these listed species could develop within portions of the restored habitat.

Wetland Biological Resources

A key secondary objective of the Prospect Island Habitat Tidal Restoration Project is to enhance tidal marsh habitats to support a wide range of native wetland plant and wildlife species including special status species. The EIR will evaluate the potential effects of breaching of levees, creation of tidal slough channels, and placement of fill on freshwater tidal emergent marsh, and subtidal open water aquatic habitats, including submerged aquatic vegetation.

Terrestrial Biological Resources

As part of the project design, the (already limited) amount of upland terrestrial habitat and aquatic-terrestrial transitional habitat, including riparian forest and riparian scrub-shrub habitat, may be reduced. The EIR will evaluate the potential for detrimental impacts to special-status terrestrial and avian species, including species that use riparian habitats.

Cultural Resources

A cultural resources assessment has been prepared for the property (Parus Consulting, April 2012). No site resources were found to be eligible for the National Register of Historic Places. In addition, due to the substantial ground disturbance that has previously occurred on the site, no impacts are anticipated, therefore no additional study is proposed in the EIR.

Geology and Soils

Potential geologic impacts could include erosion during and/or after construction resulting from proposed levee reconfiguration and breaching, slough channel excavation, or soil placement. The EIR will consider existing and reconfigured perimeter levee stability, and existing and modified island soil stability.

Hazards and Hazardous Materials

The EIR will address potential site contamination issues associated with project construction activities, and based on a Phase I Environmental Site Assessment (ASTM E1527-05) to be conducted in support of the project. Potential hazards to boaters, if any, will be evaluated.

Hydrology and Water Quality

The EIR will evaluate potential project effects on hydrology, including changes in local Delta hydrodynamics, tidal ranges, and the flood conveyance capacities of Miner Slough and the Yolo Bypass, as well as potential for breach-induced crosscurrents in the DWSC or Miner Slough, potential scour effects to on-site levees or the Ryer Island Miner Slough levee, and potential effects on Ryer Island groundwater levels.

The EIR will evaluate potential short-term water quality effects during construction through the release of turbidity and sediment-borne contaminants introduced by re-suspension of bottom sediments, and the release of sediments excavated and emplaced as part of planned levee breaches and other reconfigurations. Potential short-term effects of accidental releases of fuel, lubricants, and other materials used by construction equipment will be evaluated.

The EIR will evaluate long-term effects on water quality that could result from hydraulic exchanges of water from the Prospect Island site to the surrounding waterways, potentially affecting the transport of turbidity, sediment-borne contaminants, and methylmercury, and changes in disinfection byproduct formation potential in potable water supplies due to natural organic matter and dissolved organic carbon (DOC) sources within Prospect Island.

Recreation

The EIR will evaluate potential project impacts to recreational use of the Arrowhead Harbor and to hunting and fishing activities along Miner Slough and the DWSC.

Aesthetics

The EIR will evaluate potential effects of the various project components on the aesthetic character of the project site.

Land Use/Planning

The EIR will evaluate the project's conformance with Solano County and other applicable land use plans and policies, and with adjacent land uses.

Mineral Resources

The EIR will determine if the project may affect mineral and gas rights over, under, or across the property held by third party entities.

Noise

The EIR will evaluate the potential for temporary noise effects that may result from project construction, with respect to property owners occupying housing adjacent to Prospect Island, on Ryer Island, and users of Arrowhead Harbor.

Public Services

The EIR will evaluate the potential for changes in demand on local police and fire protection services or other public facilities, if any.

Population and Housing

The EIR will evaluate the potential for changes in population or housing, if any.

Transportation/Traffic

The EIR will evaluate potential of the project to affect ingress/egress easements along the DWSC and/or Miner Slough levees as a result of transport of earth and other materials and equipment to and/or from the site, or of other construction or post-construction adaptive management activities.

Utilities/Service Systems

The EIR will identify any potential effects of construction and operation of the project on utility infrastructure.

SCOPING PROCESS

This NOP is being circulated for a 35-day comment period, beginning on May 17, 2013. Public participation in the environmental scoping process is an important step in determining the full range of issues to be addressed in the EIR. DWR requests your comments on the scope and content of the EIR, as outlined in this NOP.

Pursuant to CEQA Section 21080.4(a), responsible and trustee agencies are asked to provide, in writing, the scope and content of the environmental information that is germane to their statutory responsibilities, as these agencies will need to use the EIR prepared by DWR when considering permits or other approvals for the project. Responsible and trustee agencies are also requested to provide a list of the permits and/or other approvals that must be obtained in order to implement the project (see Table 1).

A formal scoping hearing has been scheduled for **Monday, June 10, 2013, from 7:00 PM to 9:00 PM at the City of West Sacramento Community Center Community Room, 1075 West Capitol Avenue, West Sacramento, CA.**

Written or oral comments can be provided at the public scoping meeting below, or written comments may also be provided directly to Dan Riordan at DWR **no later than June 21, 2013.**

Dan Riordan
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236
Tel: (916) 376-9738
Fax: 916-376-9688
Email: dan.riordan@water.ca.gov

Table 1: Potential Agency Actions and Approvals

The following actions and approvals are anticipated to be required.

REGULATION	AGENCY	TRIGGER	COMPLIANCE MECHANISM
Section 404, Clean Water Act	Sacramento District, US Army Corps of Engineers (USACE)	Discharge of dredge or fill material into Waters of the U.S.	Individual Permit, Letter of Permission (LOP), or Nationwide Permit (NWP)
Section 10, Rivers and Harbors Act	Sacramento District, USACE	Work in, under, or over a navigable water of the U.S.	Individual Permit, LOP, or NWP
Section 401, CWA	Central Valley Regional Water Quality Control Board (CVRWQCB)	Federal action that has the potential to result in a discharge to waters of the State	Water Quality Certification
Porter-Cologne Water Quality Control Act	CVRWQCB	Action that has the potential to result in a discharge to waters of the State, including surface or ground waters	Waste Discharge Requirements, typically folded into the Section 401 Water Quality Certification
Section 303(d), CWA, Delta Methylmercury TMDL	CVRWQCB	Action that has potential to result in discharge of methylmercury to Delta waters	Control Study
Section 402, CWA	CVRWQCB	Construction-related activities that disturb 1 or more acres	Permit Registration Documents
Title 23 CCR, Division 1	Central Valley Flood Protection Board	Projects that involve construction, enlargement, revetment, or alteration of any levee, embankment, canal, or bed of any drainage within the Sacramento or San Joaquin River watersheds, or on any land adjacent to or within the overflow basins of such drainages	Encroachment Permit
Section 1602 et. seq., FGC	California Department of Fish and Wildlife (CDFW), Bay-Delta Region	Activity that may substantially modify a river, stream or lakebed	Streambed Alteration Agreement
Delta Reform Act	Delta Stewardship Council	Projects that are carried out, approved, or funded by a state or local agency; that occur within the boundaries of the Delta or Suisun Marsh; and that are covered by one or more provisions of the Delta Plan, including habitat restoration actions	Consistency Determination

REGULATION	AGENCY	TRIGGER	COMPLIANCE MECHANISM
Federal Endangered Species Act	US Fish and Wildlife Service (USFWS), Sacramento Office; National Marine Fisheries Service (NMFS), Sacramento Office	Federal action that may affect a federally-listed species or result in destruction or adverse modification of their critical habitat	ESA compliance documents; e.g., Biological Opinion(s) or Not Likely to Adversely Affect determination(s).
Magnuson-Stevens Fishery Conservation and Management Act	NMFS, Sacramento Office	Potential effects on Essential Fish Habitat (EFH)	EFH Conservation Recommendations
Migratory Bird Treaty Act	USFWS, Migratory Bird Division	Take of any migratory bird, or collection of any part, nest, or eggs of a migratory bird	None
California Endangered Species Act	CDFW, Bay-Delta Region	Action that may affect state-listed plants or wildlife	2081(b) Permit: State-listed species; 2080.1 Consistency Determination: species that are State- and federally-listed
National Historic Preservation Act	State Historic Preservation Officer	Federal action that may affect historic resources	Varies
California State Leasing and Permitting Regulations	State Lands Commission	Modification of sovereign lands of the State	State Lands Lease Amendment
Federal Navigation Regulations	US Coast Guard	Work or operation in a navigable water that may affect the safe navigation of vessels	Local Notice to Mariners

Figure 1. Prospect Island Tidal Habitat Restoration Project Location Map

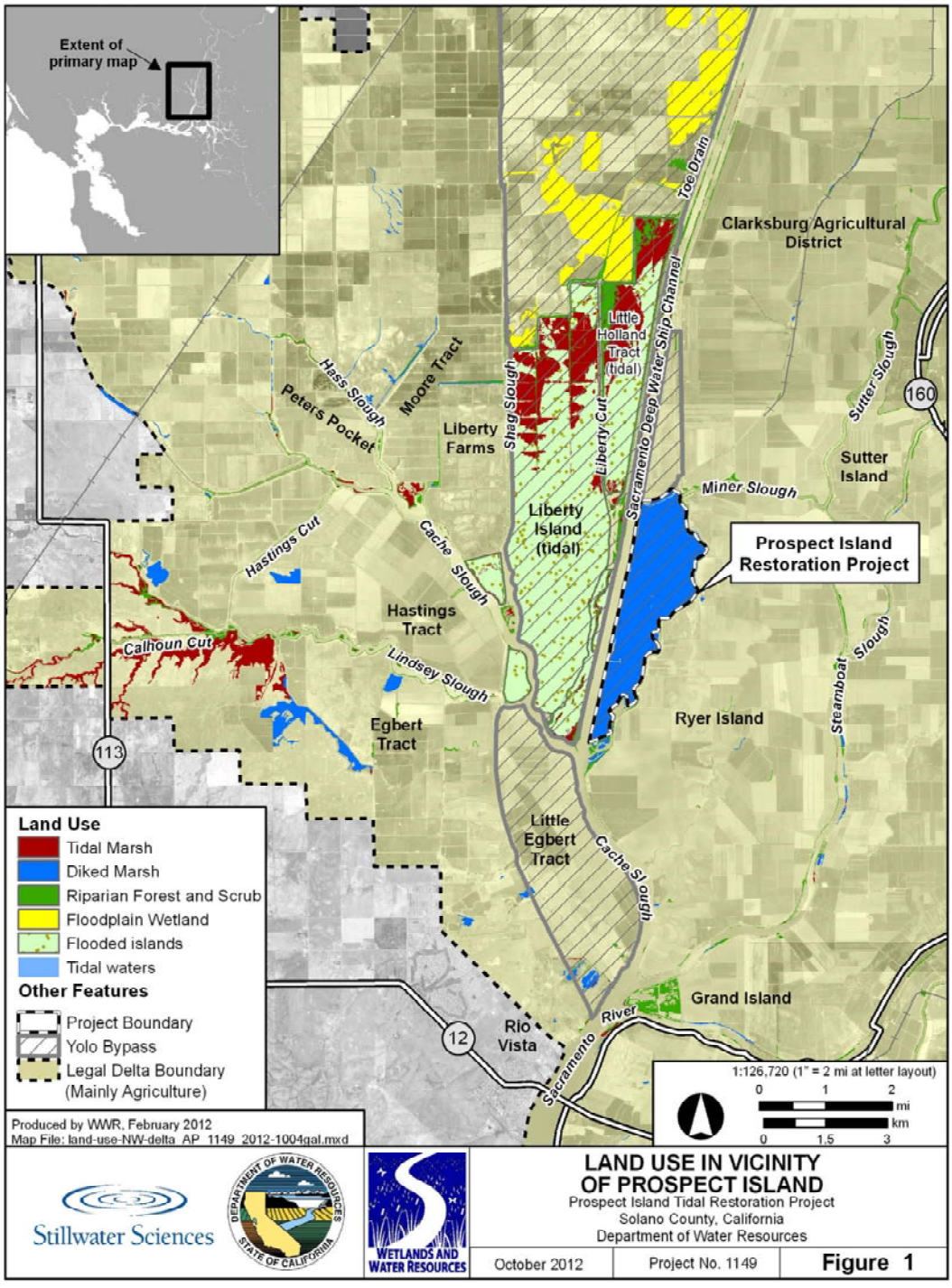
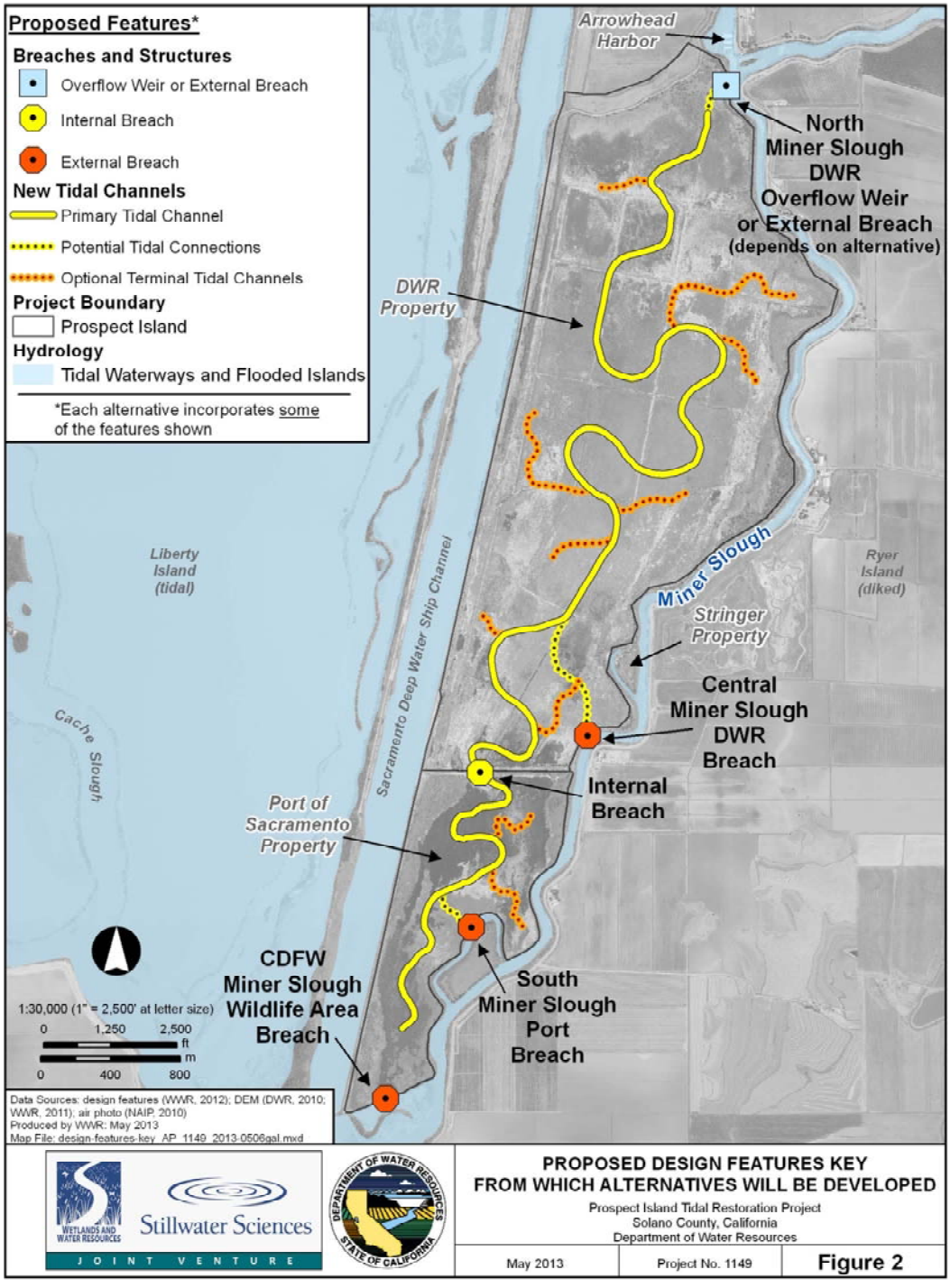


Figure 2. Prospect Island Restoration Design Elements



ATTACHMENT NO. 1
Distribution List

NOP DISTRIBUTION:
This Notice of Preparation was sent to entities listed below.

State of California

California Air Resources Board
California Department of Fish and Wildlife
California Department of Conservation
California Department of Parks and Recreation
California Department of Food and Agriculture
California Department of Toxic Substances Control
California Department of Transportation, District 3
California Department of Transportation, District 4
California Natural Resources Agency
California State Clearinghouse
California State Coastal Conservancy
California State Lands Commission
California State Senator District 3 (Wolk)
California State Assembly District 11 (Frazier)
Central Valley Flood Protection Board
State Water Resources Control Board
Central Valley Regional Water Quality Control Board
Delta Conservancy
Delta Protection Commission
Delta Stewardship Council
University of California Natural Reserve System
State Historic Preservation Office

Federal

U.S. Environmental Protection Agency
U. S. Army Corps of Engineers, Sacramento District
U. S. Bureau of Reclamation
U. S. Fish and Wildlife Service
U.S. Coast Guard, Eleventh District
National Marine Fisheries Service (National Oceanic and Atmospheric Administration Fisheries)
USDA-Natural Resource Conservation Service (Dixon and Elk Grove Service Centers)
Office of Historic Preservation
Congressional Representative, District 3 (John Garamendi)
Congressional Representative, District 5 (Mike Thompson)
Office of Senator Dianne Feinstein, Sacramento Field Office
Office of Senator Barbara Boxer, Sacramento Field Office

Indian Tribes

Cortina Wintun Band of Indians
Cortina Wintun Environmental Protection Agency
Wintu Tribe of Northern California
Yocha Dehe Wintun Nation

Local Agencies

City of Rio Vista
City of West Sacramento
Contra Costa County Administrator
Contra Costa County Water Agency
Central Delta Water Agency
North Delta Water Agency
Sacramento County
San Joaquin County Administrator
Solano County Administrator
Solano County Community Development Department
Solano County Department of Resource Management
Solano County Water Agency
South Delta Water Agency
State and Federal Contractors Water Agency
Yolo County Administrator
Yolo County Agricultural Commission
Yolo County Counsels Office
Yolo County Intergovernmental Affairs

Public Districts

Alameda County Resource Conservation District
Association of Bay Area Governments
Contra Costa Mosquito and Vector Control District
Contra Costa Resource Conservation District
Contra Costa Water District
Dixon Resource Conservation District
North Delta Conservancy
Port of West Sacramento
Reclamation District 150
Reclamation District 307
Reclamation District 501
Reclamation District 900
Reclamation District 999
Reclamation District 2068
Reclamation District 2098
Sacramento Area Council of Governments
Sacramento Yolo Port District

Sacramento Yolo Mosquito and Vector Control District
San Joaquin Mosquito Abatement District
Solano County Mosquito Control District
Solano Resource Conservation District
Suisun Resource Conservation District
Westlands Water District
Yolo County Flood Control and Water Conservation District
Yolo Resource Conservation District
Yolo-Solano Air Quality Management District

Non-Governmental Organizations

Allied Fishing Groups
American Rivers
AquAlliance
Bar Pilots Association for San Francisco Bay and Delta
CA Waterfowl Association
California Sportfishing Protection Alliance
California Water Alliance
Center for Collaborative Policy CSUS
Central Valley Habitat Joint Venture
Defenders of Wildlife
Delta Counties Coalition
Discover the Delta
Ducks Unlimited
Environmental Defense Fund
Environmental Water Caucus
Farm Bureau Delta Caucus
Friends of Swainson's Hawk
Native American Heritage Commission
Natural Heritage Institute
Natural Resources Defense Council
North Delta CARES
Planning and Conservation League
Restore the Delta
Sierra Club- Mother Lode Chapter
Solano County Farm Bureau
Solano County Land Trust
The Bay Institute
The Nature Conservancy, Sacramento Office
Trust for Public Land
Yolo Basin Planning Forum
Yolo County Farm Bureau
Yolo County Heritage Foundation
Yolo County Land Owners Association

Yolo Land Trust

Adjacent Property Owners

Brimmer, John & Kathy
Fahn, Alexander & Shirley
Fonss, John G
Gladys Company, Inc.
Hall, Jerry & Susan
Islands, Inc
Lewis Nixon Co.
Nakahara, Craig
Ryer Island Bird Farm, LLC
Stringer, John & Lorraine
Terminello, William

Other Interested Parties

AECOM
Ann Burris
AnnPatrick LLC
Archer & Ficklin, Inc.
Bill Eisenstein
Bob Shaeffer
BSK, Inc
CDM
Charles Tyson
Chris Wilkinson
Chuck Dalldorf
Conaway Ranch
Dan Ramos
Dustin Smith
Glen Holstein
Glide In Ranch
Greg Garriss
Harris Ranch
Herb & Lynell Pollock
HRS
James Patterson
JB Environmental Communications
Karen Medders
Kearns & West
Kent Brittan (UCD Emeritus)
Kesner Flores
M Stripling
MWH

Ostrach Consulting
Pacific Gas and Electric Company
San Luis and Delta-Mendota Water Authority (Greg Zlotnick)
T Rodrigues
Tim Miramontes
Tom Zuckerman
Wildlands
Yolo Flyway Farms
Yolo Law

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3610

Fri-Sun, 8am East Wise Rd. in furn, some g wheel, solid e & 4 chairs, pcs) & many llectibles!

SCOLN. Estate uchard Lane tesales.com

TE SALE! rs-Sun, 9a-5p clocks, head linen, washer much more! s.com

ands 3612

LE Sat 9-3 & More! 95660.

yr collection: Sys, sports. Watt & I-80.

dova 3615

eighborhood n. Off Coloma for signs!

1PM Toys, S,Dog Pen it/Tinker Tualatin Way

3617

NOON Tools, nets and tuff. 6001 5765

3618

2; 9am-5pm e photos at der "Upcom- ie Wy,

nly 8-2PM tools, furn, anchland Wy

URDAY 7AM- rcycle gear, s, loft bed, loseville, Ca

Community at 8 & close ng will have ge area, Parkway.

m-3pm. oushld Dr., Rsvl.

3630

Pursuit ardly used. 213

3635

mos $800 & 6-434-8669

3645

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3660

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SPAS, Pre Loved, excellent shape! 4 to choose from! $995+ Call 530-852-2838

Restaurant, Store, Bar Equip. 3678

Hood Systems-Stainless Steel Design fab/install. 920.3733 Carson Mech.

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Used Restaurant/Bar Equip 446-9600

Sporting & Camping Equipment 3680

ACHILLES 12 Man Raft, great condition for $495 & 2 person Aire Tomcat IK for $695 & Rocky Mountain 13ft S/B raft for $1795. 623-687-7478

Farm

Farm Equipment 4025

KUBOTA TRACTORS
Rental returns 29-95 horsepower ex: 32 HP 4WD 8 speed with loader $14950. plus tax 0% fin. for 60 months
DOLK TRACTOR CO. 707-374-6438

Farm & Food Products 4035

DRAGONFLY PEONY FARM The bloom is in and beautiful. Come see these big girls and maybe purchase some for your very own. Mapquest to 5590 Charles St., Wilseyville, 95257. About 25 miles from Jackson. You will love it!More info. at dragonflypeonyfarm.com Also, thank you to all of my customers, you have been wonderful. Julia dragonflypeony-farm@volcano.net 209-293-1242

GRASS-Fed Beef, half or whole, cut & wrapped (vacuum sealed). $385/lb hanging weight 530-559-6907 (Auburn)

Notices

Legal Notices 2005

TO PUBLISH A LEGAL NOTICE IN THE SACRAMENTO BEE,
Call 916-321-1371,
Fax 916-321-1110 or email
legaladvertising@sacbee.com

NO 572 Public Notice
Qing Yu 5016 Percheron Dr, Elk Grove, CA 95757 is doing business under the fictitious business name, QYU Stone Co. Same address as above. Filed in Sacramento County #FBNF2013-03772

Legal Notices 2005

NO 635 Public Notice
Uniters North America, LLC a Delaware Limited Liability Company, 300 North Greene St , #200, Greensboro, NC 27401 is doing business under the fictitious business name, Uniters. Same address as above. Filed in Sacramento County #FBNF2013-04109

*** PRIVATE PARTIES ***
Place your ad at your convenience from www.sacbee.com/placeanad

Legal Notices 2005

NO 634 PUBLIC NOTICE
Notice Of Application To Sell Alcoholic Beverages. Filed May 28, 2013.
To Whom It May Concern Kansai Ramen & Sushi House LLC is applying to the Department of Alcoholic Beverage Control to sell alcoholic beverages at 2992 65th St, Ste 288, Sacramento, CA 95817. Lic. type: 41 - On-Sale Beer And Wine - Eating Place.

BEE CLASSIFIED WORKS!
CALL (916) 321-1234

*** PRIVATE PARTIES ***
Place your ad at your convenience from www.sacbee.com/placeanad

NO 628 PUBLIC NOTICE

NOTICE OF PUBLIC SCOPING MEETING FOR THE PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

The California Department of Water Resources (DWR) has published a Notice of Preparation for an Environmental Impact Report (EIR). DWR will prepare an EIR for the Prospect Island Restoration Project (project) in Solano County, California. DWR will be the lead agency under the California Environmental Quality Act (CEQA). In accordance with CEQA, the lead agency is responsible for the scope, content, and legal adequacy of the document. The EIR will evaluate the environmental effects of implementing a project to restore tidal freshwater emergent marsh wetland and open water habitats on Prospect Island.

The project, which is located in the northern portion of the Sacramento - San Joaquin River Delta in Solano County, would restore approximately 1600 acres of currently submerged non-tidal lands to tidal habitat. The project is intended to partially fulfill the 8,000-acre tidal habitat restoration obligations of DWR, as required by the U.S. Fish and Wildlife Service Delta Smelt Biological Opinion and referenced in the National Marine Fisheries Service Salmonid Biological Opinion, for long-term coordinated operations of the State Water Project (SWP) and the federal Central Valley Project (CVP).

DWR is seeking public input on alternatives, concerns, and issues to be addressed in the EIR through a public scoping meeting at the following location:

Date: June 10, 2013
Time: 7:00-9:00 p.m.
Location: City of West Sacramento Community Center
Community Room 1075
West Capitol Avenue, West Sacramento, CA

Comments on the scope and content of the EIR should be made in writing to DWR at the earliest possible date, but not later than June 21, 2013. Responses should be sent to:

Mr. Dan Riordan
California Department of Water Resources
Office of Environmental Compliance
3500 Industrial Blvd.
West Sacramento, CA 95691

dan.riordan@water.ca.gov

For further information, including the Notice of Preparation, background, and a map of the project area, please visit: http://www.water.ca.gov/environmental services/ frpa_prospect_restoration.cfm

NO 616 PUBLIC NOTICE

The Sacramento County Office of Education is calling for proposals for Medi-Cal reimbursement services to file actual and estimated reimbursement claims and estimated claims with the California Department of Health Care Service and/or/Local Education Consortium (LEC) for the claim years ending June 30, 2014, June 30, 2015 and June 30, 2016. This Request for Proposal is set up in six part sequences comprised of the following:

I. Bidding Instructions and Conditions
II. Special Conditions
III. Request for Proposal for Medi-Cal Reimbursement Services
IV. Contract Agreement
V. Attachments
VI. Proposal Summary and Forms/Statement of Qualifications

Parts I, II, III and V are for informational purposes only. Part IV will require completion after a firm or individual is selected. Part VI must be completely filled out and signed by authorized signatory personnel of the bidding firm.

Cajun & Blues Festival Parade

Cajun & Blues Festival Parade is looking for entries. If you are a school, service club,business or just you. Call them at 916-777-4800 or eMail to: isletonchamber@up for entry form. Must be in by June 1st. For your information anyone needing ticket information or a direct link to purchase go to Festival website http://www.isletoncajunfestival.net

Date of the Cajun & Blues Festival is June 15 and 16 in downtown Isleton



Fair continued from page 8

–

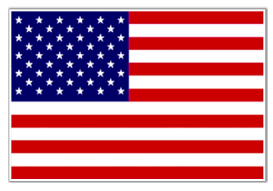
Pablo Cruise To Perform Opening Night

Solano County, CA – The best entertainment value of the summer can be found at this year's Solano County Fair, July 31 – August 4, with five nights of FREE headline concert entertainment included with the price of admission. Just announced for Wednesday, July 31 is the legendary pop/rock band, Pablo Cruise. This performance is in addition to the previously announced headline concerts by eclectic funk band, WAR, on Thursday, August 1, followed by R&B legends, The Spinners, on Friday, August 2, and soul superstars, Tower of Power, on Saturday, August 3.

All four concerts will begin at 8:00 p.m. "We're very excited about the variety and quality of concerts we have scheduled for this year," stated Fair General Manager Mike Paluszak. "The evening concerts, followed by nightly fireworks will be a fantastic way to top off a full day of Fair activities and entertainment."

Concert entertainment for the Fair's closing night, Sunday, August 4, will be announced soon.

In 1975, Pablo Cruise released its first album simply entitled, "Pablo Cruise." The album cover was shot in the tropical gardens of San Francisco's Golden Gate Park and featured a huge gorilla standing front and center. The band, David Jenkins (guitars and vocals), Cory Lerios (keyboards and vocals), Steve Price



NOTICE OF PUBLIC SCOPING MEETING FOR THE PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

The California Department of Water Resources (DWR) has published a Notice of Preparation for an Environmental Impact Report (EIR). DWR will prepare an EIR for the Prospect Island Restoration Project (project) in Solano County, California. DWR will be the lead agency under the California Environmental Quality Act (CEQA). In accordance with CEQA, the lead agency is responsible for the scope, content, and legal adequacy of the document. The EIR will evaluate the environmental effects of implementing a project to restore tidal freshwater emergent marsh wetland and open water habitats on Prospect Island.

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DWR is seeking public input on alternatives, concerns, and issues to be addressed in the EIR through a public scoping meeting at the following location:

Date Time
June 10 7:00-9:00 p.m. City of West Sacramento Community Center Community Room
1075 West Capitol Avenue, West Sacramento, CA

Comments on the scope and content of the EIR should be made in writing to DWR at the earliest possible date, but not later than June 21, 2013. Responses should be sent to:
Mr. Dan Riordan
California Department of Water Resources
Office of Environmental Compliance
3500 Industrial Blvd.
West Sacramento, CA 95691

dan.riordan@water.ca.gov
For further information, including the Notice of Preparation, background, and a map of the project area, please visit: http://www.water.ca.gov/environmentalservices/frpa_prospect_restoration.cfm.

DELTA AYSO Fall Soccer Registration

Where: Montezuma Fire Station at the corner of Main and 4th Street in Rio Vista

When: Wednesday, May 30 6:00pm till 8:30 pm
Saturday, June 1 9:00am till noon.

Fees: $100.00 for one player each additional player is $ 80.00

Questions: Call 707 374 2029

AYSO is an all volunteer youth sports organization and not sponsored or affiliated with the River Delta School District.

St. Brigid's Episcopal Church

We meet at 218 California St.

All Who Seek Christ are Welcome
Community Outreach is a Priority of this Church

Holy Eucharist every Sunday at 10:30

Evening Prayer Service the First Tuesday of the Month at 7:00 pm

Bible Study the First Thursday of the Month at 10:00 am

P.O. Box 580 Rio Vista, CA. 94571

www.stbrigidsriovista.org

Office **707-374-2667**

Shafer Real Estate

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Rio Vista, CA 94571

707-374-5222



993 Olympic Dr $249,000
1451 sq ft
2db, 2ba



323 Crystal Downs Dr. $244,900
Atherton
1579 sq ft
2br, 2 ba,
2.5, garage



10 Arrowhead $185,000
Schooner
1154 sq ft
2br, 2ba,
corner lot



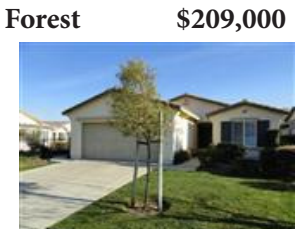
1000 Michaelbook Ln. $275,000
San Carlos
1907sq ft
2br, 2ba,
Corner Lot,
Extended
Garage



409 Bay Oaks Way $239,000
Atherton
1579 sq ft,
2br, Plus
Den, 2ba,
2 Car Garage



342 Desert Forest $209,000
Carmel
1154 sq. ft
2br, 2ba,



320 Springhill. Dr. $314,900
Windsor
2031 sq.ft
2 br, 2 ba, 3
car garage.
Shows like a
Model



290 Cedar Ridge $289,000
2065 sq ft
2br, 2 .5 ba,
2.5 garage



108 Riviera Dr. $319,900
Woodside
1701 sq ft
2br, 2ba, on
2nd Fairway



400 Riverwood Ln. $264,900
Belmont
1767 sq ft
2br, 2ba,
No Rear
Neighbors



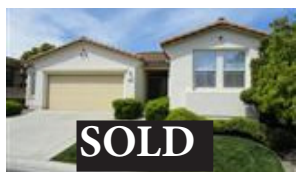
533 Black Diamond Dr. $220,000
Big Sur
1359 sq ft
2 br, 2.ba
No Rear
Neighbors



361 Glenn Lakes Dr. $367,000
Asti
2475 sq ft. 2
bd, 2 ba, 3
car garage,
on 8th Fair-
way



382 Paradise Pines Dr. $249.900
Hillsborough
1675 sq ft
2 br , 2 ba,
Extended
Garage



418 Western Hill Dr. $375,000
Yountville
2567 sq ft
3 br, 2.5
ba 3 car
garage



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Sun 1 pm-8:30 pm

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June 1st-June 4

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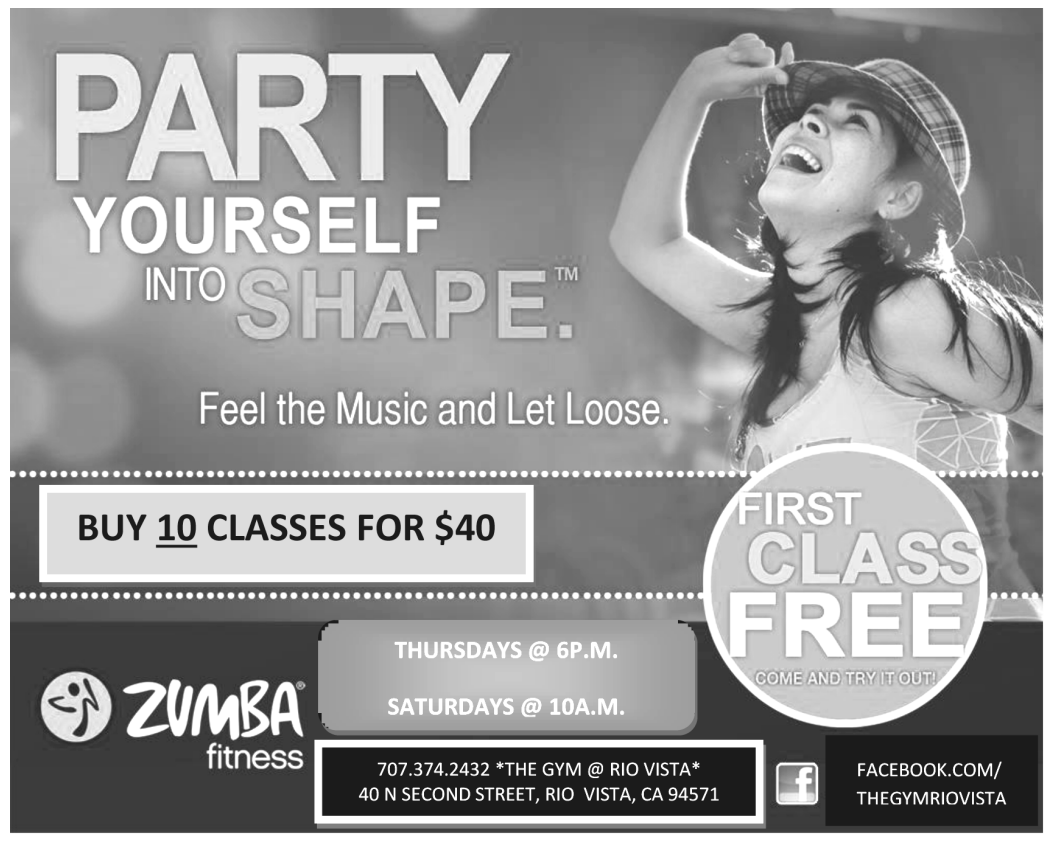

Prospect Island Notice of Preparation (NOP)

McEwan, Dennis@DWR [Dennis.McEwan@water.ca.gov]

Sent: Monday, May 20, 2013 12:19 PM

To: McEwan, Dennis@DWR [Dennis.McEwan@water.ca.gov]

Subject: Notice of Preparation of a Draft EIR for Prospect Island Tidal Habitat Restoration Project now online.

Hello,
This email is to announce the availability of the Notice of Preparation (NOP) of a Draft Environmental Impact Report for the Prospect Island Tidal Habitat Restoration Project. The NOP is now posted on our Prospect Island Website:

http://www.water.ca.gov/environmentalservices/docs/frpa/Signed_Complete_Final%20Prospect_NOP_2013-0517b.pdf

Information about the Project and the Scoping meeting can be found within the NOP.

Please send all comments to:
Dan Riordan
Department of Water Resources, P.O. Box 942836, Sacramento, CA 94236
Fax: 916-376-9688, Email: dan.riordan@water.ca.gov

Thank you,
Dennis McEwan

Dennis McEwan, Chief
Mitigation and Restoration Branch
Division of Environmental Services
Department of Water Resources

Office: (916) 376-9760
3500 Industrial Blvd.
West Sacramento, Ca
95691

Mailing address: PO Box 942836
Sacramento, Ca. 94236

SCH Number	Title / Lead Agency / City--County / Description	Document Type	Ending Date
	DIST.: 4) (APN: 340-070-67).		
2013051057	Solvang Senior Apartments Solvang, City of Solvang--Santa Barbara The project is a 45 unit senior apartment project in one building with 45 parking spaces. The site is an in-fill parcel. The project involves extension of a public street.	**MND**	06/19/2013
2013051048	State Route 67 Median Barrier Feasibility Safety Project Caltrans #11 Poway--San Diego Caltrans is proposing three build and one no-build alternative to be studied for this project. The proposed project is approximately 13 miles in length and proposes to study the feasibility of installing a median barrier to reduce the number and severity of cross centerline accidents. Alternatives 1 and 2 each have three types of barrier as options: either a concrete barrier, high tension cable barrier, or metal barrier rail. Alternative 1 proposes removing the existing inside lane to install the median barrier Alternative 2 proposes to install a median barrier on the existing centerline. Alternative 3 proposes to remove a lane and install a 12' median buffer. Alternative 4 is the no-build alternative.	**NOP**	06/18/2013
2013051049	Central Metal Expansion (Project No. R2004-00324-(2)/CUP No. 200500040/ENV No. 200500053) Los Angeles County --Los Angeles Central Metal is a currently operating scrap metal processing facility at 8201 Santa Fe Avenue in the unincorporated communities of Florence-Firestone and Walnut Park. The project site is 11.28-acres, which includes the eastern 4-acre portion which currently operates as a scrap metal processing facility and western 7.28-acre portion which is currently used for truck storage. The proposed project expands the operations of the scrap metal facility operations to include the western and southern portion of the project site. The volume of scrap metal processed is projected to increase from 50,000 annual tons up to 80,000 annual tons. The site is currently developed with two main structures (a 46,500 sf warehouse and a 2,379-sf office building). The site is enclosed by a solid metal fence that varies in height from 8 to 12 feet. A railroad spur runs through the site diagonally from its northwest corner to its southeast corner. Currently, the facility has authorized hours of operation Monday to Friday from 7:30 AM to 4:00 PM and the proposed operations include limited operations on Saturdays from 7:30 AM to 2:00 PM. The facility is expected to employ approximately 20 workers per shift, up to 2 shifts per day. The existing scrap metal facility was authorized under CUP No. 01-262 to operate on the eastern 4-acre portion of the site in September 2002 for a grant term of ten years, and the applicant is requesting the continuance of the existing facility.	**NOP**	06/18/2013
2013052056	Prospect Island Tidal Habitat Restoration Project Water Resources, Department of --Sacramento The project would entail restoration of emergent wetlands and subtidal habitats on both properties comprising the approximately 1600-acre Prospect Island.	**NOP**	06/18/2013

Documents Received on Monday, May 20, 2013

APPENDIX B: SCOPING MEETING MATERIALS

- Scoping Meeting Agenda
- Comment Sheet
- Speaker Card
- Presentations: Overview, FRPA and Prospect Island
- Poster Board Map

Fish Restoration Program Agreement (FRPA)
Prospect Island Tidal Habitat Restoration Project
Scoping Meeting

AGENDA

June 10, 2013
City of West Sacramento Community Center, Community Room
1075 West Capitol Avenue, West Sacramento, CA 95691
7:00 – 9:00 p.m.

Meeting Objective: To solicit public input on the scope of the environmental analyses to be conducted for the Prospect Island Tidal Habitat Restoration Project.

7:00 – 7:15 p.m. Welcome and Sign-In

- Sign in and receive a meeting packet with agenda, blue speaker card (to sign up for oral comments), yellow comment sheet (to provide written comments) and Prospect Island fact sheet
- Browse project maps and provide written comments
- **If you would like to provide an oral comment, please fill out a blue speaker card and hand it to the facilitator or FRPA project staff.**

7:15 – 8:00 p.m. Presentations

- Scoping meeting process overview
- Environmental Impact Report (EIR) regulatory and scoping process, and compliance with California Environmental Quality Act (CEQA) regulations
- FRPA and Prospect Island project overview, background, and process

8:00 – 9:00 p.m. Public Input Session

- Please focus your comment on the scope of the Prospect Island project
- Speaker oral comments will be limited to 3 minutes or less.
- If providing an oral comment, please consider also submitting your comment in writing (on a yellow comment sheet or electronically). See comment sheet for more information.

9:00 p.m. Adjourn

Thank you for participating in this process.
More information is available on the Prospect Island website:
http://www.dwr.water.ca.gov/environmentalservices/frpa_prospect_restoration.cfm

Fish Restoration Program Agreement (FRPA)
Prospect Island Tidal Habitat Restoration Project
Scoping Meeting Comment Sheet

- Thank you for your input. You may provide your written comments by:
  - Turning in this form at the scoping meeting in the comment box provided.
  - E-mailing your comments to **Dan Riordan, dan.riordan@water.ca.gov, with the subject line "FRPA Prospect Island Tidal Habitat Restoration Project Scoping Comment"**
  - Faxing this form to (916) 376-9688
  - Or mailing this form to the CA Department of Water Resources (address on back)
- Whatever method you choose, please note that all written comments must be **postmarked by June 21, 2013.**
- Please focus your comments on the scope of the Prospect Island project.
- You may use additional paper if necessary or provide comments on the map (on back).
- Please print clearly. All comments become part of the public record.

Name: _____

Organization: _____

Mailing address: _____

Phone: (___) -_____**Email:** _____

Date: _____

Would you like to be added to the FRPA listserv to receive periodic updates about FRPA (please circle one)? YES NO

Comment:

_____

_____

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_____

_____

_____

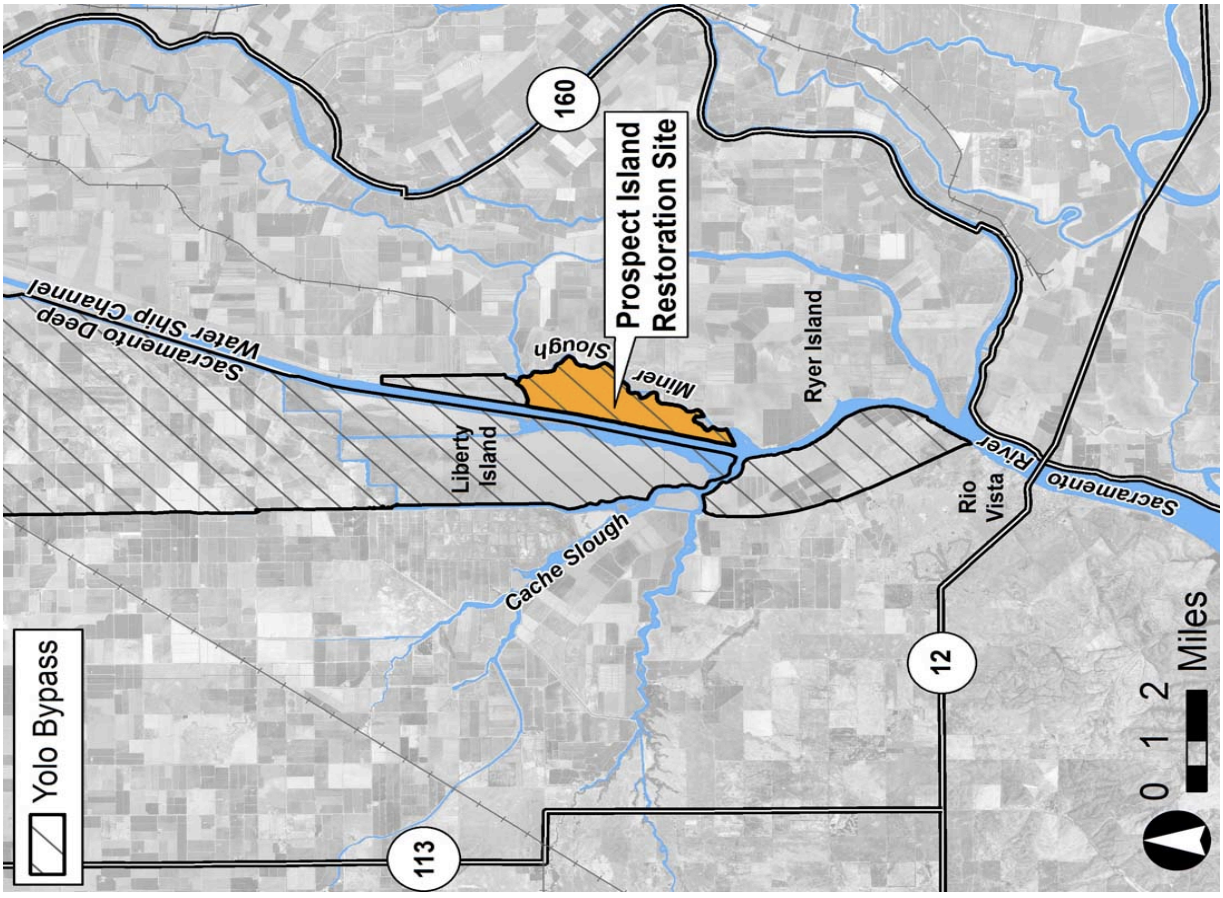
_____

Place
First Class
Stamp
Here

Fish Restoration Program Agreement
Prospect Island Tidal Habitat Restoration Project

Attn: Dan Riordan
Department of Water Resources
PO Box 942836
Sacramento, CA 94236

Please fold, staple/tape, stamp and mail



Fish Restoration Program Agreement
Prospect Island Tidal Habitat Restoration Project
Scoping Meeting

SPEAKER CARD

If you would like to provide an oral comment,
please fill out and hand this speaker card to the facilitator or FRPA staff.

- Please focus your oral comments on the scope of the Prospect Island project.
- Oral comments will begin after the presentations are completed at 8:00 p.m.
- Oral comments will be heard in the order that the speaker cards were received. Comments are limited to 3 minutes or less (final timing will be established once the number of speakers is known).
- Please consider also submitting your comment in writing (on a yellow comment sheet or electronically). See comment sheet for more information.

Please provide the following information:

NAME:

ORGANIZATION:

MAILING ADDRESS:

PHONE:

EMAIL:

Please briefly summarize your oral comment:

Would you like to be added to the FRPA listserv to receive periodic updates about FRPA (please circle one)?

YES **NO**

SCOPING MEETING

Fish Restoration Program Agreement (FRPA)

Prospect Island

Tidal Habitat Restoration Project

June 10, 2013

West Sacramento Community Center

West Sacramento, California

Scoping Meeting Objective

Solicit public input on the scope of the environmental analyses to be conducted for the Prospect Island Restoration Project
Draft Environmental Impact Report (DEIR) to be prepared under the California Environmental Quality Act (CEQA)

Meeting Agenda

7:00 – 7:15 p.m.	Welcome, Sign-In, Introductions
7:15 – 8:00 p.m.	Presentations
8:00 – 9:00 p.m.	Public Input Session
9:00 p.m.	Adjourn

Public Comment Process

- To provide an oral comment, fill out and hand a speaker card (blue) to the facilitator or FRPA staff
- **Focus your oral comments on the scope of the Prospect Island EIR**
  - Comments will begin after the presentations, in the order that the speaker cards were received
  - Comments will be captured by a court reporter
  - Comments are limited to 3 minutes or less
- **Written comments are encouraged – please consider submitting your comment in writing (on a yellow comment sheet or electronically)**

Ground Rules

1. Participation encouraged
2. **Honor the focus of the meeting**:
   - Environmental issues, concerns, and alternatives to evaluate in the EIR
   - Not a public hearing or debate on the merits of FRPA or Delta restoration
3. One person speaks at a time; no side conversations
4. Be respectful, even in disagreement
5. Silence or turn off cell phones

CEQA Process

- Notice of Preparation (NOP): May 17, 2013
  - NOP Comment Period: May 17 – June 21, 2013
- Public Draft EIR (Winter/Spring 2014)
  - 45-Day DEIR Public Review Period
  - Draft EIR Public Hearing (during public review)
- Final EIR (responses to comments)
- Project Approval (CEQA Findings and Mitigation Monitoring and Reporting Plan)

Questions on Process?

FISH RESTORATION PROGRAM AGREEMENT

Implementing Habitat Restoration Requirements Of The Biological Opinions

Dennis McEwan
Department of Water Resources

Listed Fish Species











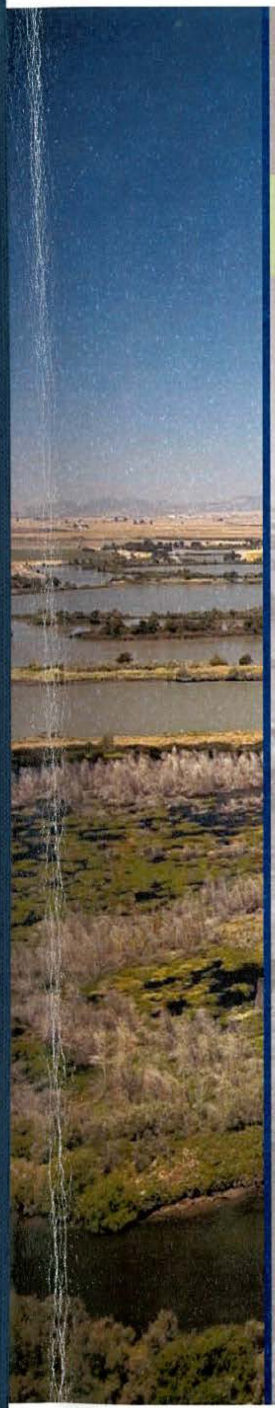
Source: NOAA

DWR Habitat Restoration Requirements

- **USFWS Delta Smelt Biological Opinion:**
  - *Restore 8,000 acres of intertidal and associated subtidal habitat*
- **NMFS Salmonid/Sturgeon Biological Opinion:**
  - *Restore salmonid rearing habitat*
  - *Enhance existing habitat in Liberty Island and lower Cache Slough*
- **CDFW Longfin Smelt Incidental Take Permit:**
  - *Restore 800 acres of brackish tidal habitat*
- **DWR Environmental Stewardship Policy:**
  - *Contribute to the recovery of listed species*

Fish Restoration Program Agreement (FRPA)

- Executed October 2010
- Joint DWR and DFW program
- Fulfill habitat restoration obligations
- Establishes framework for selecting, funding, implementing and managing restoration projects



Fish Restoration Program Agreement

Implementation Strategy

Habitat Restoration and Other Actions for Listed Delta Fish

March 2012

Department of Water Resources and Department of Fish and Game in coordination with the US Fish and Wildlife Service and the National Marine Fisheries Service

FRPA Goals and Objectives

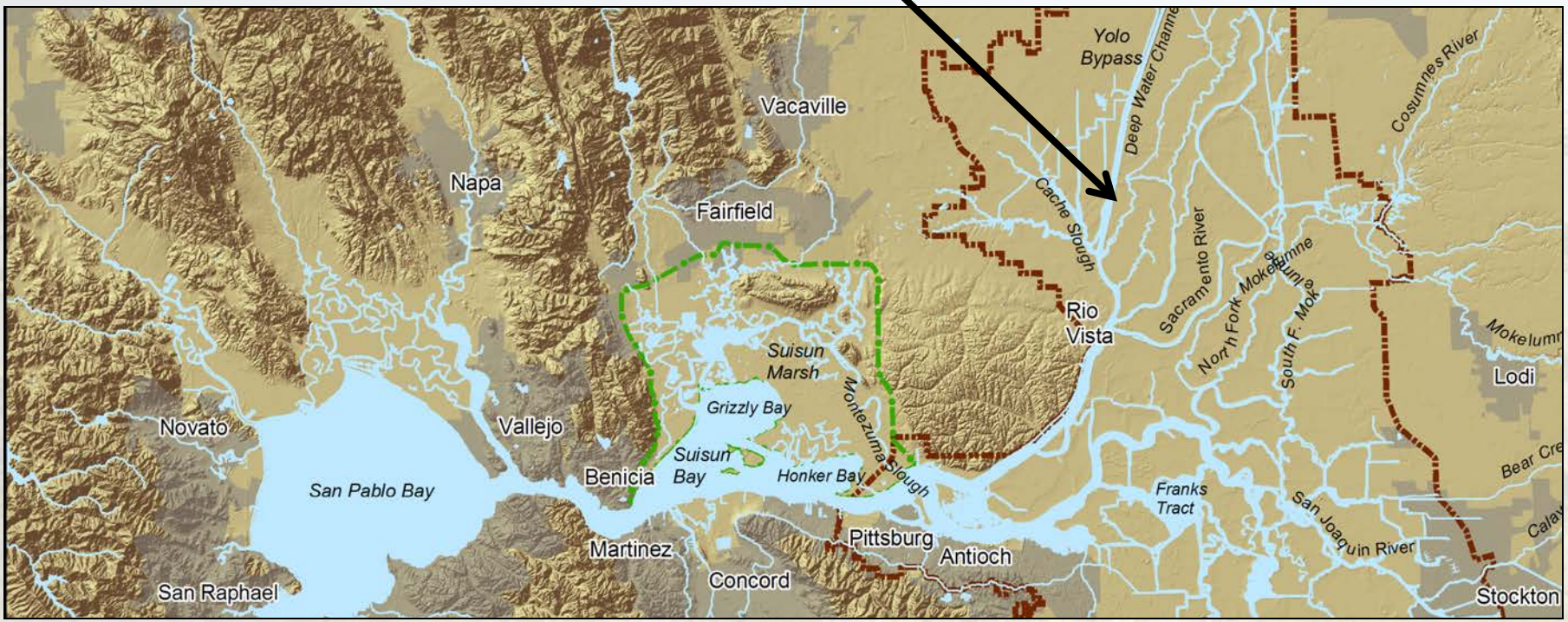
- Restore 8,000 acres of tidal habitat
- Restore functions and processes that promote productivity and nutrient export
- Increase the amount and quality of salmonid rearing habitat and through-Delta survival
- Include other agencies, stakeholders, and the public in the decision-making process
- Use sound science and current information
- Maintain consistency with other Delta plans and programs

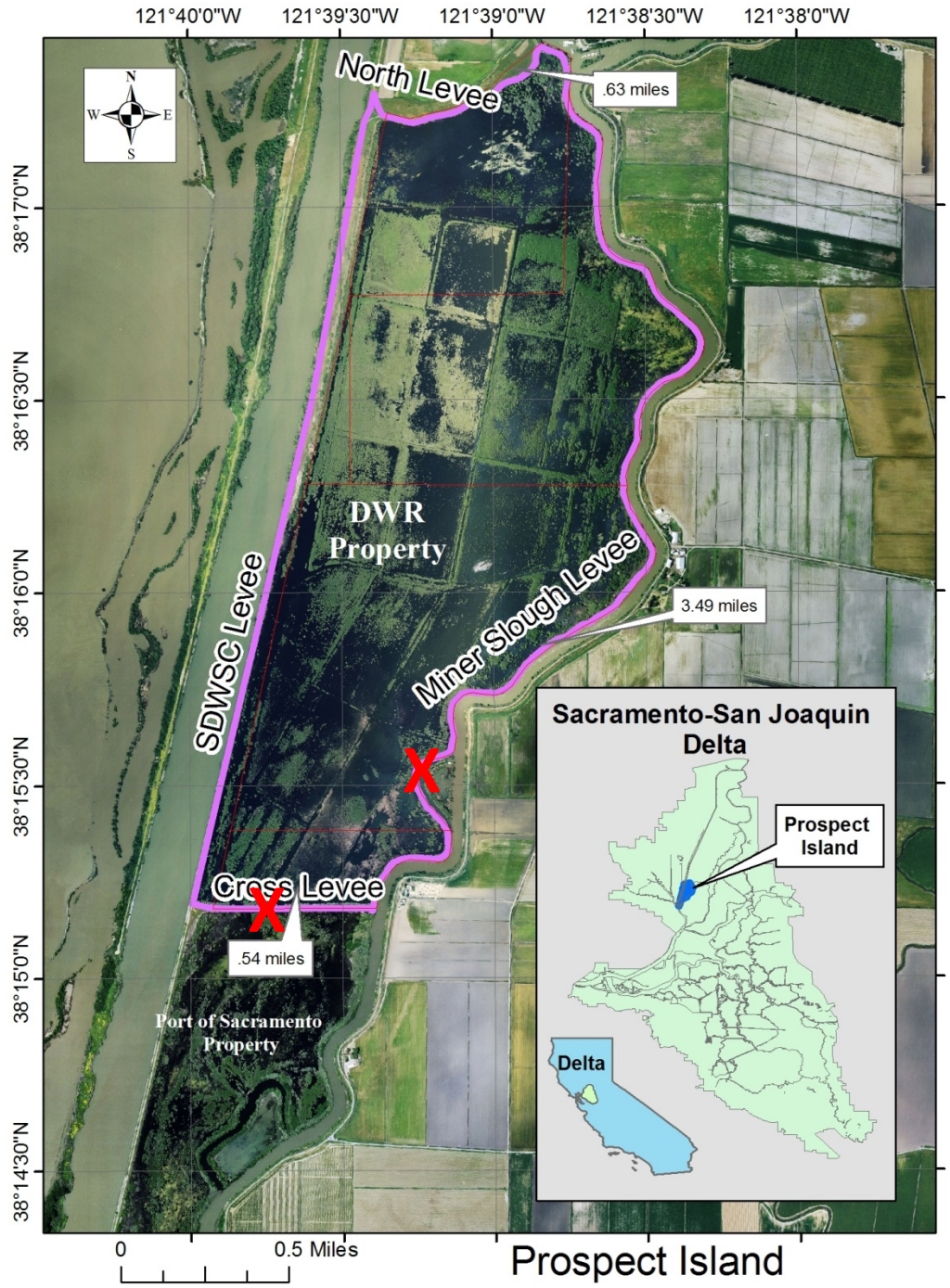
PROSPECT ISLAND RESTORATION



Dan Riordan
Fish Restoration Program
Division of Environmental Services

Prospect Island





Prospect Island

- Historically farmed
- Part of Yolo Bypass
- Bought by USBR in 1994 for NDNWR
- 2000 – Congress fails to authorize NDNWR
- X – 2007 breaches
- 2009 – Federal Govt. makes available via PBC process
- Northern 3/4 of the island acquired by DWR in 2010

Prospect Island Existing 'Feral' Vegetation

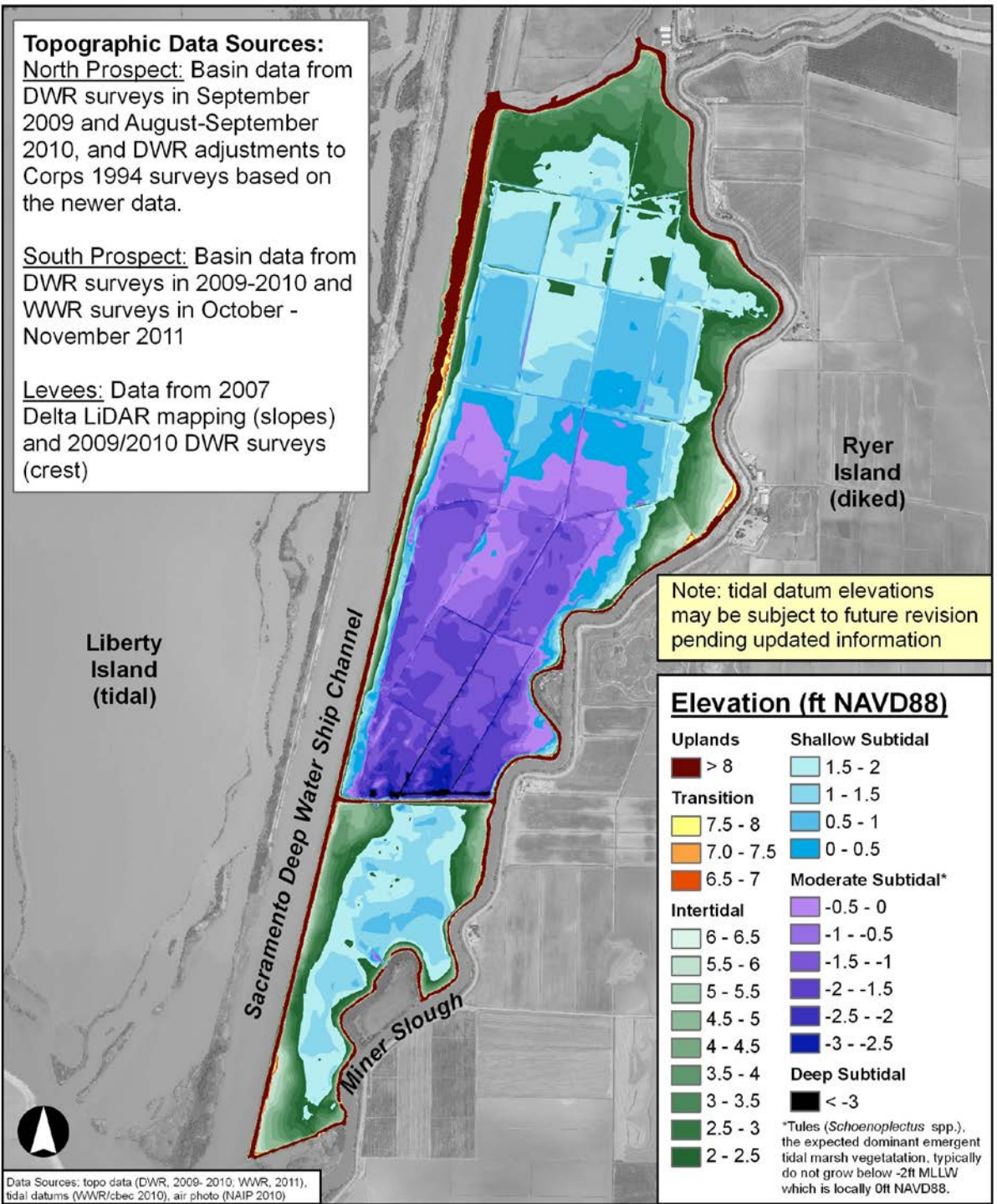








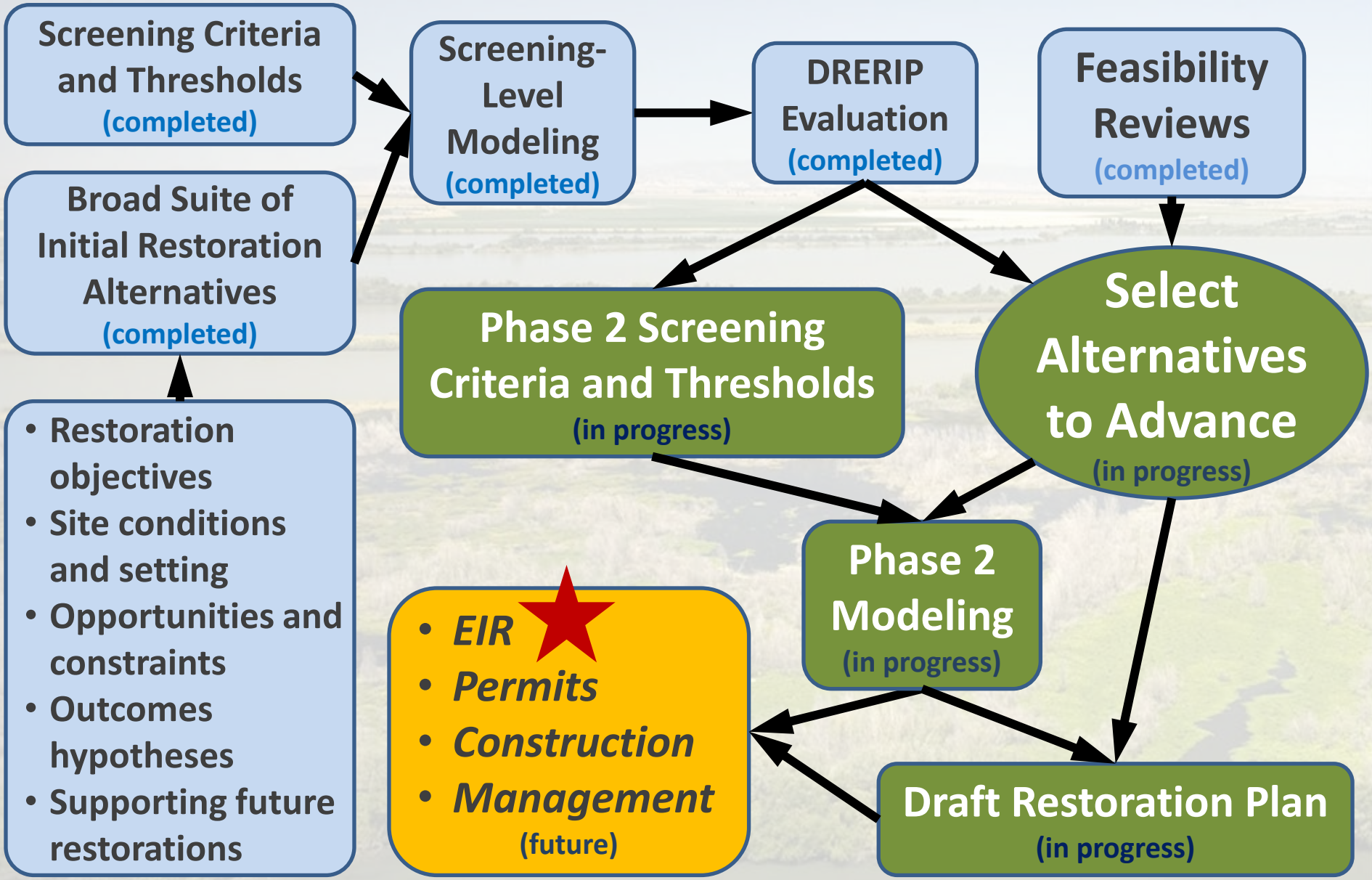




Why Prospect?

- Publicly owned
- Suitable elevations for tidal marsh and aquatic habitat restoration
- Desirable location for target fish species

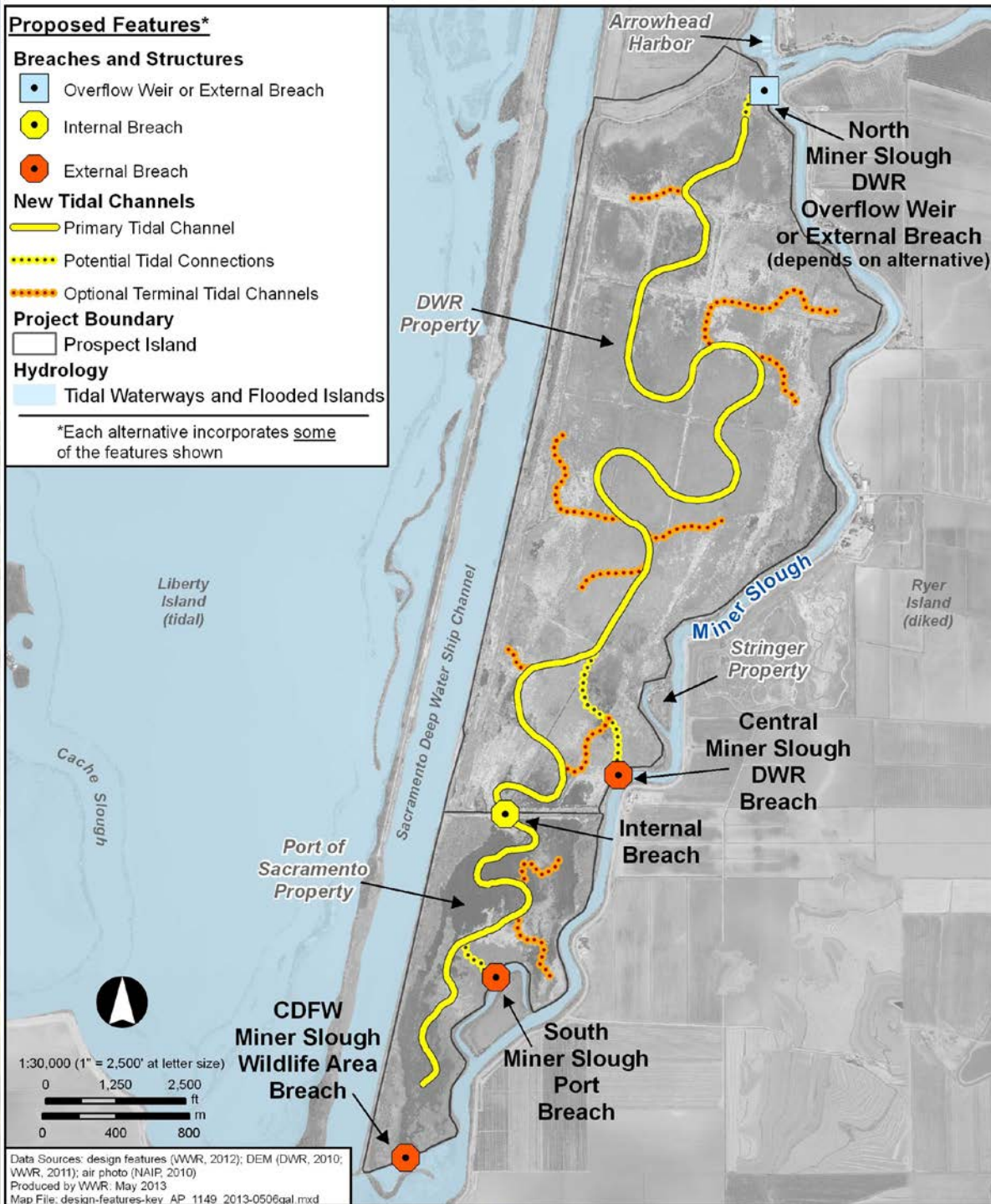
Prospect Planning Process



Design Features Key

- Breaches
- Overflow weir
- Primary channels
- Secondary branch channels
- Connecting channels to selected breaches
- DWR and Port properties
- Adjacent property access

Alternatives to be developed that mix and match these components



Potential
CEQA Project Actions

1. Breach levees
2. Install weir(s)
3. Excavate channels within Prospect Island
4. Place excavated soils within Prospect Island
5. Import clean, suitable sediment from off-site sources
6. Address adjacent property access
7. Control invasive species
8. Reinforce levees

Issues Currently Identified for EIR Analysis

Air Quality and Greenhouse Gas

- Construction and post-construction activity emissions

Agricultural Resources

- Removal of agriculturally mapped lands from future agricultural use

Cultural Resources

- No site resources eligible for the National Register of Historic Places

Geology and Soils

- Erosion from proposed earthmoving activities
- Perimeter levee stability
- Soil stability

Issues Currently Identified for EIR Analysis

Biological Resources

Aquatic

- Levee breach effects on existing habitat for listed fish species
- Creation of any conditions harmful to listed species

Wetland

- Effects of levee breaching, new tidal slough channels, and fill on
  - Freshwater non-tidal emergent marsh
  - Subtidal open water aquatic habitats
  - Submerged aquatic vegetation

Terrestrial

- Reduced upland habitats and aquatic-terrestrial transitional habitat
- Impacts to special-status terrestrial and avian species

Issues Currently Identified for EIR Analysis

Hydrology

- Potential project effects on hydrology, including: local Delta hydrodynamics and tidal ranges, flood conveyance of Miner Slough and the Yolo Bypass, breach-induced crosscurrents in Miner Slough, potential scour effects to Ryer Island Miner Slough levee, effects on Ryer Island groundwater levels

Water Quality

- Potential short-term effects on water quality, from release of turbidity and sediment-borne contaminants, excavated sediments, releases of fuel, lubricants, and construction materials
- Potential long-term effects on water quality from transport of turbidity, release/transport of sediment-borne contaminants, creation/release/transport of methylmercury, changes in disinfection byproduct formation potential in potable water supplies from natural organic matter and dissolved organic carbon

Issues Currently Identified for EIR Analysis

Hazards and Hazardous Materials

- Potential site contamination issues associated with project construction activities,
- Potential hazards to boaters, if any

Recreation

- Impacts to recreational use of the Arrowhead Harbor, and hunting and fishing activities along Miner Slough and the DWSC

Other Issues

- Aesthetics, Land Use/Planning (plan compliance), Mineral Resources (onsite mineral rights), Construction Noise, Public Services, Population and Housing, Transportation/Traffic (construction and post-construction access), Utilities/Service Systems (conflicts with onsite utilities)

Prospect Island Restoration
Schedule

	START	FINISH
1. OBTAIN BASELINE INFO:	Jul 2010	Oct 2013
2. DESIGN:	Jun 2011	Feb 2015
3. CEQA:	May 2013	Jun 2014
4. PERMITS:	Jan 2013	Feb 2015
5. INTERIM MGMT:	2010	2016
6. CONSTRUCTION:		**2016**



Blacklock Levee Breach, Oct 2006
Photo: S. Siegel

Prospect Island Restoration Project

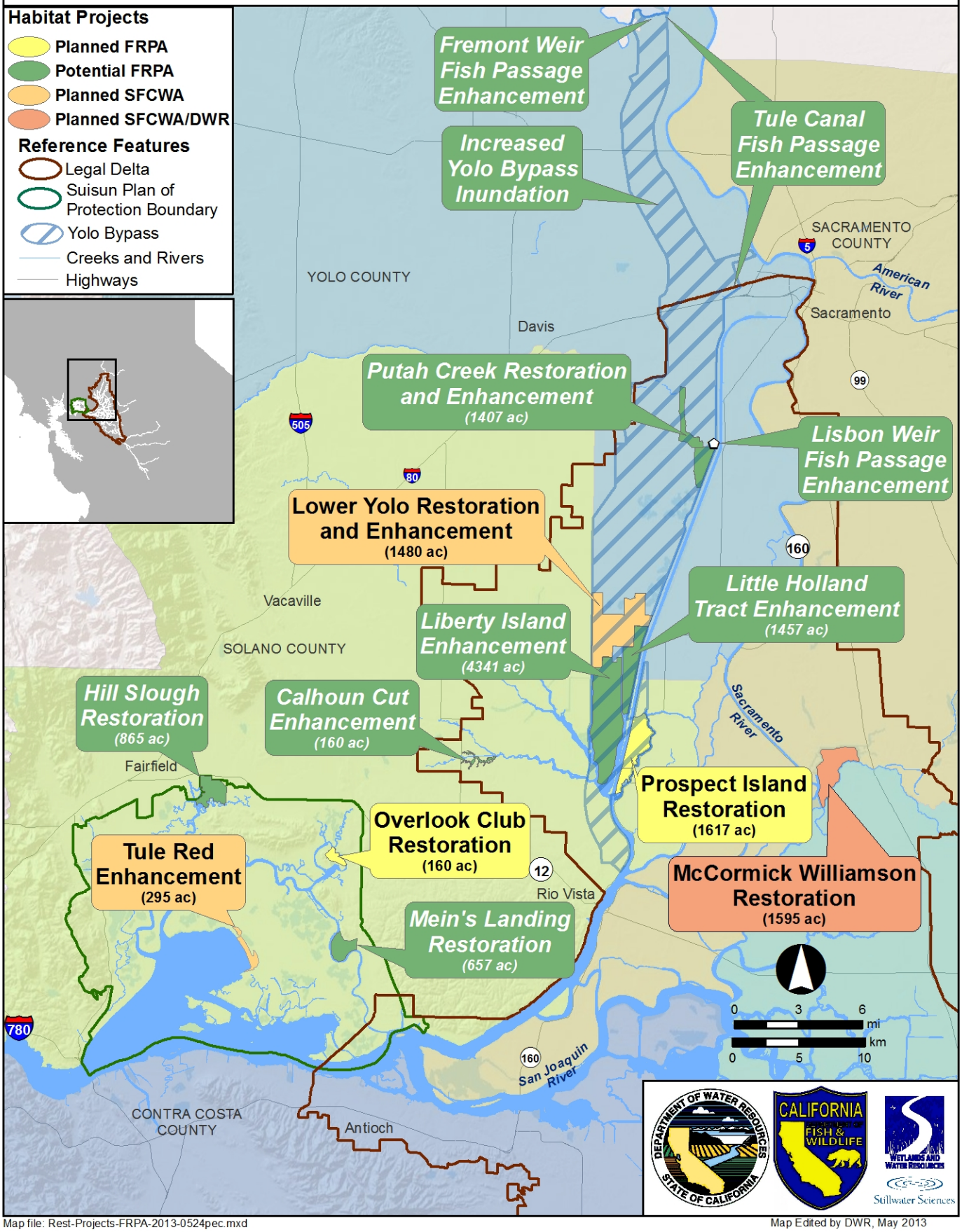
Written or oral comments can be provided at the public scoping meeting, or written comments may also be provided directly to DWR:

Dan Riordan
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236
Fax: 916-376-9688
Email: dan.riordan@water.ca.gov

For more info:
www.water.ca.gov/environmentalservices/frpa.cfm

Scoping comments postmarked by
****** June 21, 2013 ******

FRPA AND OTHER HABITAT RESTORATION PROJECTS FOR BiOps AND ITP COMPLIANCE IN THE DELTA AND SUISUN MARSH



Map file: Rest-Projects-FRPA-2013-0524pec.mxd

Map Edited by DWR, May 2013

APPENDIX C: WRITTEN & ORAL COMMENTS

- Written comments received during the scoping period (see Table 3.2)
- Written transcript of public scoping meeting (presentations and oral comments)

State of California
Department of Fish and Wildlife

Memorandum

Date: June 18, 2013

To: Mr. Dan Riordan
California Department of Water Resources
Post Office Box 942836
Sacramento, CA 94236

From: Scott Wilson, Acting Regional Manager
California Department of Fish and Wildlife – Bay Delta Region, 7329 Silverado Trail, Napa, California 94558

Subject: Prospect Island Tidal Habitat Restoration Project, Notice of Preparation of an Environmental Impact Report, SCH #2013052056, Solano County

The California Department of Fish and Wildlife (CDFW) has reviewed the Notice of Preparation (NOP) for an Environmental Impact Report (EIR) for the Prospect Island Tidal Habitat Restoration Project. CDFW is providing comments on the NOP as a Trustee Agency and Responsible Agency. As Trustee for the State's fish and wildlife resources, CDFW has jurisdiction over the conservation, protection and management of the fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species for the benefit and use by the people of California. CDFW is also considered a Responsible Agency if a project would require a discretionary approval, such as a California Endangered Species Act (CESA) Permit or a Lake and Streambed Alteration Agreement (LSAA).

The California Department of Water Resources (DWR) is proposing the Prospect Island Tidal Habitat Restoration Project (Project) to partially fulfill the 8,000-acre tidal habitat restoration obligations of DWR for the U.S. Fish and Wildlife Service Delta Smelt 2008 Biological Opinion and the National Marine Fisheries Service Salmonid 2009 Biological Opinion for the State Water Project and the Central Valley Project. DWR has indicated that the Project could also serve as partial habitat fulfillment of tidal restoration objectives under the proposed Bay Delta Conservation Plan.

The Project is an approximately 1,600-acre property located in Solano County in the Sacramento-San Joaquin River Delta. The majority of Prospect Island is owned by DWR, with the southern 300-acre portion owned by the Port of West Sacramento (Port).

The Project would include restoration of emergent wetlands and subtidal habitats. The design elements would include breaching of perimeter levees in one or more locations on Miner Slough, breaching of the cross levee between DWR and Port properties, installation of a fixed or variable-height weir, excavation of subtidal-elevation tidal slough channels, placement of soils for the purpose of raising subsided site elevations and/or for improving erosion protection of levees on the site, and provision of physical access to adjacent properties.

General Comments

Please include a complete project description of all phases of the Project, including the equipment to be used, access roads, staging areas, construction procedures, construction schedule, and long-term monitoring of mitigated lands and biological resources.

Please include a complete assessment in the EIR (including but not limited to type, quantity and locations) of the habitats, flora and fauna within and adjacent to the project area, including endangered, threatened, and locally unique species and sensitive habitats. The assessment should include the reasonably foreseeable direct and indirect changes (temporary and permanent) that may occur with implementation of the project, including impacts downstream of the project. Rare, threatened and endangered species to be addressed should include all those which meet the California Environmental Quality Act (CEQA) definition (see CEQA Guidelines, Section 15380). The EIR should also include an analysis of the off-site source locations for the imported sediment to be used at the Project site.

Lake and Streambed Alteration Agreement

CDFW may require an LSAA, pursuant to Fish and Game Code Section 1600 et seq., for the proposed Project-related activities within or near Miner Slough and the Sacramento Deep Water Ship Channel. Notification is required for any activity that will divert or obstruct the natural flow, change the bed, channel, or bank including associated riparian or wetland/marsh resources, use material from the stream/channel bed, or substantially adversely affect fish and wildlife resources. Issuance of an LSAA is subject to CEQA. CDFW, as a Responsible Agency under CEQA, will consider the CEQA document for the Project. Therefore, the CEQA document must specify impacts, mitigation measures, and include a mitigation monitoring and reporting program.

California Endangered Species Act

Please be advised that a CESA Permit is recommended if the Project has the potential to result in take of species of plants or animals listed under CESA, either during construction or over the life of the project. Issuance of a CESA Permit is subject to CEQA documentation. If the Project will or has the potential to impact CESA listed species, early consultation is encouraged, as significant modification to the Project and mitigation measures may be required in order to obtain a CESA Permit.

If you have any questions, please contact Ms. Crystal Spurr, Senior Environmental Scientist, at (209) 234-3442; or Mr. Jim Starr, Environmental Program Manager, at (209) 234-3440.

cc: State Clearinghouse

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY EDMUND G. BROWN JR., GOVERNOR

CENTRAL VALLEY FLOOD PROTECTION BOARD
3310 El Camino Ave., Rm. 151
SACRAMENTO, CA 95821
(916) 574-0609 FAX: (916) 574-0682
PERMITS: (916) 574-2380 FAX: (916) 574-0682

June 19, 2013

Mr. Dan Riordan
Department of Water Resources
P.O. Box 942836
Sacramento, California 94236

Subject: Prospect Island Tidal Habitat Restoration Project
SCH Number: 2013052056
Document Type: Notice of Preparation

Dear Mr. Riordan:

The Central Valley Flood Protection Board (Board) staff appreciates the opportunity to review and comment on the subject document. Our comments are related to (a) clarifying the Board's authority, (b) consistency with the Central Valley Flood Protection Plan, and (c) concern about sedimentation and erosion issues, as presented below:

Board Authority - The Board is responsible for flood safety within California's Central Valley and maintains the integrity of existing flood control systems, regulated streams and designated floodways through its regulatory authority. The Board has provided assurances to the U.S. Army Corps of Engineers to operate and maintain federal-State facilities of the State Plan of Flood Control, including Miner Slough and the east levee of the Sacramento Deep Water Ship Channel (DWSC). In turn, the Board has assigned the operations and maintenance responsibilities of Miner Slough and project levees along Miner Slough and the DWSC to the local levee maintaining agency, Reclamation District 501. The facilities listed above are within the proposed restoration project area and may be impacted by the proposed project.

A Board encroachment permit is required prior to any work within the Board's jurisdiction for the following activities:

> The placement, construction, reconstruction, removal, or abandonment of any landscaping, culvert, bridge, conduit, fence, projection, fill, embankment, building, structure, obstruction, encroachment, excavation, the planting, or removal of vegetation, and any repair or maintenance that involves cutting into the levee (California Code of Regulations, Title 23, Section 6).

The Board's jurisdiction, including all tributaries and distributaries of the Sacramento and the San Joaquin Rivers, and designated floodways, can be viewed on the Board's website at http://gis.bam.water.ca.gov/bam/.

Consistency with the Central Valley Flood Protection Plan - The Board adopted the Department of Water Resources' 2012 Central Valley Flood Protection Plan (CVFPP) in June 2012. The CVFPP provides a path for improving public safety, environmental stewardship, and long-term economic stability. The primary goal of the CVFPP is to improve flood risk management, with supporting goals to improve operations and maintenance, promote ecosystem functions,

restoration project as evaluated, designed, and constructed should to be consistent with the CVFPP.

The project proposes to construct tidal habitat restoration by increasing tidal flooding within Prospect Island. Consideration should be made early in the project design phase to provide maximum flexibility to sustain the primary flood control purpose and avoid adverse cumulative impacts to facilities of the State Plan of Flood Control and the Sacramento River Flood Control Project within and adjacent to the proposed project area. Any activity that encroaches on Miner Slough or the east levee of the DWSC shall not adversely impact flood system integrity, conveyance, design water surface elevation, or operations and maintenance.

Sedimentation and Erosion Issues - Board staff is concerned about the potential increase of sedimentation and erosion within the Sacramento River Flood Control project as a result of breaching levees on Miner Slough. Maintenance work, including vegetation management and sediment removal, is performed to maintain flood flow capacities of Miner Slough. The ability of the levee maintaining agencies to perform operations and maintenance activities could be financially impacted due to increased mitigation and regulatory permitting requirements as a result of the proposed project. Impacts on maintenance, including erosion, vegetation management, and sediment removal, should be addressed under the cumulative effects analysis for the project. Mitigation measures and project design alternatives should avoid potential adverse impacts to the facilities and design flood carrying capacities of the project.

The Board's Encroachment Permit Application forms and California Code of Regulations, Title 23, Division 1, can be found on the Board's website at http://www.cvfpb.ca.gov/. You may need to contact local, federal and State agencies to determine the need for other permits.

If you have any questions, please contact Senior Engineer Ali Porbaha at (916) 574-2378, or by e-mail at Mohammad.Porbaha@water.ca.gov, or Staff Environmental Scientist James Herota at (916) 574-0651, or by e-mail at James.Herota@water.ca.gov.

Sincerely,

Jay S. Punia

Jay S. Punia
Executive Officer

cc: Governor's Office of Planning and Research
State Clearinghouse
1400 Tenth Street, Room 121
Sacramento, California 95814

Mr. Dean F. Messer
Department of Water Resources
P.O. Box 942836
Sacramento, California 94236

DELTA STEWARDSHIP COUNCIL
A California State Agency

980 NINTH STREET, SUITE 1500
SACRAMENTO, CALIFORNIA 95814
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(916) 445-5511

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Randy Fiorini
Gloria Gray
Patrick Johnston
Hank Nordhoff
Don Nottoli

Executive Officer
Christopher M. Knopp

June 21, 2013

Dan Riordan
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

Via email: dan.riordan@water.ca.gov

Dear Mr. Riordan:

We have reviewed the Notice of Preparation (NOP) for the Prospect Island Tidal Habitat Restoration Project Environmental Impact Report (EIR). We welcome the opportunity to provide input regarding how to ensure the consistency of the Prospect Island Project with the Delta Plan, which was adopted on May 16, 2013. Furthermore, DSC Science Program staff has participated in Cache Slough Technical Team discussions and facilitated expert panel deliberations on alternative designs for the Prospect Island Project using the DRERIP conceptual models. We appreciate the opportunity to comment on the NOP and look forward to continued coordination between our agencies to further our related efforts.

As you may know, in 2009 the California Legislature created the Delta Stewardship Council (DSC) to play a synthesizing and coordinating role among the many agencies and interest groups who have a stake in the Delta's future. The DSC was also tasked with developing, adopting and implementing the Delta Plan. The Delta Plan is an enforceable plan to further the achievement of the coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals are to be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

The DSC sets state policy for the Delta through the Delta Plan and coordinates state and local agencies to achieve policy objectives. In addition, the Council was granted specific regulatory and appellate authority over certain actions that take place in whole or in part in the Delta. To do this, the Delta Plan contains a set of regulatory policies with which state and local agencies are required to comply. The Delta Reform Act specifically established a certification process for compliance with the Delta Plan. This means that state and local agencies that propose to carry out, approve, or fund a qualifying action in whole or in part in the Delta, called a "covered action," must certify that this covered action is consistent with the Delta Plan and must file a certificate of consistency with the Council that includes detailed findings.

It is important to note that not all actions that occur in whole or in part in the Delta are covered actions. For the Department of Water Resources to determine whether the proposed Prospect Island Project is a covered actions under the Delta Plan and therefore subject to the regulatory provisions in the plan, it must start with the Delta Reform Act, which defines a covered action as (Water Code section 85057.5(a)):

"Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place."

– CA Water Code §85054

> *...a plan, program, or project as defined pursuant to Section 21065 of the Public 9 Resources Code that meets all of the following conditions:*
>
> *1. Will occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh;*
> *2. Will be carried out, approved, or funded by the state or a local public agency;*
> *3. Is covered by one or more provisions of the Delta Plan;*
> *4. Will have a significant impact on the achievement of one or both of the coequal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and state interests in the Delta.*

We encourage you to participate in early consultation with DSC staff. We can assist you in determining whether or not the project is a covered action, and if so, we can review the consistency of the proposed action with the Delta Plan's policies and make recommendations, as appropriate[1].

The DSC staff's review of the NOP for the Prospect Island Project identified the following policies[2] to consider in order to ensure consistency with the Delta Plan. In addition, we recommend that DWR consider these policies, as appropriate, in its environmental analysis and its evaluation of alternatives in the EIR.

- **Best available science and adaptive management.** The proposed project would restore emergent wetlands and subtidal habitats on the approximately 1600 acres of Prospect Island. The NOP states that the project is intended to partially fulfill the 8,000-acre tidal habitat restoration obligations of DWR under the federal biological opinions regarding delta smelt and salmonids for the operation of the state and federal water projects. The project also could help meet the habitat restoration goals of the proposed Bay Delta Conservation Plan, if and when it is approved.

  We understand that this project is currently a component of the Fish Restoration Program Agreement (FRPA) between DWR and the Department of Fish and Wildlife (DFW). The *FRPA Implementation Strategy* (DWR and DFW in coordination with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, 2012) states that an adaptive management plan consistent with the framework described in the Delta Plan will be developed for each restoration action.

  Delta Policy G P1 (23 CCR Section 5002) specifies what must be addressed in a certification of consistency filed by a state or local public agency with regard to a covered action. As relevant to the purpose and nature of the project, all covered actions must document use of best available science (as described in Appendix 1A of the Delta Plan regulations). Ecosystem restoration covered actions **must** include adequate provisions, appropriate to the scope of the covered action, to assure continued implementation of adaptive management. This requirement shall be satisfied through:

  - An adaptive management plan that describes the approach to be taken consistent with the adaptive management framework in Appendix 1B; and

---

[1] Delta Stewardship Council. 2013. Delta Plan, Appendix B, Administrative Procedures Governing Appeals, Statutory Provisions Requiring Other Consistency Reviews, and other Forms of Review or Evaluation by the Council.
[2] In order to become legally binding, the Delta Plan policies must be approved as regulations by the Office of Administrative Law. Each policy is therefore referenced by both its Delta Plan policy number and its regulatory code section number. The DSC expects the regulations to go into effect no later than October 1, 2013.

- Documentation of access to adequate resources and delineated authority by the entity responsible for the implementation of the proposed adaptive management process.

The DSC staff looks forward to continue collaboration with DWR, DFW and others to support the use of best available science and the development of a robust adaptive management plan for this project.

- **Habitat restoration.** The NOP states that the objectives of the Prospect Island Project include enhancing food availability for native fishes; increasing salmonid rearing habitat; increasing habitat to support other listed species; enhancing water quality, recreation and carbon sequestration; promoting resiliency to climate change and other future conditions; and avoiding promotion of conditions that would favor the establishment or spread of nonnative invasive species. DWR should verify that these objectives are consistent with Delta Plan Policy ER P2 (23 CCR Section 5006), which calls for restoring habitats at appropriate elevations and in a manner consistent with Appendix 3, which is Section III of the California Department of Fish and Wildlife's *Draft Conservation Strategy for the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Region* (DFG 2011).

- **Nonnative invasive species.** As mentioned above, one of the project objectives is to avoid promotion of conditions that would favor nonnative species. Please verify that the project will be consistent with Delta Plan Policy ER P5 (23 CCR Section 5009), which states that the potential for new introductions of, or improved habitat conditions for, nonnative invasive species, striped bass, or bass must be fully considered and avoided or mitigated in a way that appropriately protects the ecosystem.

- **Respect local land use.** Concerns have been raised regarding the potential adverse effects of the proposed project on adjacent land, such as increases in Ryer Island groundwater levels, increased scour on the Ryer Island Miner Slough levee, and increased flood risk. Please verify that these concerns will be addressed in a manner consistent with Delta Plan Policy DP P2 (23 CCR Section 5011). This policy states that ecosystem restoration projects must be sited to avoid or reduce conflicts with existing uses or those uses described or depicted in city and county general plans for their jurisdictions or spheres of influence when feasible, considering comments from local agencies and the Delta Protection Commission. (Because the project is located entirely on public land, it is consistent with the part of DP P2 that calls for plans for ecosystem restoration to consider sites on existing public lands, when feasible and consistent with a project's purpose, before privately owned sites are purchased.)

- **Flood risk reduction.** The Prospect Island Project should reduce, or at least not increase, flood risk. The Delta Plan contains two policies that may be relevant to DWR's consideration of this issue: Policy RR P3 restricts encroachments in floodways, and Policy RR P4 restricts encroachments in floodplains.

We have the following additional recommendations regarding ways in which the Prospect Island Project could further promote the achievement of the coequal goals.

- **Habitat restoration.** Delta Plan Recommendation ER R2 states that the habitat restoration project should ensure connections between areas being restored and existing habitat areas and other elements of the landscape needed for the full life cycle of the species that will benefit from the restoration project. Where possible, projects should improve water quality. Project proponents should follow best practices for mosquito abatement. In addition, ER R2 specifically

recommends enhancing the ability of the Yolo Bypass to flood more frequently to provide more opportunities for migrating fish, especially Chinook salmon, to use this system as a migration corridor that is rich in cover and food.

- **Recreation on public lands.** Delta Plan Recommendation DP R11 calls for water management and ecosystem restoration agencies to provide recreation opportunities, including visitor-serving business opportunities, at new facilities and habitat areas whenever feasible. Recommendation DP R14 calls on DFW, in cooperation with other public agencies, to collaborate with nonprofits, private landowners, and business partners to expand wildlife viewing, angling and hunting opportunities. Recommendation DP R16 states that public agencies owning land should increase opportunities, where feasible, for bank fishing, hunting, levee-top trails, and environmental education.
- **Water quality.** The NOP states that the EIR will evaluate both short-term and long-term water quality impacts. Delta Plan Recommendation WQ R1 states that water quality in the Delta should be maintained at a level that supports, enhances, and protects beneficial uses identified in the applicable State Water Resources Control Board or regional water quality control board water quality control plans. Delta Plan Recommendation WQ R2 states that covered actions should identify any significant impacts to water quality.
- **Protecting the Delta as place.** The Prospect Island Project should contribute to protecting and enhancing the unique cultural, recreational, natural resource, and agricultural values of the Delta. Delta Plan Recommendation DP R17 calls for enhancing opportunities for visitor-serving businesses.

We look forward to working with you and your staff to ensure consistency of the Prospect Island Project with the Delta Plan. If you have any questions, please contact Jessica Davenport at jdavenport@deltacouncil.ca.gov or (916) 445-2168.

Sincerely,

Jessica Davenport for

Cindy Messer
Deputy Executive Officer, Planning

cc: Phil Isenberg, Chair, DSC
DSC Council Members
Chris Knopp, Executive Officer
Dan Ray, Chief Deputy Executive Officer
Rainer Hoenicke, Deputy Executive Officer, Science Program
Carl Wilcox, Policy Advisor to the Director for the Bay-Delta, Department of Fish and Wildlife

CALIFORNIA STATE LANDS COMMISSION
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

Our 75th Year

1938 - 2013

JENNIFER LUCCHESI, *Executive Officer*
(916) 574-1800 *Fax* **(916) 574-1810**
California Relay Service TDD Phone **1-800-735-2929**
from Voice Phone **1-800-735-2922**

Contact Phone: **(916) 574-1900**
Contact Fax: **(916) 574-1885**

June 21, 2013

File Ref: SCH #2013052056

Department of Water Resources
Attn: Dan Riordan
P.O.Box 942836
Sacramento, CA 94236

Subject: Notice of Preparation (NOP) for a Draft Environmental Impact Report (DEIR) for Prospect Island Tidal Habitat Restoration Project (Project) in San Joaquin River Delta, San Joaquin County

Dear Mr. Riordan:

The California State Lands Commission (CSLC) staff has reviewed the subject NOP being prepared by Department of Water Resources (DWR) for the subject Project. The DWR, as a public agency carrying out the Project, is the lead agency under the California Environmental Quality Act (CEQA) (Pub. Resources Code § 21000 et seq.). The CSLC is a trustee agency because of its trust responsibility for projects that could directly or indirectly affect sovereign lands, their accompanying Public Trust resources or uses, and the public easement in navigable waters. Additionally, because the Project involves work on sovereign lands, the CSLC will act as a responsible agency.

CSLC Jurisdiction and Public Trust Lands

The CSLC has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways. The CSLC also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions (Pub. Resources Code, §§ 6301, 6306). All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the protections of the Common Law Public Trust.

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable lakes and waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all people of the State for statewide Public Trust purposes, which include but are not limited to waterborne commerce, navigation, fisheries, water-related recreation, habitat

preservation, and open space. On tidal waterways, the State's sovereign fee ownership extends landward to the mean high tide line, except for areas of fill or artificial accretion or where the boundary has been fixed by agreement or a court. On navigable non-tidal waterways, including lakes, the State holds fee ownership of the bed of the waterway landward to the ordinary low water mark and a Public Trust easement landward to the ordinary high water mark, except where the boundary has been fixed by agreement or a court. Such boundaries may not be readily apparent from present day site inspections.

After reviewing the information contained in the NOP, CSLC staff has determined the portion of the Project in Minor Slough will be located on State-owned sovereign land under the jurisdiction of the CSLC. Additionally, the portion of proposed Project in Prospect Slough may also involve sovereign lands under the jurisdiction of the CSLC; however, based solely on the information submitted in the NOP, CSLC staff is currently unable to determine the extent or location of sovereign ownership interests of the State in this area of the Project. CSLC staff requests submittal of additional information such as detailed maps and engineering designs to enable CSLC staff to determine the exact components of the Project that will require a lease. Because a lease from the CSLC will be required for DWR to implement the Project on sovereign lands, please contact Wendy Hall (see contact information below) for further information about the extent of the CSLC's sovereign ownership and leasing requirements.

Please also be advised that the waterways involved in the Project are subject to a public navigational easement. This easement provides that the public has the right to navigate and exercise the incidences of navigation in a lawful manner on State waters that are capable of being physically navigated by oar or motor-propelled small craft. Such uses may include, but are not limited to, boating, rafting, sailing, rowing, fishing, fowling, bathing, skiing, and other water-related public uses. The activities completed under the Project must not restrict or impede the easement right of the public.

These comments are made without prejudice to any future assertion of State ownership or public rights, should circumstances change, or should additional information become available. This letter is not intended, nor should it be construed as a waiver or limitation of any right, title, or interest of the State of California in any lands under its jurisdiction.

Project Description

The proposed Project, encompassing approximately 1,600 acres, is located in the northern portion of the Sacramento-San Joaquin River Delta, Solano County. The majority of Prospect Island is owned by DWR (1,300 northern acres) and a small portion is owned by the Port of West Sacramento (300 southern acres). DWR plans to restore tidal habitat in accordance with its obligation to restore 8,000 acres of tidal marsh pursuant to the Reasonable and Prudent Alternative in the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion (USFWS 2008) and referenced in the National Marine Fisheries Service (NMFS) Salmonid Biological Opinion (NMFS 2009). These Opinions were issued for DWR's long-term coordinated operations of the State Water Project and the federal Central Valley Project. The Project may also serve as partial habitat fulfillment of tidal restoration objectives under the proposed Bay Delta Conservation Plan, upon its approval.

The following Project objectives at Prospect Island will help meet the above described tidal restoration obligations:

1. Enhance primary and secondary productivity and food availability for native fishes within Prospect Island and surrounding Delta waterways;
2. Increase the quantity and quality of salmonid rearing habitat within and in the areas surrounding Prospect Island;
3. Increase the amount and quality of habitats to support other listed species, to the extent they can be supported by site conditions and natural processes;
4. Provide other ecosystem benefits associated with increased Delta freshwater tidal marsh habitat, including water quality enhancement, recreation, and carbon sequestration;
5. To the greatest extent practical, promote habitat resiliency to changes in future Delta conditions, such as land use conversions, climate change, sea level rise, and invasive species; and
6. Avoid promoting conditions adverse to Project biological objectives, such as those which would favor establishment of spread of invasive exotic species.

Environmental Review

CSLC staff requests that the following potential impacts be analyzed in the DEIR.

General Comments

1. Project Description: A thorough and complete Project Description should be included in the DEIR in order to facilitate meaningful environmental review of potential impacts, mitigation measures, and alternatives. The Project Description should be as precise as possible in describing the details of all allowable activities (e.g., types of equipment or methods that may be used, maximum area of impact or volume of sediment removed or disturbed, seasonal work windows, locations for material disposal, etc.), as well as the details of the timing and length of activities. Thorough descriptions will facilitate CSLC staff's determination of the extent and locations of its leasing jurisdiction, make for a more robust analysis of the work that may be performed, and minimize the potential for subsequent environmental analysis to be required.

2. Cumulative Impacts: The DEIR should also include a cumulative impacts section to determine all past, present, and probable future projects in the area that may contribute to a greater level of environmental impacts. This analysis should define the cumulative impacts "study area" boundary, show the locations of other projects included in the analysis, and explain how those projects and the proposed Project may interact. If cumulatively considerable impacts are identified, the DEIR should propose feasible mitigation measures to minimize these potential impacts.

3. Deferred Mitigation: In order to avoid the improper deferral of mitigation, mitigation measures should either be presented as specific, feasible, enforceable obligations, or should be presented as formulas containing "performance standards which would mitigate the significant effect of the project and which may be accomplished in more than one specified way" (State CEQA Guidelines, §15126.4, subd. (b)).

Biological Resources

4. Sensitive Species: The DWR should work closely with the California Department of Fish and Wildlife (CDFW), USFWS, and NMFS during development of the DEIR to identify any special-status plant or wildlife species occurring in the Project area that may be affected by the Project. Although the ultimate outcome of the Project's restoration components may provide a benefit to target species, Project construction could nonetheless result in temporary impacts to those species, and possibly temporary or permanent impacts to species that are not the beneficiaries of the restored tidal marsh. The DEIR should analyze the potential for the Project to impact all sensitive species in the Project area and, if impacts to these species are found to be significant, identify all feasible mitigation.

5. Invasive Species: One of the major stressors in California waterways is introduced species. Therefore, the DEIR should consider the Project's potential to encourage the establishment or proliferation of aquatic invasive species (AIS) such as the quagga mussel, or other nonindigenous, invasive species including aquatic and terrestrial plants. For example, construction boats and barges brought in from stays at distant projects may transport new species to the Project area via hull biofouling, wherein marine and aquatic organism attach to and accumulate on the hull and other submerged parts of a vessel. If the analysis in the DEIR finds potentially significant AIS impacts, possible mitigation could include contracting vessels and barges from nearby, or requiring a certain degree of hull-cleaning from contractors. The CDFW's Invasive Species Program could assist with this analysis as well as with the development of appropriate mitigation (information at http://www.dfg.ca.gov/invasives/).

   In addition, in light of the recent decline of native pelagic organisms and in order to protect at-risk fish species, the DEIR should examine if any elements of the Project would favor non-native fisheries within the San Joaquin River Delta.

6. Construction Noise: The DEIR should also evaluate noise and vibration impacts on fish and birds from construction, restoration or flood control activities in the water, on the levees, and for land-side supporting structures. For example, the DEIR should describe weir installation in detail and evaluate whether any activities necessary for the weir installation could generate noise or underwater acoustic impacts that could affect species in the Project vicinity. Mitigation measures could include species-specific work windows as defined by CDFW, USFWS, and NMFS. As stated above, in order to develop the most

comprehensive and effective measures, CSLC staff recommends DWR consult early with these agencies during development of the DEIR.

Water Quality

7. Mercury/Methylmercury: Since the proposed Project is in the San Joaquin River Delta, CSLC staff recommends testing of sediment quality and suitability. CSLC staff also requests that the DEIR include avoidance and minimization measures to reduce potential release of mercury/methylmercury and other toxins from Project activities into waterways and onto State lands underlying those waterways.

   On April 22, 2010, the Central Valley Regional Water Quality Control Board (CVRWQCB) identified the CSLC as both a State agency that manages open water areas in the Sacramento-San Joaquin Delta Estuary and a nonpoint source discharger of methylmercury (Resolution No. R5-2010-0043), because subsurface lands under the CSLC's jurisdiction are impacted by mercury from legacy mining activities dating back to California's Gold Rush. Pursuant to a CVRWQCB Total Maximum Daily Load (TMDL), the CVRWQCB is requiring the CSLC to fund studies to identify potential mercury/methylmercury control methods in the Delta and to participate in an Exposure Reduction Program. The goal of the studies is to evaluate existing control methods and evaluate options to reduce methylmercury in open waters under jurisdiction of the CSLC. Any action taken that may result in mercury/methylmercury suspension within the Sacramento-San Joaquin Delta Estuary may affect the CSLC's efforts to comply with the CVRWQCB TMDL.

Climate Change

8. Greenhouse Gases (GHG): Page 4 of the NOP indicates the DEIR will include an analysis of short-term air quality impacts including GHG emissions from construction-related activities. CSLC staff encourages DWR to develop a GHG emission analysis that is consistent with the California Global Warming Solutions Act (Assembly Bill [AB] 32) and section 15064.4 of the State CEQA Guidelines.[1] The DEIR should list all expected equipment and vehicles to be used as well as their duration of use and their GHG emissions rate, identify a threshold of significance for GHG emissions, calculate the level of GHGs that will be emitted as a result of construction and ultimate build-out of the Project, determine the significance of the impacts of those emissions, and, if impacts are significant, identify mitigation measures that would reduce them to the extent feasible.

9. Sea Level Rise: Because the Project will require DWR to obtain a lease for use of State sovereign lands, the DEIR should also consider the effects of sea level rise on the proposed Project. At its meeting on December 17, 2009, the CSLC approved the recommendations made in a previously requested staff report, "A

[1] The State "CEQA Guidelines" are found in Title 14 of the California Code of Regulations, commencing with section 15000.

Report on Sea Level Rise Preparedness" (Report), which assessed the degree to which the CSLC's grantees and lessees have considered the eventual effects of sea level rise on facilities located within the CSLC's jurisdiction. (The Report can be found on the CSLC's website, www.slc.ca.gov.) One of the Report's recommendations directs CSLC staff to consider the effects of sea level rise on hydrology, soils, geology, transportation, recreation, and other resource categories in all environmental determinations associated with CSLC leases. From the initial information contained in the NOP, it appears that under the common range of sea level rise scenarios, the Project area and its facilities/infrastructure could be affected.

Please note that, when considering lease applications, CSLC staff is directed to (1) request information from applicants concerning the potential effects of sea level rise on their proposed projects, (2) if applicable, require applicants to indicate how they plan to address sea level rise and what adaptation strategies are planned during the projected life of their projects, and (3) where appropriate, recommend project modifications that would eliminate or reduce potentially adverse impacts from sea level rise, including adverse impacts on public access.

Cultural Resources

10. Cultural Resources Assessment: The NOP on page 5 states that a cultural resources assessment has been prepared for the property. CSLC staff recommends DWR further discuss the assessment and attach the findings as an appendix in the DEIR, excluding or redacting confidential sensitive site information as appropriate.

11. Submerged Resources: The DEIR should evaluate potential impacts to submerged cultural resources in the Project area. The CSLC maintains a shipwrecks database that can assist with this analysis. CSLC staff requests DWR contact Senior Staff Counsel Pam Griggs (see contact information below) to obtain shipwrecks data from the database and CSLC records for the Project site. The database includes known and potential vessels located on the State's tide and submerged lands; however, the locations of many shipwrecks remain unknown. Please note that any submerged archaeological site or submerged historic resource that has remained in State waters for more than 50 years is presumed to be significant.

12. Title to Resources: The DEIR should also mention that the title to all abandoned shipwrecks, archaeological sites, and historic or cultural resources on or in the tide and submerged lands of California is vested in the State and under the jurisdiction of the CSLC. CSLC staff requests that the DWR consult with Senior Staff Counsel Pam Griggs (see contact information below), should any cultural resources on state lands be discovered during Project construction.

Recreation

13. The NOP on page 6 appears to focus only on recreational activities such as hunting and fishing. As described above, the CSLC is a responsible agency for the Project; the CSLC will also have to determine, when it considers issuance of a lease, whether the Project is consistent with the Public Trust Doctrine. As a result, CSLC staff recommends expanding the scope of the analysis in the DEIR to include other recreational activities that are considered public trust uses or values, such as kayaking, boating, bird watching, swimming, etc. in and around the proposed Project site. Also, CSLC staff recommends measures such as, but not limited to, placing signage (in advance) in and around the site notifying members of the public about possible closure of the access to the San Joaquin River Delta and identifying alternate access points and or use areas, with the appropriate rerouting directions, during construction.

Thank you for the opportunity to comment on the NOP for the Project. As a responsible agency, the CSLC will need to rely on the Final EIR for the issuance of any new lease as specified above and, therefore, we request that you consider our comments as you develop the DEIR. Please send additional information on the Project to the CSLC as plans become finalized.

Please send copies of future Project-related documents, including electronic copies of the Draft EIR, Final EIR, Mitigation Monitoring and Reporting Program (MMRP), Notice of Determination (NOD), CEQA Findings and, if applicable, Statement of Overriding Considerations when they become available, and refer questions concerning environmental review to Afifa Awan, Environmental Scientist, at (916) 574-1891 or via e-mail at afifa.awan@slc.ca.gov. For questions concerning archaeological or historic resources under CSLC jurisdiction, please contact Senior Staff Counsel Pam Griggs at (916) 574-1854 or via email at Pamela.Griggs@slc.ca.gov. For questions concerning CSLC leasing jurisdiction, please contact Wendy Hall with the Land Management Division at (916) 574-0994 or via email at Wendy.Hall@slc.ca.gov .

Sincerely,

Cy R. Oggins, Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
Afifa Awan, DEPM, CSLC
Jennifer DeLeon, DEPM, CSLC
Pam Griggs, Legal, CSLC
Wendy Hall, LMD, CSLC
Eric Milstein, Legal, CSLC

DEPARTMENT OF TRANSPORTATION
111 GRAND AVENUE
OAKLAND, CA 94612
PHONE (510) 286-6053
FAX (510) 286-5559
TTY 771

Flex your power!
Be energy efficient!

June 7, 2013

SOL84009
SOL-084-7.66
SCH#2013052056

Mr. Dean F. Messer
California Department of Water Resources
PO Box 942836
Sacramento, CA 94236

Dear Mr. Messer:

Prospect Island Tidal Habitat Restoration Project – Notice of Preparation

Thank you for including the California Department of Transportation (Caltrans) in the environmental review process for the project referenced above. We have reviewed the Notice of Preparation and have the following comments to offer.

Bridges, Trestles, Culverts and Other Structures in Riparian Environments
Some project level activities may affect riparian flow patterns upstream of bridges, trestles, culverts or other structures for which Caltrans holds responsibility. Please ensure your project level environmental documents include hydrological studies to determine whether such impacts will occur, and to identify appropriate mitigation measures.

Dike and Levee Maintenance, Repair and Upgrade
Activities involving demolition, reinforcement or rehabilitation of dikes or levees on which transportation facilities are built may potentially affect State transportation facilities. Also, built features on top of dikes and levees may contribute additional engineering considerations related to weight loading or compaction. These factors must be addressed through geotechnical and hydrological studies conducted in coordination with Caltrans at the project level.

Habitat Restoration and Management
Project level activities related to habitat restoration and management should be done in coordination with local and regional Habitat Conservation Plans, and with Caltrans where our programs share stewardship responsibilities for habitats, species and/or migration routes.

Encroachment Permit
Please be advised that any work or traffic control that encroaches onto the State right-of-way (ROW) requires an encroachment permit that is issued by Caltrans. To apply, a completed encroachment permit application, environmental documentation, and five (5) sets of plans clearly indicating State ROW must be submitted to the address below. David Salladay, District Office Chief, Office of Permits, California Department of Transportation, District 4, P.O. Box 23660, Oakland, CA 94623-0660. Traffic-related mitigation measures should be incorporated into the

construction plans prior to the encroachment permit process. See the website linked below for more information: http://www.dot.ca.gov/hq/traffops/developserv/permits.

Should you have any questions regarding this letter, please contact Keith Wayne of my staff by telephone at (510) 286-5737, or by email at keith_wayne@dot.ca.gov.

Sincerely,

ERIK ALM, AICP
District Branch Chief
Local Development – Intergovernmental Review

c: Scott Morgan, State Clearinghouse

CONTRA COSTA
WATER DISTRICT

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June 14, 2013

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Jerry Brown
General Manager

Dan Riordan
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

Subject: Contra Costa Water District's Scoping Comments Regarding the Notice of Preparation of an Environmental Impact Report on the Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

Contra Costa Water District appreciates the opportunity to comment on the Notice of Preparation (NOP) of an Environmental Impact Report (EIR) on the Prospect Island Tidal Habitat Restoration Project (the Project). The NOP describes some of the potential hydrology and water quality impacts of the Project that will be examined in the EIR; however, potential changes in Delta salinity and seawater intrusion were not included but should be. Hydrodynamic modeling has shown that tidal marsh restoration in the Delta has the potential to increase seawater intrusion into the Delta[1]. Increases in seawater intrusion associated with the Project should be evaluated in the EIR to ensure that appropriate avoidance or mitigation measures will be developed if necessary. Listed below are the potential impacts that should be evaluated in the EIR:

- change in salinity at drinking water intakes in the Delta, including bromide and chloride concentrations
- changes in compliance with water quality objectives set by the State Water Resources Control Board's Decision 1641
- changes in the position of the 2,000 parts per thousand isohaline on the Sacramento River (the "X2 position")
- changes in upstream reservoir releases needed to meet water quality objectives
- changes in salinity at Delta drinking water intakes, including increases in salinity that could "otherwise substantially degrade water quality" in the absence of standards violations (California Code of Regulations, Division 6, Chapter 3, Article 20, Appendix G).

[1] Suisun Marsh Habitat Management, Preservation, and Restoration Plan Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR).

Thank you for your consideration of these comments. Please call me at (925) 688-8083 or call Maureen Martin at (925) 688-8323 if you have any questions. We would be happy to meet with you to discuss water quality impacts and modeling as the Project goes forward.

Sincerely,

Leah Orloff
Water Resources Manager

MM:wec

MICHAEL J. VAN ZANDT
PARTNER
DIRECT DIAL (415) 995-5001
DIRECT FAX (415) 995-3566
E-MAIL mvanzandt@hansonbridgett.com

HansonBridgett

June 19, 2013

VIA E-MAIL AND FACSIMILE

Dan Riordan
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236
Fax: 916-376-9688
dan.riordan@water.ca.gov

Re: Notice of Preparation for the Prospect Island Tidal Habitat Restoration Project Environmental Impact Report—Comments of Reclamation District 501 – Ryer Island

Dear Mr. Riordan:

Thank you for opportunity to participate in the planning process for the proposed Prospect Island Tidal Habitat Restoration Project Environmental Impact Report. Hanson Bridgett LLP serves as legal counsel for Reclamation District 501 (RD 501) and submits these comments on its behalf.

RD 501 is a special district located on Ryer Island. Ryer Island is a developed and populated levee-protected island situated adjacent to Prospect Island on the eastern side, separated by Miner Slough. RD 501 was organized in 1887 for the purpose of operating and maintaining the levees on Ryer Island and providing drainage services to the property owners within its boundaries. In that function, RD 501 operates and maintains some 20.6 miles of flood protection levees along the perimeter of Ryer Island, 34.4 miles of interior drainage canals, and three drainage pump stations. Funding for RD 501's operation and maintenance activies is obtained from property owners via annual assessments against property receiving benefits from the district's services.

Having reviewed the Notice of Preparation (NOP) for the Prospect Island Habitat Restoration Project Environmental Impact Report, RD 501 offers the following comments for the Department of Water Resources (DWR) to consider in preparing the draft environmental document:

- Prospect Island and Ryer Island are geologically and hydrologically linked. It has been RD 501's observation that on every occasion when Prospect Island has been substantially inundated, a marked increase in soil saturation and groundwater seepage in certain areas of Ryer Island inevitably follows. RD 501's understanding is that this occurs due to the presence of horizontal sand lenses running beneath both islands, channeling infiltration of surface water rapidly along those physical corridors. Transformation of Prospect Island into permanent wetland habitat would likely increase the overall head pressure on these sand lenses, leading to greater soil saturation and

groundwater seepage on Ryer Island. The environmental impact report (EIR) should examine the geologic and hydrologic structure of Prospect Island, identify potential linkages with surrounding areas (such as sand lenses shared with Ryer Island), and consider the effects that permanent flooding of Prospect Island would have based on any linkages identified.

- As acknowledged in the NOP, the restoration project may alter flow conditions in and around Miner Slough, with the potential to cause scouring damage to Ryer Island levees. RD 501 agrees that this aspect of the project should receive careful scrutiny in the EIR. RD 501 has an obligation to maintain the Ryer Island levees. Any additional erosion or damage to those levees directly increases maintenance costs for RD 501. However, RD 501 also has concerns regarding the potential scour effects caused by changed diversion and pumping practices on a restored wetland Prospect Island. The EIR's examination of scour effects should not be limited only to changes in surface water flow caused by the proposed levee breaches on Prospect Island. The EIR's analysis of scour effects should also consider the impact of changes in surface water flow related to the location, method, and quantity of surface water diversions onto Prospect Island as well as the location, method and quantity of surface water releases from Prospect Island back into the surrounding waterways.

- The NOP describes several potential project elements involving breaches of perimeter and cross levees on Prospect Island, with the objective of creating a thoroughly inundated wetland habitat inside the boundaries of Prospect Island. RD 501 has concerns regarding where responsibility for maintenance of the remaining Prospect Island levees will rest, and how that maintenance will be conducted when the levees are surrounded by wetland habitat. Ryer Island's levees were designed based upon the presence of the Prospect Island levees, and the continued functionality of the Prospect Island levees remains important in that regard today. As the only barrier between Ryer Island and the Sacramento Deep Water Shipping Channel, the Prospect Island levees are critical to maintaining fetch length across the water within tolerable limits for the Ryer Island levees. If the levees on Prospect Island were allowed to erode, winds could build larger waves that would damage Ryer Island levees. The EIR should address the perpetual, ongoing maintenance of the remaining Prospect Island levees, identifying where responsibility for maintenance rests and describing approaches for conducting that maintenance in light of the flooded and ecologically sensitive surroundings.

- Even with adequate maintenance of the remaining Prospect Island levees, the levee breaches contemplated by the restoration project may change the overall local hydrodyamics. Accordingly, the EIR should consider how scour effects will be impacted under a variety of river conditions, particularly conditions involving high flows from upstream reservoir releases. The EIR should address how rises in river level from upstream reservoir releases will be monitored and managed to prevent scouring of the Ryer Island levees.

- The NOP states that a primary objective of the restoration project is to create rearing habitat for several endangered or potentially threatened species of native fish. The attraction of these fish to the area, particularly in their most juvenile stages, creates a need for additional safeguards to reduce the risk of harm from intake pumps used to

divert surface water for irrigation on Ryer Island. However, some potential safeguards present their own problems. For example, installing fish screens with small screen openings is very expensive and can lead to interference with pumping operations due to clogging of intake screens with silt and debris, possibly causing physical damage to the pumps themselves. The EIR should consider these issues and how to address them, such as with the implementation of Safe Harbor Agreements and appropriate mitigation measures.

- Global warming is anticipated to cause widespread and substantial rises in sea levels along the California coast. Rising sea levels will necessarily impact water levels in Delta, likely altering regional and local hydrodynamics and potentially exacerbating scour effects caused by flow changes resulting from breaches to Prospect Island levees. The EIR should consider the anticipated effects of global warming as part of its analysis of project effects on local hydrology and Ryer Island perimeter levee stability.

RD 501 looks forward to reviewing the draft EIR and providing additional comments relative to these interests as analyzed in the context of the proposed project and its various alternatives. Should you have any questions regarding RD 501's comments on the NOP, please contact me directly.

Sincerely,

Michael J. Van Zandt

cc: Neil Hamilton, President
Board of Trustees, RD 501
Stacey Boyd, Supt.
Christopher H. Neudeck, Engr.

From: Riordan, Dan@DWR
To: Chu, Ling-ru@DWR
Subject: FW: Prospect Island Tidal Habitat Restoration Project, RD999 Comments.
Date: Thursday, June 20, 2013 1:53:53 PM

-----Original Message-----
From: RecDist999 [mailto:recdist999@sprintmail.com]
Sent: Thursday, June 20, 2013 1:52 PM
To: Riordan, Dan@DWR
Cc: Cosio, Gilbert@mbkengineers.com; Steve Heringer; Tom Slater
Subject: Prospect Island Tidal Habitat Restoration Project, RD999 Comments.

Good Afternoon.

Reclamation District request close coordination on the flood control and seepage control elements of the project.

Contact: John Webber, recdist999@sprintmail.com, Tel 916-775-2144, Cell 916-417-0999

Comments: 1. The north levee of Prospect and the south east levee on Little Holland are limited height levees. These levees need to be raised to the height of RD999's unit 1 project levee and connect to the Little Holland west levee.

2. All levees need to have protection for water and wave action on both the water and land side. Levee maintenance and operations (levee patrols in high water events) need to have an agency to conduct the operations and a funding long term source.

3. The project shall not lower water quality or water levels during irrigation season.

4. This project will place flood tides in the Island during all future high water events. We ask you to consider designing operable overflow weirs that can limit the number of Island flood events and have a positive flood effect by flooding the Island in the face of high water with high tides. The controlled flooding of the Island can lower water elevation during flood flows and high tides.

Best Regards

John Webber

From: Toft, Rick [mailto:rickt@cityofwestsacramento.org]
Sent: Monday, June 24, 2013 12:09 PM
To: Riordan, Dan@DWR
Cc: McEwan, Dennis@DWR
Subject: Prospect Island NOP

Dan,

Please find the Port's comments below:

As the owner of the southerly 300 acres of Prospect Island, the Port of West Sacramento has a strong interest in the Prospect Island habitat project, particularly as it relates to the value of the Port's land and mitigation credits for which the property may be suitable. The Port may require the property as mitigation acreage for the deep water ship channel deepening project, and would like to coordinate with DWR to ensure that the habitat project is consistent with USACE mitigation requirements related to dredging.

We understand that the project alternatives have been modified to exclude breaching of the navigation levee. The deep water ship channel is the Port's "lifeline"; any planning, design, or construction activities related to the habitat project will need to be coordinated with the Port to minimize/eliminate impacts to navigation of the channel.

Thank you for the opportunity to comment on the NOP. Please use me as your contact person for the Port.

Regards

Rick Toft
Port of Sacramento
Port Business Manager
(916) 617-4880
(916) 617-4565 direct

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June 19, 2013

VIA E-MAIL AND FACSIMILE

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dan.riordan@water.ca.gov

Re: Notice of Preparation for the Prospect Island Tidal Habitat Restoration Project Environmental Impact Report—Comments of Islands Inc.

Dear Mr. Riordan:

Thank you for inviting Islands Inc. to participate in the planning process for the proposed Prospect Island Tidal Habitat Restoration Project Environmental Impact Report. Hanson Bridgett LLP serves as legal counsel for Islands Inc. and submits these comments on its behalf.

Islands Inc. is an agricultural enterprise that owns over 5800 acres on Ryer Island. Ryer Island is a developed and populated levee-protected island situated adjacent to Prospect Island on the eastern side, separated by Miner Slough. Islands Inc. uses a portion of its Ryer Island acreage for growing its own fruit and row crops. The remainder, Islands Inc. leases to other agricultural enterprises. Islands Inc. has a strong interest in the long-term vitality of the Delta region as both an ecosystem and home to highly productive agriculture.

Having reviewed the Notice of Preparation (NOP) for the Prospect Island Habitat Restoration Project Environmental Impact Report, Islands Inc. offers the following comments for the Department of Water Resources (DWR) to consider in preparing the draft environmental document:

- Prospect Island and Ryer Island are geologically and hydrologically linked. It has been Islands Inc.'s observation that on every occasion when Prospect Island has been substantially inundated, a marked increase in soil saturation and groundwater seepage in certain areas of Ryer Island inevitably follows. Islands Inc.'s understanding is that this occurs due to the presence of horizontal sand lenses running beneath both islands, channeling infiltration of surface water rapidly along those physical corridors. Transformation of Prospect Island into permanent wetland habitat would likely increase the overall head pressure on these sand lenses, leading to greater soil saturation and groundwater seepage on Ryer Island. The environmental impact report (EIR) should examine the geologic and hydrologic structure of Prospect Island, identify potential linkages with surrounding areas (such as sand lenses shared with Ryer Island), and

consider the effects that permanent flooding of Prospect Island would have based on any linkages identified.

- As acknowledged in the NOP, the restoration project may alter flow conditions in and around Miner Slough, with the potential to cause scouring damage to Ryer Island levees. Islands Inc. agrees that this aspect of the project should receive careful scrutiny in the EIR. However, Islands Inc. also has concerns regarding the potential scour effects caused by changed diversion and pumping practices on a restored wetland Prospect Island. The EIR's examination of scour effects should not be limited only to changes in surface water flow caused by the proposed levee breaches on Prospect Island. The EIR's analysis of scour effects should also consider the impact of changes in surface water flow related to the location, method, and quantity of surface water diversions onto Prospect Island as well as the location, method and quantity of surface water releases from Prospect Island back into the surrounding waterways.

- The NOP describes several potential project elements involving breaches of perimeter and cross levees on Prospect Island, with the objective of creating a thoroughly inundated wetland habitat inside the boundaries of Prospect Island. Islands Inc. has concerns regarding where responsibility for maintenance of the remaining Prospect Island levees will rest, and how that maintenance will be conducted when the levees are surrounded by wetland habitat. Ryer Island's levees were designed based upon the presence of the Prospect Island levees, and the continued functionality of the Prospect Island levees remains important in that regard today. As the only barrier between Ryer Island and the Sacramento Deep Water Shipping Channel, the Prospect Island levees are critical to maintaining fetch length across the water within tolerable limits for the Ryer Island levees. If the levees on Prospect Island were allowed to erode, winds could build larger waves that would damage Ryer Island levees. The EIR should address the perpetual, ongoing maintenance of the remaining Prospect Island levees, identifying where responsibility for maintenance rests and describing approaches for conducting that maintenance in light of the flooded and ecologically sensitive surroundings.

- Even with adequate maintenance of the remaining Prospect Island levees, the levee breaches contemplated by the restoration project may change the overall local hydrodyamics. Accordingly, the EIR should consider how scour effects will be impacted under a variety of river conditions, particularly conditions involving high flows from upstream reservoir releases. The EIR should address how rises in river level from upstream reservoir releases will be monitored and managed to prevent scouring of the Ryer Island levees.

- Islands Inc. is also concerned about how diversions of surface water onto and return flows from Prospect Island will be monitored and managed. Surface water diversions are subject to restrictions in time, quantity, and location, as determined by established water rights. The use of Prospect Island as wetland habitat necessarily involves substantially different use of water as compared to the historic agricultural activities on Prospect Island. Further, by flooding Prospect Island, the project will be creating a large evaporation pond. The EIR should consider how use of water on Prospect Island will be monitored and managed to ensure that consumptive use remains within the limits of

existing Prospect Island water rights, and that the interests of other water rights holders are not injured.

- The NOP states that a primary objective of the restoration project is to create rearing habitat for several endangered or potentially threatened species of native fish. The attraction of these fish to the area, particularly in their most juvenile stages, creates a need for additional safeguards to reduce the risk of harm from intake pumps used to divert surface water for irrigation on Ryer Island. However, some potential safeguards present their own problems. For example, installing fish screens with small screen openings is very expensive and can lead to interference with pumping operations due to clogging of intake screens with silt and debris, possibly causing physical damage to the pumps themselves. The EIR should consider these issues and how to address them, such as with the implementation of Safe Harbor Agreements and appropriate mitigation measures.

- As acknowledged in the NOP, the restoration project is intended to satisfy habitat restoration offset objectives related to the Bay Delta Conservation Plan, and ultimately to the larger objective of coordinating the operation of state and federal water projects to facilitate the transport of water to southern California. Any cross-regional water transfer involving Delta water supply obviously has the potential to impact local water salinity levels around Ryer Island. But, the alteration of existing flow patterns due to Prospect Island levee breaches has the potential to alter local water salinity levels around Ryer Island, as well. The EIR should incorporate continued monitoring of local water salinity levels, with particular attention to how changed flow conditions from the proposed Prospect Island levee breaches could impact local water salinity conditions, both under current conditions, and under future conditions expected to occur as a result of reasonably anticipated cross-regional water transfer agreements.

- Global warming is anticipated to cause widespread and substantial rises in sea levels along the California coast. Rising sea levels will necessarily impact water levels in Delta. Rising sea levels would also impact water quality in the Delta, particularly with regard to salt water intrusion. The EIR should consider the anticipated effects of global warming as part of its analysis of project effects on local hydrology, water quality, and perimeter levee stability impacting Ryer Island.

Islands Inc. looks forward to reviewing the draft EIR and providing additional comments relative to these interests as analyzed in the context of the proposed project and its various alternatives.

Should you have any questions regarding Islands Inc.'s comments on the NOP, please contact me directly.

Sincerely,



Michael J. VanZandt

cc: Tom Hester, Islands Inc.
Christopher H. Neudeck, Engr.

KEARNS & WEST, INC.,

ON BEHALF OF

CALIFORNIA DEPARTMENT OF WATER RESOURCES (CDWR)

IN THE MATTER OF

FISH RESORATION PROGRAM AGREEMENT (FRPA)

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

SCOPING MEETING

WEST SACRAMENTO COMMUNITY CENTER

1075 WEST CAPITOL AVENUE

WEST SACRAMENTO, CALIFORNIA

MONDAY, JUNE 10, 2013

7:17 P.M.

REPORTED BY:
PETER PETTY

APPEARANCES

Kearns & West, Inc.

Eric Poncelet
Julia Golomb

CDWR

Staff Present

Dennis McEwan
Dan Riordan
Laura Flournoy
Pam Conavay
Ling Chu
Gina Benigno

WWR (Water Resources)

Richard Grassetti (Grassetti Environmental)
Stuart Siegel
Melissa Carter
Noah Hume (Consultant

CDFW (Fish & Wildlife)

Jim Starr
John Downs

ALSO PRESENT

Public Comment

John Brimmer
Tom Hester
Dave Stringer
Kathy Brimmer

INDEX

	PAGE
Introduction/Overview - Dennis McEwan	4
Presentation - Eric Poncelet	6
Presentation - Richard Grassetti	10
Presentation -- Dennis McEwan	14
Presentation -- Dan Riordan	19
Public Comment	31
Adjournment	49
Reporter's Certificate	50

P R O C E E D I N G S

JUNE 10, 2013 7:17 P.M.

MR. MC EWAN: Why don't we go ahead and get started. Thanks for coming everybody, appreciate you being here.

My name is Dennis McEwan. I'm an Environmental Program Manager with the California Department of Water Resources.

So, the purpose of tonight's meeting, as I'm sure you're aware, the Department of Water Resources put out a notice that we are beginning to prepare an Environmental Impact Report for the Prospect Island, Tidal Habitat Restoration Project.

So, this is the first step in the environmental analysis process, the first -- I should say the first step for getting public input.

And the reason we're here is to solicit information from you all as to what you believe we need to look at in this environmental document. So, that's why we're here.

We've got a short series of presentations, first, and then we'll open it up for public comment.

And before we get into that, I thought I would introduce some of the staff that are here today.

Eric Poncelet, one of our consultants on the project. And when I'm finished he's going to go over the agenda, some of the ground rules, and stuff like that.

To his left is Dan Riordan. Dan is the Project Manager for the Department of Water Resources for the Prospect Island Project.

Richard Grassetti, to his left, another one of our consultants, Grassetti Environmental.

And then his left is Stuart Siegel, one of our chief consultants on the project as well, Wetlands and Water Resources.

We have Gina Benigno. Raise your hand, Gina. She's on the Fish Restoration Program staff of the Department of Water Resources, Laura Flournoy, as well,

Ling-Ru Chu, Pamela Lindholm.

And in back are our California Department of Water Resources partners, also on the Fish Restoration Program, Jim Starr, Environmental Program Manager, California Department of Water -- did I say Water Resources? I'm sorry, California Department of Fish & Wildlife, formerly the California Department of Fish & Game. And then John Downs to his left, also on that program, and Noah Hume, also another one of our consultants.

And did I miss anybody?

Okay, would you folks like to introduce yourselves?

MR. BRIMMER: We're the people that are affected by all of you people.

(Laughter)

MR. BRIMMER: There seems to be only two of us, or three of us. We live on Ryer Island, I'm John Brimmer.

MR. HESTER: Tom Hester.

MR. MC EWAN: Right. I think we've all met before, so okay.

MR. STRINGER: Dave Stringer.

MR. MC EWAN: Okay, great. Welcome, glad you're here.

Okay, I'm going to turn it over to Eric.

MR. PONCELET: Thank you, Dennis. I think Dennis already talked about the objectives for the evening. In terms of the way the meeting's going to progress, it's going to be pretty straight forward. We're going to start with some brief presentations describing the Prospect Island Tidal Habitat Restoration Project.

And then we want to make sure that everyone here tonight has a good understand of what that project is, and where we are in the environmental impact report and the CEQA process.

And then the main purpose for tonight is really to take public comment and we have a robust amount of time to do that. And I'm hoping that folks here tonight will be making oral comment, but we can also take written comment. And the public comment period is open until the 21st of June, as we'll hear more.

In terms of how the public comment process will take place, if you're interested to make an oral

comment tonight you, in your packet, got a blue card and we just ask that you fill that out, put your name on it and then hand that to my colleague Julia Golomb. Julia, raise your hand. Oh, she's behind you guys there. And just hand it to her and she'll pass those on to me, and we'll take them in the order that we receive them.

We're really asking folks tonight to focus the comments on the particular scope of the meeting tonight which, again, is on the Prospect Island Environmental Impact Report.

One other thing I want to note is we do have one other person who didn't get introduced tonight, Peter Petty --

THE REPORTER: Yeah.

MR. PONCELET: -- who's our court reporter. He will be capturing all the comments verbatim this evening and we will be preparing a scoping report that incorporates the comments for tonight, as well as other written comments received during the comment period.

And tonight, I don't think this is a big issue, but we were looking to limit comments to three minutes.

One other thing is that we do, even though

we're inviting oral comment tonight, that we do encourage written comments if you're -- even if you provide oral comment tonight and you think about this tomorrow, you have a couple more weeks until the 21st. Please consider and feel free to submit additional comments in writing.

And those instructions are on the yellow comment sheet that you guys were provided with and that gives the e-mail address of Dan Riordan, who will be collecting those.

So, that's basically how the comments work.

We have a couple of ground rules tonight that I just wanted to go over. Obviously, we want to encourage everybody to participate tonight and, again, just want to focus on the specific purpose of this evening, which is really the environmental impact report, and the CEQA process. And in particular we're looking to hear from participants about what are some of the environmental issues, or concerns, or alternatives that should be evaluated as part of the environmental impact report process. And that's the nugget. That's why we're here and what we're hoping to hear from you.

This is not intended to be a general public

debate or hearing on the topic of FRPA or on restoration projects in the Delta more broadly. So, we do ask you to focus your comments.

Again, I'll ask everybody to have one person speak at a time. Please be respectful.

And then, finally, if you do have cell phones, as I do, please remember to turn them off or onto silent mode.

So, does that work for folks for tonight? I know you're getting a formal presentation for a very informal group here, but I think this will help us proceed in I think a way that will be productive for everybody.

All right, one other piece of process that we do want to describe before we jump into the description of the Fish Restoration Program Agreement and the Prospect Island Project is to describe how the CEQA process works.

And I've given you a little bit of a preview to that, but I'd like to invite Richard Grassetti to come up.

MR. GRASSETTI: Okay, as Eric mentioned, this is what's called a scoping meeting and it's the first

step in the CEQA process, the California Environmental Quality Act process, which is the process intended to look at environmental issues and to give the public and the decision makers all the necessary environmental information on the project and alternatives to the project.

So, the first step is this meeting. The Notice of Preparation actually was the first step and that went out a few weeks ago.

There has to be a minimum of 30 days between when the Notice of Preparation goes out and when any sort of Environmental Impact Report can be issued. It will be longer than that. But you have 30 days formally to comment on the Notice of Preparation.

And this scoping hearing is to allow you to verbally comment on that -- on what you want to see covered in the Environmental Impact Report.

So, a decision was made to do a full Environmental Impact Report on the project and now we're trying to make sure that we cover all of the issues that we need to cover, and this is part of that process.

Once the -- once we get all the comments, in terms of what people want to see covered, the issues

people want to see covered in the Environmental Impact Report, we'll start working on the Environmental Impact Report.

And it will be sometime in the winter or spring of next year a public draft version of that report will go out, it's called the Draft Environmental Impact Report. And that will go out to all the agencies. It also goes out to anybody requesting a copy of it. It will go to libraries and it will be available, presumably, online as well.

And you will have 45 days to comment on the adequacy of that report. And the comments at that point would be -- for example, if you still think that there's something that needs to be better addressed, that wasn't addressed as well as you'd like, that's your opportunity to comment again and make sure that we get it right.

And so there's a 45-day period there. There will be a public hearing at that point, also, sort of like this hearing where you can put in orally your comments on the Draft Environmental Impact Report.

So, you get a couple of bites at the apple. This is the first chance, then we'll reduce the report, and then you'll get to look at it and put in your

comments, again, or any new comments, or any things that you find that wasn't done right, or needs more explanation, or something changed, something new showed up out there that you'd let us know about that.

And then we can work that into what's called the Final Environmental Impact Report. And so the Final Environmental Impact Report is we take all of your comments on the draft report and respond to them in writing.

And again, the comments will be oral and written, but we encourage you to do written comments as much as possible.

So, once that document is done, the Final Environmental Impact Report is done, then the Department of Water Resources, as the lead agency for this project, lead agency meaning they are in charge of doing the CEQA process, and they will then consider project approval.

And if they approve the project, they will do a series of findings that are required under the California Environmental Quality Act with respect to mitigation measures, and alternatives, and if there's any significant unavoidable impacts. And they'll

prepare a mitigation monitoring program.

And at that point, if they approve the project, they'll issue something called a Notice of Determination and that completes the CEQA process. And that we're looking at probably, what, late 2014 for that to occur.

MR. PONCELET: All right, thank you, Richard. So, just to remind folks, if you do want to make an oral comment tonight just please, just fill this out and hand it to Julia or me. And again, if you would like to submit written comments tonight, this is the yellow form. Please fill that out and there's a box for collecting those in the back.

Any questions on the process for tonight? Please.

MR. BRIMMER: Just a question about me, do we need to fill any of these out to ask questions about all of this or is this -- is that a -- do we need to fill out a speaker card to require --

MR. PONCELET: To just ask questions about the process?

MR. BRIMMER: Yeah.

MR. PONCELET: No. I think, so, on that note

we'll be doing, now, some substantive presentations about the program and the project.

And if, over the course of that, your questions aren't answered and you have any confusions about something that will be, I think, the best time to ask those questions.

MR. BRIMMER: Thank you.

MR. PONCELET: Does that work?

MR. BRIMMER: Yeah, uh-hum.

MR. PONCELET: All right. So, let's move on, then, to the next step.

MR. MC EWAN: Yeah, I think a lot of our perceived formality here is that at a lot of these scoping sessions you can have a large crowd and we need to have some procedures.

But with a small crowd like this, I don't think it really is.

So, I'm going to talk a little bit about the Fish Restoration Program Agreement. Prospect Island restoration is being done under the auspices of this program, so I want to tell you a little bit about what that is. And then when I'm done, Dan's going to talk more specifically about Prospect Island.

Let me see if I can work this. There we go. Okay, so what is driving all of this, and I think you folks are probably familiar with this, there's been several listings of -- or several listings of fishes under both the Federal and the California State Endangered Species Act, Delta Smelt, Longfin Smelt, Central Valley Steelhead, winter run and spring run Chinook Salmon, and Green Sturgeon.

So, because of these listings, the two Federal agencies and the State agency that are in charge of those respective Endangered Species Act write what's called a biological opinion. And it's basically opinion on any activity that may affect the listed species.

In this case, the biological opinions were for the State Water Project and the Federal Central Valley Project water projects that pump water out of the Delta.

And in the biological opinions there's a whole slew of requirements for the agencies that are in charge of those projects.

And one small part of the biological opinions are the requirements for habitat restoration. And that's what the Fish Restoration Program is dealing with, the habitat restoration requirements that are

within those biological opinions.

And I should say, also, the California Department of Fish & Wildlife incidental take permit for Longfin Smelt because of the State listing of Longfin Smelt.

So, chief among those are we are charged with or we're required to restore 8,000 acres of inner tidal and associated sub-tidal habitat under the Delta Smelt biological opinion.

We are to restore a substantial amount of some habitat for Salmon and Steelhead in the Delta, and also to enhance existing habitat in the Liberty Island and the Lower Cache Slough area, and that's under the National Fishery Service and Sturgeon biological opinion.

And then last, but not least, we have the California Department of Fish & Wildlife Longfin Smelt incidental take permit for the projects that require the restoration of 800 acres of brackish tidal habitat. This will be somewhere in the Suisun Marsh, Suisun Bay Area.

And then last, but not least, the Department of Water Resources now has an environmental stewardship

policy which basically says we need to -- our actions need to contribute to the recovery of these listed species.

So, when these biological opinions came out in 2008 and 2009, I believe it was, or 2009 and 2010 -- 2008 and 2009, our two departments, the Department of Water Resources and the California Department of Fish & Wildlife got together basically to talk at first, and to decide how our two agencies are going to work together to try to implement these habitat restoration projects.

And that's where the Fish Restoration Program Agreement or FRPA was born. And it was hammered out over a series of a couple of years, an interagency agreement between the two State agencies. It was executed in October of 2010. And as I mentioned, it's a joint DWR and DFW program to fulfill the habitat restoration requirements.

And basically, the agreement establishes the framework for selecting, funding, implementing and managing the restoration projects.

One of the first things we produced was our implementation plan, called the Implementation Strategy. We released that in March of 2012. There was a public

review process on the draft of this and we took comments and incorporated that into the final document.

We have a few copies back there and we have some other material back there if folks want to take some of this stuff home for some rather light reading later on.

One of the things that we have in the Implementation Strategy are the goals and objectives of the FRPA program. First and foremost to restore 8,000 acres of tidal habitat and we don't want to just focus on habitat. What we want to focus also on are restoring the function and processes that promote some of the ecological conditions that are necessary to support some of these listed fishes, primarily productivity and the export of that productivity outside of the marsh areas, the tidal habitat areas and into the interior Delta to try to feed some of the -- or to enhance the food web in other parts of the Delta for these fishes, also, to increase the amount and quality of Salmonid growing habitat and free Delta survival of juvenile Salmon and Steelhead.

The Delta at one time was an extremely important growing area for salmon and steelhead before

they go to the ocean. It's very important that we try to restore a little bit of that function.

Another real important goal was to -- or objective, I should say, to include other agencies, stakeholders and the public in the decision making process.

And we take this very seriously. For the past, oh, three or four months we've been meeting with various stakeholder groups. Tom, we met with your Reclamation District. We met with Solano County Water Agency, Solano County, Yolo County, North Delta Water Agency.

MR. RIORDAN: The Delta Protection Commission.

MR. MC EWAN: The Delta Protection Commission, thank you Dan. And a few others, those are just a few. So, we really want to -- we take this seriously.

Another objective is to use sound science and current information. The Delta is -- has -- there's been quite a bit of research and studies that have gone on in the Delta in the past, say, 50 years almost and some of this has really intensified in the last ten years. There's a lot of good information coming out, now, hopefully to guide us in these restoration

projects.

And last, but not least, we need to maintain consistency with other Delta plans and programs. As I'm sure you know, there's a lot going on in the Delta, we're just one small part, but we need to maintain consistency with those other programs.

And probably the most important one is the Delta Plan that just came out from the Delta Stewardship Council.

So with that, I think I'll turn it over to Dan to talk about Prospect Island.

MR. RIORDAN: Thank you, Dennis.

All right, so I'm going to start out with just --

MR. PONCELET: Can folks hear? The music's a bit loud. I can have that turned off.

MR. RIORDAN: All right, so I'm going to give you an overview, really, of the project and how it's going. I'll start out with the history and existing conditions, tell you why we're doing -- why we chose Prospect Island to do some restoration, kind of our planning process, design features, potential CEQA actions that we're going to be evaluating and issues for

the Environmental Impact Report, which is why we're here tonight.

All right, with this group I don't really need to tell you where Prospect Island is. I think we all know, you guys better than us.

So, historically, Prospect Island was farmed and in 1994 it was purchased by the Bureau of Reclamation. They wanted to make it part of the North Delta National Wildlife Refuge.

Well, in 2000 Congress failed to authorize the NDWA, and the Bureau was stuck with a piece of property that they weren't really sure what to do with.

And as you probably know, there's been numerous breaches around the island. In 2007 there was a pretty significant fish kill that went along with some of those breaches. And at that point the Bureau was really kind of antsy to get rid of it and DWR was able to obtain it under the Public Benefit Conveyance Process, where they make properties available to State or public agencies.

It shows up on that diagram, but that purple, the purple border around the northern part of Prospect Island, that signifies what DWR owns, about the northern

three-quarters, which is about 1,300 acres.

The southern portion is owned by the Port of West Sacramento. We are working with the Port of West Sacramento to try and incorporate both parts of the island into our project here.

West Sac uses their property for dredge spoils, I believe, for their dredging, just maintenance dredging on the deep watershed channel.

And as you probably know right now, Prospect Island has pretty much gone feral. There's a lot of submerged aquatic vegetation, lots of water fowl, pelicans. Beavers, as you probably, working on our levies there to try and breach them for us, and various things like that.

So, you might be wondering why we actually chose Prospect Island. So, we really have three main reasons. First of all, it's publicly owned, which you can't say that about a whole lot of properties in the Delta.

Another reason is the elevations on Prospect Island really are suitable for the type of restoration that we need to do. As we all know, the Delta is very subsided. As you get more to the Cache Slough area and

Prospect Island the elevations are a little bit higher. So, thinking about global warming and sea level rise, that lends itself to be pretty good properties, at least in the immediate future and, hopefully, in sort of long-term future for doing the type of restoration that we need to do.

It's also -- you may or may not know, it's a pretty good location in that it's right next to some prime Delta Smelt habitat, which is in the deep water ship channel.

And the estuary, that's one of -- that's really one of the hot spots for people finding Delta Smelt.

I'm not going to go into this process too much, but just so you guys know this is the process that we look at or that we're going to be using in doing our restoration projects.

Right now in Prospect, all of the blue squares there are things that we've actually completed. We've done phase one modeling. We've looked at those alternatives. We had 15 alternatives that were put through a phase one modeling and those 15 were evaluated by a panel of experts.

We've done feasibility reviews. The green boxes and all those there are things that are actually in progress right now. So, we're going to do into some more in-depth modeling. We took what the expert panel told us in our DREP evaluation, off of the phase one results, and we're going to choose five alternatives to evaluate in the EIR.

And we are currently coming up with criteria and thresholds that we want to look at in that more detailed phase two modeling, also drafting a restoration plan.

That red star indicates kind of where we're at right now. We're in the EIR process and the very beginning phases of the scoping meeting and the NOP.

We've also started looking at the different permits that we're going to need and, as you guys might know, there's a lot of them. And construction and management of the project, actually after it's been constructed, you know, monitoring and things like that, that's going to be in the future.

But this is kind of our blueprint for how we're going to go about doing our restoration projects.

Now, this is -- we call this our menu slide.

Those orange dots there and the yellow dot are potential levy breaches. The blue square up there at the north, which is close to Arrowhead Marina, is a potential overhead weir.

Now, this is not what the restoration project is going to look like when it's completed. It's going to be some mix and match of these different components. So, it might be decided that we do just on breach around the island or it may be two.

But this is, like I said, it's our menu slide. This kind of gives you all of the options that we're evaluating.

MR. MC EWAN: And please don't take where the locations are to be the locations for the actual breaches. So, we don't know that, yet, but we're just showing some of the elements up here that could go into it.

MR. RIORDAN: Thank you. And this is a -- yeah, this is a slide that requires some explanation.

Now, the yellow lines there are potential tidal channels that would be -- we would excavate, do some excavation and potentially connect some of our breach sites.

Those orange dotted lines there are secondary channels that will just come off of those -- off the tidal channels.

Is there anything that you guys think I should -- we should talk about in this slide? I don't always do this one justice like I'd like to.

MR. SIEGEL: One thing I might add is that we're also looking at different measures to have the eastern, the levy along Miner's Slough be reinforced so that while there might be a breach location in it -- there we go.

So, the idea is that we want to have the eastern levy along Miner's Slough remain intact with the -- so, one thing we haven't shown here is different approaches to preserving the integrity of that levy, even with one of our breaches in it. And that's for the purpose of protecting the Ryer Island levy on the east side of Miner's Slough.

MR. RIORDAN: Thank you. And if anybody has any questions after this, we can go on that slide in particular a little bit.

So, potential CEQA actions that this project might include are breaching levies. You know, we need

to breach levies around Prospect Island to put water on it and make it open to tidal action, potentially installing the weir that I showed at the northern end of the island, excavating channels within the island and somewhere -- and putting those soils that we excavate somewhere along Prospect. You know, possibly as reinforcing levies. We're not sure of the analysis that would go into that.

It's also possible that we would need to import clean soil form site that we don't know, yet, if we need to reinforce the levies, like Stuart mentioned.

Also addressing adjacent property access, so the Stringers and the Halls.

Controlling invasive species, I don't know if I mentioned that, but there is a lot of submerged aquatic veg on the island right now which, for the species that we're trying to protect, you know, the fish species, the Smelt and the migrating, the juvenile stringers, that submerged aquatic veg is great habitat for things like Striped Bass and Large Mouth Bass to hide in. You know, those ambush predators like that, so the small fish come in and they're just getting picked off.

So, we want to try to keep submerged aquatic veg out of our restoration sites. Try, that's really one of our goals, and also reinforcing the levies, as Stuart mentioned.

So, these next three or four slides, these are general issues that have been identified that we need to analyze in our EIR. This is a pretty standard thing for all EIRs, but looking at air quality and greenhouse gasses when you actually go to construction, so with the construction equipment, agricultural resources, if you're affecting those.

Cultural resources, so if there are Native American burial sites or things of that nature, looking at geology and soils, soil stability.

Looking at the biological resources and also aquatic, the effects of levy breaches and are we going to be making anything worse than it already is by breaching levies and then looking at the wetlands and terrestrial impacts.

And like I said we'll make this presentation available on our website and if anybody wants to e-mail me and would like a copy of it, I'd be more than happy to send it to you.

So, like I said, I'm going to blow through these a little bit here.

MR. SIEGEL: And I'll also say that all of this information on these slides is in the Notice of Preparation document that, hopefully, you all received.

MR. MC EWAN: As well as Dan's contact information is on that last page.

MR. RIORDAN: Yeah. So, looking at hydrology, like Dennis mentioned, and in particular looking at -- well, I shouldn't say in particular. But one of the things that we'll be looking at are the impacts on the Ryer Island Levy. It's possible that by opening up levies on Prospect Island that the flows are going to increase going down Miner's Slough, which would have an effect on us and on Ryer Island. And also water coming off of those breaches across from Ryer Island and the effects on those levies, so that will be evaluated.

Also looking at water quality, through the construction or, you know, excavation of soils and sediments, anything that might get churned up, any type of water quality of -- there's tons of issues that we can look at there that will be monitored and evaluated.

Hazards and hazardous material, one of the

hazards, like I said, could be increased flows. So, in particular, if you're thinking about Arrowhead Marina, if we're increasing flows around Miner's Slough and coming down out towards Cache Slough that could have negative impacts on boaters who are going into there, so that's something that we'll evaluate.

Recreational, I mentioned Arrowhead Marina.

Fishing activities, again, that's going to be the flows and how it affects the small vessels.

And then other issues, aesthetics, land use, mineral resources, things like that.

MR. MC EWAN: So, Dan, let me just interject something really quick, something that I know you folks are concerned with.

The study that we're doing, looking at the hydrologic connection between Prospect and Ryer, that will be finished, as I mentioned, sometime this fall and that will be incorporated into the environmental document. So, we will be looking at that in great detail.

MR. RIORDAN: Sorry for not mentioning it. Go ahead. I was going to say sorry for not mentioning it. That is definitely on the top of our list.

So, the schedule that we're following and this is a very condensed version of it, but this essentially is where we are right now. Hopefully, we will be finishing up our baseline data collection this fall. The design is constantly ongoing. Right now we're in the CEQA process and starting to look at the different permits that we're going to need.

Interim management of the site, which is looking at the integrity of the levies right now, we actually just had a levy inspection report come out. We don't want the levies to breach where we haven't modeled them. So, its potential -- you know, as we all know, these levies are -- you know, they're not as strong as they could be. And if they breach in a spot that's not going to give us the ideal, that's not going to meet our objectives of this project which are to, you know, increase the quality fish habitat for the species that we're really targeting. So the migrating Salmonids and the Delta Smelt and, also, trying to keep away the submerged aquatic veg that is really good for the Bass that we really don't want to encourage to be on the island.

We need to fix those levies and -- you know,

in the interim fix those levies to -- well, we don't want to spend a ton of money doing it because we're going to be breaching levies anyways, but it's something that we need to definitely think about and try to make sure that these breaches happen where all of our science and research shows that it's best for them to happen.

And then to take it home, we'll hopefully go into construction in 2016.

And that pretty much finishes up my talk. My information is on the packet that you have there. Like they said, if you choose to mail in your comments just have them postmarked by the 21st, but you can e-mail me. That would be fine, also. I think that's the --

MR. BRIMMER: I have a couple of questions.

MR. RIORDAN: Okay.

THE REPORTER: Can you speak into the mic so I can pick you up for the record.

MR. BRIMMER: Okay, I thought I read somewhere that you were going to breach the levy into the deep water channel so you've got cross flow from Miner's Slough into the deep water channel. That map didn't show me that.

MR. RIORDAN: That's right, that was one of

our initial ideas was to breach those levies. The Corp has since said that if we breach those levies it would mean decommissioning the Navigational Project. So, those options, because of -- we wouldn't -- we probably would not get our permits if we breach levies on the ship channel, so we removed those alternatives from the analysis.

MR. BRIMMER: The next question, are you -- is this tied in any way to Governor Brown's water program, to where is the water height on Prospect ever going to exceed the level of the river currently in Miner's Slough right now?

MR. RIORDAN: I don't know the answer to that.

MR. MC EWAN: Exceed the -- so it would be higher than the --

MR. BRIMMER: Well, I mean if you just breach the levy and the tide comes in, and typical tide-in pool or tide situation the water would rise on the island and it would fall as the tide goes out.

MR. MC EWAN: Right, right.

MR. BRIMMER: Are you going to trap that water in there and hold it as a holding pond for later use or whatever? That's been one of Governor Brown's issues.

MR. MC EWAN: Oh, no, no, no. Yeah, no, this is going to be strictly a restoration project. There's not going to be any sort of water storage or anything like that.

MR. BRIMMER: Okay, on the weirs that you put in to allow the water in and out, are these going to be navigable, so you open this up to duck hunters and all that stuff? Because that's what, officially, I guess, keeps them on the Prospect. If they can take a boat through there, they can hunt it.

MR. MC EWAN: Yeah --

MR. PONCELET: Dennis, can I ask you to come up just to capture the mic?

MR. MC EWAN: Sure. So, we're looking primarily to bring water on and off the island mostly through breaches. And one of the ideas was to, instead of having one of the breaches, we might have a weir up in the northern part and it would be a fixed weir, most likely. So, when the water level reaches a certain stage it spills off into the island.

And our thinking there is that would enhance bringing the juvenile Salmon that are coming downriver, to go to the ocean, onto the restoration project. And

when they're coming down it's usually in high flows, so that's the point they would go through that overflow weir.

So, we would use that overflow weir in conjunction with other breaches.

Now, whether or not we open the project up to hunting and allow duck hunters that remains to be seen. There is, I know, State Senator Lois Wolk from that area is very concerned about the loss of public access and public opportunities on some of these restoration projects, so there is some -- some folks out there that do want to open these areas up to public use.

So, to be honest with you, there's a good chance that would happen, yeah.

MR. BRIMMER: Okay, that was a sidebar. As far as raising the water, that's where I think it affects anybody on Ryer Island because now we're back to the hydrology.

MR. MC EWAN: Right.

MR. BRIMMER: If the water just goes with the flow, which I don't think by rights should affect us anymore than it does right now.

MR. MC EWAN: Uh-hum, right.

MR. BRIMMER: But if you raise it, then whatever is there --

MR. MC EWAN: Yeah. So, these breaches most likely will be fairly wide, a couple of hundred feet, so it's not going to really impede the water and slow it down that much.

You might be familiar now we have a situation where we had a leaky culvert. That's the water you see on Prospect right now is coming out of the Miner's Slough. And it comes in, on the low tide it doesn't go out very fast, so it is right now probably trapping some water, like you're talking about.

We don't think that's going to be -- that's not our objective to continue that. We want to make this thing fully tidal and we want a large amount of tidal energy input into the island.

MR. SIEGEL: So, the inside of the tide the water would be the same as Miner's Slough, in essence. Everything, Miner's Slough, Ship Channel Island would be -- you know, there's maybe a little time lag, but the same water heights at the same tide stage.

MR. BRIMMER: How about in the extreme floods when that river rises up 16 feet or whatever it is?

MR. SIEGEL: Right. Then the site would be used for -- then flood waters would fill across that. So, right now Prospect is part of the old bypass and so it has what's called a restricted tight levy. So in extreme flood events it can overtop and the same with Little Egbert and a few other properties. Right now that only happens in rare events.

But once it's restored then all of those flood events where those water levels would -- as Cache, where the whole place would rise up inside Prospect, the same with Miner's Slough, the same with the ship channel, and Cache Slough, all of them would go up together.

MR. BRIMMER: And they will drain together.

MR. SIEGEL: And they will drain together, exactly.

MR. BRIMMER: Okay.

MR. MC EWAN: Yeah, we're hoping that we can provide a -- it's not a goal of the project, but we're hoping that one of the outcomes of the project is that it provides a positive flood benefit.

And Bob Weber, the Superintendent of RD999 has told me that it's observations that when Prospect has breached in the past that it takes some of the pressure

off of that northern Miner's Slough levy. So, I'm hoping that we can achieve some sort of benefits that way to flood.

MR. BRIMMER: Thank you.

MR. PONCELET: If I could make a process, though, you're raising, I think, really important issues that we'd like to have as part of the official record, as part of the scoping meeting context. That's exactly what this meeting is intended to elicit is participation.

So, maybe we can shift to that. And because there are really -- because we don't have members of the public here tonight, I'd just invite you, if you have a specific comment, you know, in terms of flow dynamics or flood levels, those are important things to share and thank you.

MR. RIORDAN: Actually, I wanted to add one thing onto the comment in answer to your question. We really want to design restoration projects to let nature do the work. So, you know, we don't want to try to trap water on the project. We want to be able to breach levies and having the waters going on and off with the tides, and things are kind of happening without us

intervening. So without like -- you know, we don't want to have gates where we're stopping water and, you know, locking it on the island and things like that. But that's really, that's kind of a --

MR. BRIMMER: We don't want you to, either.

MR. RIORDAN: Yeah, and that's good. That's one of the things that Dennis really champions and I think all of us do, too, is that make these projects so like once they're constructed, you know, everything is natural and it's very little, you know, if any human interaction, just monitoring, hopefully.

MR. BRIMMER: Thank you.

MR. PONCELET: So I'd like to actually open it up to formal public comment period here and ask you to show hands if you'd like to make a public comment that we would enter into the record at this point to --

MR. HESTER: Well, I'll just state our --

MR. PONCELET: If you can share your name for us, please?

MR. HESTER: Sure, Tom Hester. You know, you addressed a lot of the concerns and so I'll just say, again, seepage is a big issue. And with the excavation of these channels out there, that could maybe open

things up some more, you know, because you're going deeper, actually to those.

So, we're concerned to see what the -- what the study shows when it comes out in the fall. But we're pretty sure that we see a hydraulic influence for Prospect.

And then the other thing is Ryer Island, as you all know, is protected, and so we aren't -- Prospect needs to maintain -- we have a prevailing west wind, so Prospect needs to maintain their levy so that it can protect our levy, so we don't get that big lake action in our levy. So, we're real concerned about that.

And endangered species, you know, I mean we're going to have neighbors of endangered species, habitat for endangered species. How's that going to affect us? Is that going to change the way we run our operations out there? So, we are concerned about that.

So, I can't think of anything else. Those are our main concerns.

MR. MC EWAN: Yeah, one, you didn't mention that you've done so fast, that we're going to look at, is the potential community at the tidal. The tidal action in Miner's Slough and the potential effect that

could have on your intakes, so we'll be looking at that as well.

MR. PONCELET: So, John, Kathy or Dave, do you guys want to say something this evening?

MR. MC EWAN: So, just, you know, we've captured those who are here, but I think just on the record it would be good if you could just jot those down or send in your --

MR. HESTER: Well, we're going to send our comments.

MR. MC EWAN: Okay.

MR. BRIMMER: I had one further question. What is the -- what is the purpose of clearing the -- I live right up in the northern tip, across from the Arrowhead Harbor. And right in front of my house I had a beautiful grove of trees right across the river and they've been clear cut. I don't understand how that helps the environment in any way, shape or form, or habitat, or anything.

MR. MC EWAN: Oh, on the --

MR. BRIMMER: And there seems to be some element of secrecy what's going on out there. Nobody wants to talk. It's all done with unmarked vehicles.

It's almost like some kind of black ops thing going on.

(Laughter)

MR. MC EWAN: Are you referring to on Prospect Island, itself or --

MR. BRIMMER: Pardon?

MR. MC EWAN: You're talking about Prospect Island?

MR. BRIMMER: No, right in front of my house. I mean, all the surveying and everything else, I don't know if that's in conjunction with the water that's going down south or what, but they've been surveying the Highway 84 for quite some -- for the last year.

MR. MC EWAN: Yeah, I don't know. You're talking about on Ryer Island?

MR. BRIMMER: On Ryer Island, right adjacent. And then right after that happened you had the Department of -- oh, what are the prison guys that come out and do all the --

MR. HESTER: Oh, the CCC.

MR. BRIMMER: Yeah, they've been out clear cutting everything along the road there, on Prospect, on the west or eastern side of that. And I don't understand the intent.

MR. MC EWAN: Yeah, so the first part I can't answer what's going on, on Ryer. I can tell you that's not part of this program.

And what is happening on Prospect is that we had a levy inspection down there. When we first took levy inspectors out there it had been probably since the Sakata Brothers had the property that that levy was inspected officially.

And the first of the levy inspectors told us that they can't do their job without some level of clearance so they can actually see the levy, itself.

So, that's why we cleared on the Prospect side.

After they -- after we had a crew out there, a Water Resources crew out there doing that clearing, then the clean-up, we brought the CCCs in to do the cleanup. But like I said, that's all on the Prospect side.

MR. BRIMMER: A lot of endangered species went away on that one. But that will be in our written report.

(Laughter)

MR. MC EWAN: Okay, very good.

MR. SIEGEL: So, I know Kathy or Dave,

anything?

So, I --

MR. MC EWAN: We're early.

MR. PONCELET: We're early. I hate to end too early in case folks end up showing up late. But maybe one thing we could do is we could adjourn informally.

MR. MC EWAN: Sure.

MR. PONCELET: To the extent that we're done with public comments. But I'd like to ask everyone to stay for a while in case some people show up late and still want to make comment.

MR. MC EWAN: Sure, yeah.

MR. PONCELET: That will give them the opportunity to do that.

If you guys would like to just say some more, this is your chance to grab FRPA staff and some of their consultants to answer some of the questions you've been asking.

MR. BRIMMER: I think the only comment is I don't think anybody in this room has a problem with saving the fish and bringing the Delta back to the way it is.

Government works in some pretty weird ways

where they use different programs to fund different agendas. And the last thing I would want to do is be caught supporting this thing, that has good merit, just to find out this is just a surface storage for water to be shipped down south, and ruin the Delta, and all this other garbage that ties in with this.

MR. MC EWAN: Yeah.

MR. BRIMMER: And if DWR is being up front and this all on the up and up, it's a good thing.

MR. MC EWAN: Well, I can tell you if that is the case, we have not been told that.

MR. BRIMMER: Good.

MR. MC EWAN: Yeah.

MR. BRIMMER: Because again, Tom does 50 percent of the farming on Ryer Island and I just have a little pin piece of it.

MR. MC EWAN: Right.

MR. BRIMMER: But if you do bring the water up there, I know it's going to severely impact everything we do.

MR. MC EWAN: Yeah.

MR. BRIMMER: And right now I'm -- I seem to be okay. I don't know how he's faring, but it's been

good.

MR. MC EWAN: You don't have big issues on --

MR. BRIMMER: No, I've been very fortunate. The one thing, on one of these maps that came out in the mailing, instead of those channels that you're putting in there, the second page had -- it was done in a color sketch and it showed the whole island being flooded. I don't -- yeah, it was land use vicinity -- no, that's not it.

MR. RIORDAN: Is that the one with the blue and purple colors on it?

MR. BRIMMER: Yeah, it's -- it is figure 1.

MR. RIORDAN: Yes.

MR. BRIMMER: But you show the whole island being flooded instead of a tidal.

MR. RIORDAN: Yeah.

MR. BRIMMER: And again, if the north end of the island is the highest, in order for you to flood that, to get it to hold water you're either going to have to excavate quite a bit of dirt or you're going to make the water at the south end of the island extremely deep.

MR. MC EWAN: Yeah. No, what this is showing

is actually the current condition.

MR. BRIMMER: I'm dry, fairly dry at the north end right now.

MR. MC EWAN: No, you're talking about the blue on Prospect?

MR. BRIMMER: Yes.

MR. MC EWAN: The blue shading. Yeah, that's basically -- we have two types of marshes in the Delta -- well, I shouldn't say that, there's more than two. But one way of looking at it is what are called dike marshes, and those are marshes that -- there's a lot of them like on Suisun Marsh where we have all the individual duck clubs, and there's levies all the way around and they flood it and take the water off.

We're going to do -- we're trying to do a aquatic habitat that isn't diked, but where we have breaches in the levy. So, what this is showing is basically that whole area is, in a sense now, diked, except for maybe one small breach on the southern part of Prospect Island. And so that's showing the existing condition, so that's not changing what we're looking to do in the future.

MR. BRIMMER: Okay. It appears, when I look

across the river from my house, it looks pretty vegetated right now without any standing water.

MR. MC EWAN: Right.

MR. BRIMMER: But if I go down, half a mile down the road, it's like a lake out there.

MR. MC EWAN: Yeah, there are -- this doesn't, you know, depict everything, but there are areas where it's dry, dry land.

MR. BRIMMER: How are you going to attempt to keep the Bass and all that stuff out of there? I mean when they were killing them like the bazillions, they love it in there once it's breached.

MR. MC EWAN: That's one thing that we don't really know, yet. That's one of the things we're going to analyze and look at. We have some ideas.

As I mentioned earlier, there's been a lot of research looking at things like that in the Delta and we hope to incorporate some of those techniques and those features into this restoration project.

MR. BRIMMER: Have you guys seen the Delta Smelt? I think I've seen them.

(Laughter)

MR. BRIMMER: There's certain times at night

when, I don't know what they are, but they do real well in that slough without having habitat formed for them. I mean you can go out there on certain evenings and the water will come alive. And they're little fingerlings that jump up about six inches and it will run down the river for a stretch of a quarter of a mile.

And I've talked to people and they go I don't even know what the Delta Smelt is. I think those are them, but there's a lot of them out there.

MR. MC EWAN: I haven't heard that they actually jump out of the water like that. I know that some fish --

MR. BRIMMER: Oh, they're just little guys, and they're little silver ones, and they just start going and the water just comes alive, it just starts churning.

MR. MC EWAN: Yeah, and a lot of the times they seem like they're being chased by predators, like Striped Bass so --

MR. BRIMMER: Well, they do it like -- they'll do it like, literally, you'll see like 300, 400 yards of it just start boiling, and then it will move down the river and you'll see it again.

MR. MC EWAN: Really. John have you -- or Jim?

MR. STARR: It's probably Shad being chased by stripers and large mouth. Test it out. Just throw a little silver jig out in the middle of that.

(Laughter)

MR. PONCELET: So, any other questions? I think this is a good opportunity to --

MR. STRINGER: You know you've got seals out there, you know that, right?

MR. MC EWAN: Yeah.

MR. STRINGER: I had to stop on the road there today to let them go by.

MR. BRIMMER: Sea Lions.

MR. STRINGER: Yeah, they run around all out there.

MR. BRIMMER: And beavers, the beavers are quite a problem.

MR. STRINGER: They beavers and they love those fish out there, you guys.

MR. BRIMMER: Well, the beavers are taking out trees about yay big right there by my house, so they are active.

MR. MC EWAN: Yeah, we think that's probably the biggest problem to the levy system that are out there.

MR. PONCELET: Fair enough. Okay, so I think we'll formally adjourn for those of us who are here. If you have any other questions DWR staff and Fish and Wildlife staff are available for those.

And again, I'd like to ask everybody else to stay here in case someone shows up late and wants to provide public comment.

So, thank you everybody.

(Thereupon, the Scoping Meeting was adjourned at 8:06 p.m.)

CERTIFICATE OF REPORTER

I, PETER PETTY, a Certified Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission Committee Conference; that it was thereafter transcribed.

I further certify that I am not of counsel or attorney for any of the parties to said conference, or in any way interested in the outcome of said conference.

IN WITNESS WHEREOF, I have hereunto set my hand this 19th day of June, 2013.

PETER PETTY, CER**D-493

APPENDIX D: ABBREVIATIONS

BDCP	Bay Delta Conservation Plan
BiOp	Biological Opinion
C&E Plan	Communications and Engagement Plan
CEQA	California Environmental Quality Act
CDFW	California Department of Fish & Wildlife
CSLC	California State Lands Commission
CVFPB	Central Valley Flood Protection Board
CVP	Central Valley Project
DWR	California Department of Water Resources
DWSC	Sacramento Deep Water Ship Channel
EIR	Environmental Impact Report
FRPA	Fish Restoration Program Agreement
GHG	Greenhouse gas
ITP	Incidental Take Permit
NMFS	National Marine Fisheries Service
NOP	Notice of Preparation
RPA	Reasonable and Prudent Alternative
SWP	State Water Project
USACE	US Army Corps of Engineers
USFWS	US Fish & Wildlife Service

Appendix D

Response to Comments on the 2016 Draft Environmental Impact Report

Table of Contents

1 INTRODUCTION D-1
2 GENERAL RESPONSE TO COMMENTS D-4
A. Comment Relates to a Recirculated Section of the 2016 DEIR D-4
B. Not a Comment on the 2016 DEIR D-5
C. Access to Technical Reports D-6
D. Good Neighbor Checklist D-6
E. Local Water Diversions and Increased Abundance of Listed Fish Species and Terrestrial/Avian Species of Concern to Agricultural Landowners D-12
F. Invasive Plant Management, Planting and Revegetation D-15
G. Future and Cumulative Impacts D-19
H. Monitoring and Management Plans Associated with the Proposed Project D-20
3 SPECIFIC RESPONSES TO AGENCY, TRIBAL, AND INDIVIDUAL COMMENTS D-22
a. Specific Responses to Agencies and Tribes D-22
Contra Costa Water District D-22
Central Delta Water Agency D-28
California Farm Bureau Federation D-35
California State Lands Commission D-38
Central Valley Regional Water Quality Control Board D-43
Delta Stewardship Council D-43
Local Agencies of the North Delta D-44
Reclamation District 501 ..... D-57
Solano County Water Agency D-65
Solano County D-67
U.S. Bureau of Reclamation D-71
Yocah Dehe Wintun Nation D-75
b. Specific Responses to Individuals D-75
Charles Chatfield D-76
Mia Brown for Chuck Chatfield D-76
Thomas Keeling on behalf of Lorraine Stringer D-76
4 REFERENCES D-78

List of Attachments

Attachment 1. Governor's Office of Planning and Research, State Clearinghouse and Planning Unit, DEIR Circulation (including agency comment letters received)

Attachment 2. 2016 DEIR Comment Letters

1 INTRODUCTION

The public comment period for the Prospect Island Tidal Habitat Restoration Project Draft Environmental Impact Report (2016 DEIR) was August 23, 2016 to October 7, 2016. The Governor's Office of Planning and Research, State Clearinghouse and Planning Unit provided a copy of the comments on the 2016 DEIR from responding state agencies on October 11, 2016 (**Attachment 1**). In response to requests from Local Agencies of the North Delta (LAND) and the California Department of Transportation (Caltrans), DWR extended the comment period to November 6, 2016 for these submitters only; however, no comments on the 2016 DEIR were received from Caltrans. DWR received comments on the 2016 DEIR from one federal agency, four state agencies, six local agencies, one tribal entity, and two individuals. DWR identifies each comment letter with a unique identifier code and each comment with a number (**Table D-1**; **Attachment 2**). DWR appreciates and thanks the agencies, entity, and individuals who took the time to review and submit comments on the 2016 DEIR. These comments are important to DWR and have been taken into consideration in preparation of the Final Environmental Impact Report (2019 FEIR). Following review of the 2016 DEIR comments and project progression, DWR recirculated portions of the EIR in 2019 (2019 Partial Recirculated DEIR). The responses to comments on the 2019 Partial Recirculated DEIR can be found in **Appendix E** to the 2019 FEIR.

As discussed in the 2019 Partial Recirculated DEIR (Section 4 *Summary of Changes*) and this 2019 FEIR (see *Executive Summary, Alternatives to the Proposed Project*; Section 1.1 *[Introduction] Overview of the Proposed Project and Alternatives*; and Section *[Alternatives]* 4.7 *Comparison of Alternatives and Identification of Environmentally Superior Alternative*), DWR is considering moving forward with Alternative 2 (two breaches of the Prospect Island – Miner Slough levee at a central and southern location, and a weir near the northern end of the property) instead of the Proposed Project (two breaches of the Prospect Island – Miner Slough levee at northern and southern locations). As discussed in Section 4.7 of the 2019 FEIR, environmental analysis generally showed that environmental effects for most of the resources would be similar among the "build" alternatives (i.e., all Alternatives except the No Project Alternative). Alternative 2 and 3 (three breaches of the Prospect Island – Miner Slough levee) are environmentally superior to the Proposed Project because they do not require dredging. Except for mitigation measures relating to dredging (Mitigation Measure 3.2-2.1), the mitigation measures that were developed for the Proposed Project also apply to Alternative 2.

DWR has prepared written responses to all comments received on the 2016 DEIR. Although the comments were focused on the Proposed Project, DWR has responded to comments as if they apply to the Prospect Island Tidal Habitat Restoration Project inclusively, including the Proposed Project and the other "build" Alternatives (2 and 3). In these responses to comments, where the "Proposed Project" is referred to, this includes the Proposed Project and all "build" Alternatives. If a separate response is appropriate for Alternative 2 or 3, this is included, but is more common for Alternative 2 because recent technical reports focused on this alternative.

DWR's response to comments is divided into two parts: the first part is a General Response to Comments which provides responses that apply to multiple comments (Section 2); and the second part includes specific responses to agency, entity, and individual comments (Section 3). At the beginning of each response, the corresponding comment code is listed, and a summary of the comment is provided. The summary is provided for informational purposes only. For each comment, DWR responds to the full comment provided by the commenter. Where multiple commenters provided the same comment, DWR prepared one general response, or refers the reader to the similar response. In some cases, the reader is referred to responses to comments on the 2019 Partial Recirculated DEIR, which can be found in **Appendix E** of the 2019 FEIR.

Throughout this document, 2016 DEIR is used to refer specifically to the circulated 2016 DEIR, 2019 Partial Recirculated DEIR is used to refer specifically to the portions of the DEIR that were recirculated in 2019, 2019 FEIR is used to refer specifically to the 2019 FEIR, and EIR is used to refer generally to the 2016 DEIR, 2019 Partial Recirculated DEIR, and/or 2019 FEIR. The 2019 FEIR includes clarifying and amplifying changes to the 2016 DEIR and the 2019 Partial Recirculated DEIR, as well as responses to comments on the 2016 DEIR (this appendix – 2019 FEIR **Appendix D**) and responses to comments on the 2019 Partial Recirculated DEIR (see 2019 FEIR **Appendix E**). DWR has taken the comments into consideration in preparing the 2019 FEIR.

The original impact and mitigation numbering from the 2016 DEIR remains consistent with the 2019 Partial Recirculated DEIR and 2019 FEIR, with the exception of one additional mitigation measure in each of the *Transportation and Traffic* and *Air Quality* sections of the 2019 FEIR (refer to the 2019 Partial Recirculated DEIR for further explanation). Impact 3.3-5 *Short-term impairment of essential fish behaviors due to potential increases in turbidity during underwater sediment sampling* in Section 3.3.3 *[Aquatic Biological Resources]*

Impacts and mitigation has been removed because the sediment sampling has already been completed; however, a placeholder of this previous 2016 DEIR impact has been retained so that the numbering of other impacts has not changed. In Impact 3.17-2 *Potential long-term loss of access to the Miner Slough levee* in Section 3.17.3 *[Transportation and Traffic] Impacts and mitigatio*n, Mitigation Measure 3.17-2.1 has been removed because purchase of the Stringer property by DWR is complete.

Table D-1. Index of Agencies, Tribes, and Individuals who Submitted Comments on the 2016 DEIR

Entity	Type	Entity Identifier
Agencies and Tribes		
Contra Costa Water District	Local Agency	CCWD
Central Delta Water Agency	Local Agency	CDWA
California Farm Bureau Federation, Office of the General Counsel	State Agency	CFBF
California State Lands Commission	State Agency	CSLC
Central Valley Regional Water Quality Control Board	State Agency	CVRWQCB
Delta Stewardship Council	State Agency	DSC
Local Agencies of the North Delta[1]	Local Agency	LAND
Reclamation District (RD) 501	Local Agency	RD501 HBOCT / RD501 KSN
Solano County Water Agency	Local Agency	SCWA
Solano County - Department of Resource Management	Local Agency	SOLC
U.S. Bureau of Reclamation	Federal Agency	USBR
Yocha Dehe Wintun Nation	Tribe	YDWN
Individuals		
Charles (Chuck) Chatfield	Individual	MSB / CC-2
Lorraine Stringer	Individual	LS

[1] Listed LAND participants included Reclamation Districts 3, 150, 307, 317, 349, 407, 501, 551, 554, 556, 744, 755, 813, 999, 1002, 2111, 2067, Maintenance Area 9 South, and the Brannan-Andrus Levee Maintenance District.

2 GENERAL RESPONSE TO COMMENTS

A. Comment Relates to a Recirculated Section of the 2016 DEIR

Where **General Response A** is referred to, the comment was made on a section of the 2016 DEIR that was subject to recirculation. Pursuant to the CEQA Guidelines Section 15088.5(f)(2), DWR need only respond to comments received during the initial circulation period that relate to chapters or portions of the 2016 DEIR that were not revised and recirculated. Responses to comments on the 2019 Partial Recirculated DEIR, which included the below-listed sections, are included in **Appendix E** of the 2019 FEIR. Note that some of the comments on these sections are also responded to in this **Appendix D**, where the comment differs substantially from comments received on the 2019 Partial Recirculated DEIR and a response is deemed valuable to the commenter's knowledge of the Proposed Project, or where clarity is generally important.

Section 2 *Proposed Project Description*.

- In Section 3.1 *Hydrology (Surface and Groundwater):*
  - 3.1.1 *Setting*
  - 3.1.2 Significance criteria
  - In Section 3.1.3 *Impacts and mitigation*, the following impacts:
    - Impact 3.1-3 *Groundwater seepage impacts from Prospect Island to adjacent areas*;
    - Impact 3.1-4 *Potential wind-wave erosion of the interior side of Prospect Island levees*;
    - Impact 3.1-5 *Potential toe-scour and erosion of Miner Slough levees affecting Ryer Island levee stability*; and
    - Impact 3.1-6 *Potential increase in seepage on adjacent lands due to Miner Slough bed scour*.
- In Section 3.2 *Water Quality (Surface and Groundwater)*:
  - 3.2.1 *Setting*;
  - 3.2.2 *Significance criteria*;
  - In Section 3.2-3 *Impacts and mitigation*, the following impacts:
    - Impact 3.2-2 *Short-term construction-related increases in turbidity and/or mobilization of contaminants from dredging and excavation of levee breaches*;
    - Impact 3.2-5 *Long-term effects on salinity in waterbodies near Prospect Island*; and

  - Impact 3.2-8 *Long-term effects on methylmercury production, bioaccumulation, and export*.
- In Section 3.7 *Air Quality*:
  - 3.7.1 *Setting*;
  - 3.7.2 *Significance criteria*;
  - In Section 3.7.3 *Impacts and mitigation*, the following impacts:
    - Impact 3.7-1 *Generation of criteria pollutant emissions that could contribute to air quality violations*; and
    - Impact 3.7-2 *Conflict with or obstruct applicable general plans or regional air quality plans.*
- In Section 3.10 *Noise*:
  - 3.10.1 *Setting*;
  - 3.10.2 *Significance criteria*;
  - In Section 3.10.3 *Impacts and mitigation*, the following impacts:
    - Impact 3.10-1 *Potential for short-term noise disturbance to nearby residents*.
- In Section 3.17 *Transportation and Traffic*:
  - 3.17.1 *Setting*;
  - 3.17.2 *Significance criteria*;
  - In Section 3.17-3, the following impacts:
  - Impact 3.17-1 *Potential traffic impacts during construction*;
  - Impact 3.17-2 *Potential long-term loss of access to the Miner Slough levee*.
- Section 4 *Alternatives*.

B. Not a Comment on the 2016 DEIR

Where this **General Response B** is referred to in Section 3, **General Response A** does not apply, and no issues related to the adequacy of the environmental impact analysis in the 2016 DEIR are raised by the commenter. Since no relevant issues regarding adequacy of the environmental impact analysis are raised, these comments are not generally further addressed. In some cases, further information is given so that the public and decision makers can have a better understanding of these issues.

C. Access to Technical Reports

Several commenters raised issue with access to supporting technical documents. These were provided to individuals who requested them during the public comment period and were made accessible in Section 4.1 *Access to Technical Reports* of the 2019 Partial Recirculated DEIR via a public website.

D. Good Neighbor Checklist

Several comments were received regarding elements of DWR's (2019) Good Neighbor Checklist that was developed as part of the Agriculture and Land Stewardship Framework and Strategies, which was posted online in July 2014: (now located at https://water.ca.gov/Programs/California-Water-Plan/Water-Resource-Management-Strategies/Agriculture-and-Land-Stewardship-Framework). The Checklist was developed to help project managers be aware of issues that neighbors close to a proposed project may have regarding potential impacts. It provides suggestions for managers to consider, but does not mandate any specific action. The Checklist is not required by CEQA and includes several issues that are not related to environmental impacts. As discussed below, DWR has used the Checklist to think about potential neighbor issues and respond to neighbor's concerns.

DWR is committed to be a good neighbor. DWR has held numerous discussions with affected landowners to promote collaboration in development of the proposed tidal habitat restoration on Prospect Island, in order to more thoroughly and successfully identify potential impacts, as well as to design the Proposed Project in a way that minimizes or avoids any potential impacts to neighbors. Note that neighbor discussions related to specific environmental impacts are discussed in more detail in other general responses (current section) of this Appendix and in Section 3 *Specific Responses to Agency, Tribal, and Individual Comments*, and in 2019 FEIR **Appendix E**. Although not required by CEQA, specific ways that DWR has addressed matters in the Good Neighbor Checklist are described below:

1. *Have project proponents consulted with all neighboring landowners and operators about the project and its potential impacts?*

   DWR has consulted with all neighboring landowners from the outset, as discussed in Section 2.1.4 of the EIR, including notification of activities occurring onsite, and meetings and consultation regarding the tidal habitat restoration project. In addition, DWR has undertaken the following consultation (**Table D-2**) specifically with representatives of Local

Agencies of the North Delta (LAND), which DWR has been told includes Reclamation District 501, International Farming Corporation, and Fahn Family Farming, and with RD 501.

Table D-2. DWR Correspondence with LAND and RD 501 on the Prospect Island Tidal Habitat Restoration Project

Date	Meeting, Report, or Correspondence
April 04, 2013	Prospect Island meeting with RD 501
June 19, 2014	Prospect Island site visit with neighbors, including LAND
November 04, 2014	LAND input on the NOP to DWR
September 10, 2015	ENGEO *Seepage Impact Analysis* sent by HansonBridgett on behalf of RD 501 to DWR; report dated July 14, 2015
September 26, 2016	DWR received comments from KSN, Inc. on behalf of RD 501 on the 2016 DEIR
October 07, 2016	DWR received comments from HansonBridgett on behalf of RD 501 on the 2016 DEIR
November 07, 2016	DWR received LAND comments on the 2016 DEIR
February 15, 2017	LAND letter regarding a “Collaborative Mitigation and Monitoring Proposal” to DWR
March 29, 2017	First meeting with LAND
May 08, 2017	Technical Groundwater Workshop
May 22, 2017	Second meeting with LAND
June 09, 2017	DWR Draft *Hydrological Data Analysis Plan*
June 19, 2017	Third meeting with LAND
July 10, 2017	DWR settlement discussion document to LAND
August 16, 2017	LAND response to settlement discussion document to DWR
September 14, 2017	DWR letter relating to settlement discussions
November 17, 2017	LAND response to September 14, 2017 letter to DWR
February 15, 2018	DWR report titled: *Memorandum: Review of ENGEO’s Seepage Impact Analysis, Reclamation District 501, Prospect and Ryer Islands, Solano County, California, July 14, 2015, ENGEO incorporated*
February 18, 2018	DWR report titled: *Memorandum Report: Prospect and Ryer Island Hydrologic Data Analysis October 1, 2013 to April 1, 2017 Prospect Island Tidal Habitat Restoration Project Solano County, California* [referenced in the Partial Recirculated DEIR]
August 20, 2018	ENGEO reply to February 18, 2018 DWR report
February 20, 2019	DWR letter to Osha Meserve to inform of updates to the EIR
March 01, 2019	DWR’s Partial Recirculated DEIR to LAND and RD 501
April 12, 2019	DWR received comments from HansonBridgett on behalf of RD

Date	Meeting, Report, or Correspondence
	501 on the Partial Recirculated DEIR
April 15, 2019	DWR received LAND comments on the Partial Recirculated DEIR
April 23, 2019	Fourth meeting with LAND
June 28, 2019	LAND submitted supplemental comments on the 2019 Partial Recirculated DEIR and 2016 DEIR
July 26, 2019	DWR's response to RD 501 Review of the February 2018 DWR Hydrologic Data Analysis Report

In response to comments received on the 2016 DEIR, 2019 Partial Recirculated DEIR, and supplementary consultation with neighbors, DWR has agreed to undertake, and/or already undertaken the following good neighbor actions to alleviate concerns of neighboring landowners with regard to groundwater seepage, scour, erosion, and salinity. These do not include all the actions that were suggested by neighbors or that were considered by DWR. As discussed in General Response I in 2019 FEIR **Appendix E**, these actions are not proposed as mitigation measures since the impacts related to these actions are *less than significant* without mitigation (also see General Responses E, F, G, and H in 2019 FEIR **Appendix E** in relation to the significance determinations).

Completed Actions:

- Completed a multi-year (2011–2013) groundwater and surface water study on Prospect and Ryer Islands (DWR 2014).
- Analyzed new hydrologic data (2013–2017) collected since the completion of the above study (DWR 2018).
- Conducted additional hydrodynamic modeling of stage and velocities in the Miner Slough channel under base-flow and flood conditions (RMA 2016).
- Analyzed previously modeled salinity and regional flow results (RMA 2018).
  Improved communication of modeling information in the 2019 FEIR compared to the 2016 DEIR.

Modification of the Restoration Design:

- For Alternative 2, DWR has planned to situate the northernmost breach (central to Prospect Island) at a right angle to the predominant wind direction and armor the exposed levee ends, to

dissipate wave energy, which would reduce potential for wind-wave erosion of the interior.

- In areas exposed to potential wind-wave erosion impacts, DWR will plant and water the planned eastern toe berm, as well as allow up to one year from the time of planting prior to levee breaching, which will serve to further reduce any potential erosion of the levee. Please refer to **General Response F** for further information on planting.
- DWR will undertake monitoring of existing groundwater wells and bathymetric surveys, as described in General Response I of 2019 FEIR **Appendix E**.

To facilitate continued communication with neighbors of Prospect Island, DWR prepared a Communications and Engagement Plan (DWR and CDFW 2013) and established a Fish Restoration Program online newsletter. Further information is available from DWR on request.

2. *Have project proponents designated a local contact person to meet with neighboring landowners and discuss any issues of concern?*

   All restoration project inquiries have been directed to DWR's property manager as an initial point of contact for the project. Future inquiries regarding a local contact person should be directed to: mailto:FRPA@water.ca.gov.

3. *Will the project need access through other properties?*

   Site access would occur via barge and/or public roadways, as specified in the 2019 FEIR, with the primary mode of transportation determined by the construction contractor. Site access may be needed through other properties, but final details have not yet been determined. If DWR needs access through other properties, it will negotiate with the landowner, as appropriate. Mitigation measures for potential noise, air quality, and traffic impacts to neighbors are included in the EIR (Sections 3.10, 3.7, and 3.17, respectively). Such measures include: an identified disturbance coordinator, whose contact information will be accessible to the public onsite; techniques for reducing fugitive dust recommended by the Yolo Solano Air Quality Management District (YSAQMD); and a Traffic Control Plan.

4. *Does the management plan for the project provide for an on-site patrol or manager to deter trespass and vandalism?*

   DWR has a property manager, who is frequently onsite to deter and respond to poaching, vandalism, trash accumulation, and other adverse activities that might affect neighbors.

5. *Will the project increase the presence of vegetation susceptible to fire?*

   The proposed restoration area is within a federal responsibility area fire zone and not within a high fire hazard severity zone (CAL FIRE 2007). The tidal habitat restoration is not expected to change the types of vegetation present on the levees surrounding Prospect Island; therefore, fire susceptibility is not expected to change with the Proposed Project.

6. *Will the project discontinue maintenance of flood control features, involve prolonged or repeated flooding of previously dry land, or affect wind fetch across waterways?*

   The Proposed Project would breach the Prospect Island levee along Miner Slough, which is adjacent to the Ryer Island levee – a federal flood risk management project levee under the Flood Control Act of 1917 and part of the Sacramento River Flood Control Project (SRFCP). The Prospect Island levee itself is not a federal levee. Both the north and south properties of Prospect Island are currently inundated (i.e., they are not currently dry). The properties would be dewatered as part of the construction phase, a drainage network would be reestablished, and tidal connections would ultimately restore habitat via levee breaches (Proposed Project and Alternative 3) or a weir and levee breaches (Alternative 2). Tidal wetlands and tidal aquatic habitat will increase at the expense of non-tidal wetlands, non-tidal aquatic habitat, and uplands habitat. Given the proposed increase of tidal habitat, wind-wave modeling was undertaken and is discussed in potential Impact 3.1-4 *Potential wind-wave erosion of the interior side of Prospect Island levees* of the EIR and in General Response E of 2019 FEIR **Appendix E**. Levee integrity is also discussed in potential Impact 3.1-5 *Potential toe-scour and erosion of Miner Slough levees affecting Ryer Island levee stability*, potential Impact 3.1-3 *Groundwater seepage impacts from Prospect Island to adjacent areas*, and in General Response E of 2019 FEIR **Appendix E**. None of the potential adverse hydrology impacts are significant. Further information with regards to all aspects of the hydrologic impact analyses undertaken is available in Section 3.1 of the EIR.

7. *As a result of the project, are species on the project site expected to increase markedly in abundance and move from the site to neighboring lands or waterways?*

   The purpose of the proposed tidal habitat restoration is to meet DWR's commitments to enhance the food web and habitat to benefit Delta Smelt and juvenile salmonids in the area around Prospect Island, to foster a return of these species to the area, and to increase their numbers. Movement and migration of aquatic species is complex and discussed in **General Response E** below. As also discussed in **General Response E**, it is unlikely that there will be a significant increase in terrestrial or avian species of concern to neighboring agricultural properties associated with the Proposed Project.

8. *Is it reasonably possible that species in the project area could damage crops or promote the growth of weeds or diseases on neighboring farms?*

   The Proposed Project includes terrestrial invasive weed controls as part of site preparation, as well as replanting of upland areas with native plant species. The Proposed Project is not be expected to promote the growth of weeds or diseases on neighboring farms in the short- or long-term. Please refer to **General Response F** for further details.

9. *Will the project disturb utilities, roads, bridges, or other infrastructure that serve agricultural uses?*

   Potential agricultural resource impacts are discussed in Section 3.12 of the EIR, and potential transportation and traffic impacts are discussed in Section 3.17 of the EIR. Additionally, potential hydrological impacts to agricultural water supply and drainage, and potential impacts to the stability of bridges, trestles, culverts or other structures, are discussed in Section 3.1 of the EIR. None of the potential agricultural resource or hydrology impacts would be significant. Potentially significant transportation and traffic impacts are reduced to *less than significant* with mitigation.

10. *Will the project fragment or isolate farmland?*

    Prospect Island is isolated from surrounding properties and would not contribute to fragmentation of farmlands. No portion of Prospect Island is designated as Prime, Unique, or Important Agricultural Land, and the only

land viable for agriculture is north of the northern cross-levee. During construction activities, up to 17.7 ac of land north of the northern cross-levee (comprising of 10.9 of adjacent Fahn land currently used for agriculture, and 6.8 ac of Prospect Island land that is not currently used for agriculture) would potentially be converted to a temporary staging area. Following construction activities, the 6.8 ac portion of this area on Prospect Island would be planted with a riparian mix containing both canopy and understory trees and shrubs, creating complex, high value riparian area; the other 10.9 ac would remain in agriculture.

11. *Do domestic or feral animals or livestock occur on lands neighboring the project?*

    Some domesticated animals are present at the Arrowhead Marina. The proposed tidal habitat restoration site is isolated from farm animals by protective fencing. As Prospect Island is currently flooded, a substantial change of feral animals on, or surrounding, the site is not expected. Prospect Island is buffered by Miner Slough to the east, the DWSC to the west, and Miner Slough Wildlife Area to the south. Portions of the site bordering agricultural land uses to the north will be planted with riparian species to provide a buffer between agricultural and restoration site land uses.

12. *Do neighboring farms use chemicals as fertilizer, or to control weeds or crop pests?*

    Agricultural practices on the adjacent properties have not been well documented. Riparian revegetation included in the proposed tidal habitat restoration would serve as a buffer zone to address any potentially adverse effects from neighboring agricultural lands in the future.

E. Local Water Diversions and Increased Abundance of Listed Fish Species and Terrestrial/Avian Species of Concern to Agricultural Landowners

Commenters raised concerns about impacts to agriculture from increasing numbers of avian and terrestrial species on neighboring lands due to the proposed tidal habitat restoration. Commenters also raised concerns about potential impacts to local water diversions due to increased abundance of listed fish species, and the need for additional safeguards to protect these fish and local water users.

Local Water Diversions and Increased Abundance of Listed Fish Species

The purpose of the Prospect Island Tidal Habitat Restoration Project is to meet DWR's commitments to enhance the food web and habitat to benefit Delta Smelt and juvenile salmonids in the area around Prospect Island, to foster a return of these species to the area, and to increase their numbers. Agricultural diversions in the region of Prospect Island are currently located in critical habitat for several listed fish species, and thus they are already subject to compliance with the state and federal endangered species acts. The listed fish species were once far more common in the area and it is expected that some of the fish species will return in greater numbers on a permanent basis. The expected outcome of increased abundance of listed fish species is not an adverse environmental effect that must be analyzed and mitigated by DWR in the EIR.

The effects of small diversions on fish populations, especially listed species, are complex and not well understood. Fish entrainment depends on the size, location, and timing of the diversion. Limited studies suggest that small irrigation diversions in the Delta may not have a large impact on listed species (Nobriga et al. 2004; Moyle and Israel 2005). As described below, small local agricultural water diversions in the waterways surrounding Prospect Island are likely to have minimal effects on listed fish species due to the limited overlap with regard to listed species seasonal abundance, their associated habitat use, and the irrigation season.

Most juvenile Chinook salmon, including state and federally listed Winter-run and Spring-run Chinook Salmon, pass through the Delta during the winter and spring months (NMFS 2014), before irrigation season in the Delta begins in earnest. During the summer and fall months when flows into the Delta are reduced and small diversions could have a larger hydrodynamic effect in the adjacent water body, juvenile salmon are less abundant in the system. Although adult salmonids could be in the system heading upstream, it is highly unlikely that small diversions would entrain an adult salmon or steelhead.

CDFW larval and juvenile Delta Smelt monitoring data in the Cache Slough Complex and Miner Slough suggest that Delta Smelt are rarely present in Miner Slough on the east side of Prospect Island where agricultural diversions are located, even though they can be relatively abundant in the Sacramento Deep Water Ship Channel (DWSC) on the west side of the island. CDFW's 20mm survey data indicate that the combined larval Delta Smelt catch at the two Miner Slough monitoring stations (stations 724 and 726) represent less than 1% of the

overall catch of Delta Smelt at monitoring stations throughout the Cache Slough Complex (data available at: http://www.dfg.ca.gov/delta/projects.asp?ProjectID=20mm).

Even if the restoration site successfully attracts Delta Smelt into Miner Slough, entrainment into local agricultural diversions in Miner Slough would likely be low due to the timing of the irrigation season and due to the species' pelagic (open-water) nature. Although some Delta Smelt remain in the Cache Slough Complex year-round (Sommer et al. 2011), the highest relative densities of juvenile Delta Smelt are usually found in the Low Salinity Zone in the fall, east of the Sacramento River – San Joaquin River confluence and in the Lower Sacramento region (Dege and Brown 2004, Merz et al. 2011). Delta Smelt are also an open-water species and are less likely to be entrained into pipes near the bottom of the channel or along the shoreline. A study by Nobriga et al. (2004) suggested that the low and inconsistent entrainment of Delta Smelt in a small diversion on Sherman Island was due to the species' offshore habitat use and the relatively small hydrodynamic influence of the diversion.

Juvenile Green Sturgeon could be prone to entrainment by local pumps that divert water near or at the bottom of the channel. Although the Proposed Project or Alternative 2 might produce food resources that could benefit sturgeon, it is designed primarily to enhance the food web and habitat that benefits Delta Smelt and juvenile salmonids.

To help protect listed fish species from entrainment, safeguards such as screens could be used to physically prevent fish from entering a diversion. Per Fish and Game Code sections 5980-6028, CDFW can inspect conduits and require them to be screened if CDFW determines a screen is necessary to prevent fish passage into the conduit. If screens are ordered, CDFW must fund the screening of diversions under 250 cfs and will share the cost with landowners on screens attached to conduits over 250 cfs. Program specifics may be discussed directly with CDFW.

Terrestrial/Avian Species of Concern to Agricultural Landowners

The Proposed Project is unlikely to increase terrestrial or avian species of concern to farmers and other landowners (e.g., beavers, coyotes, geese, or blackbirds). The Proposed Project would flood Prospect Island to increase tidal wetland habitats at the expense of some of the existing freshwater and riparian habitats, which is not expected to increase the abundance of terrestrial or avian species over existing pre-project levels. As stated in Impact 3.4-6 of the 2016

DEIR, valley/foothill riparian habitat would be reduced by approximately 28 ac following implementation of the Proposed Project, including proposed riparian planting. Valley/foothill riparian habitat would also be reduced (by 41 ac) if Alternative 2 is implemented. The long-term conversion of nesting and foraging habitat for special-status and migratory birds is discussed in Impact 3.4-15, which further assesses that the proposed restoration will reduce (not increase) habitat for avian species.

F. Invasive Plant Management, Planting and Revegetation

DWR agrees with commenters that the control of invasive species is important to the long-term success of the Prospect Island Tidal Habitat Restoration Project. Invasive species control measures are embedded in the Proposed Project description, and not as a CEQA-required mitigating action. As discussed in EIR Section 2.2 *Proposed Project Actions*, the proposed restoration includes dewatering, removal of existing vegetation, and targeted herbicide applications to prevent the site from becoming a source of invasive plant species dispersal into the surrounding tidal waterways. The restoration also includes revegetation with desired species to develop the site in a way that will achieve tidal habitat restoration project objectives and limit the spread of undesirable species (See EIR Section 2.2.3 *Description of Proposed Project components and construction activities*, Activities 2, 3 and 13). It is expected that the Proposed Project will reduce overall cover of invasive plant species within and around Prospect Island.

Control of Existing Invasive Plant Species on Prospect Island

The Proposed Project site is host to several invasive plant species, as mapped prior to environmental analysis and implementation (SWS & WWR 2013). As described in EIR Section 2.2.3 *[Proposed Project Description] Description of Proposed Project components and construction activities*, Activity 3, the most significant invasive plant species present at the site is water primrose (*Ludwigia* spp.), an aquatic weed which covers between 160–200 ac of the wetted areas of the site. Other invasive plant species present include emergent, submerged aquatic, riparian, and upland species, including: Eurasian water-milfoil (*Myriophyllum spicatum*), curlyleaf pondweed (*Potamogeton crispus*), giant reed (*Arundo donax*), yellow star-thistle (*Centaurea solstitialis*), poison hemlock (*Conium maculatum*), pampas grass (*Cortaderia jubata*), fennel (*Foeniculum vulgare*), perennial pepperweed (*Lepidium latifolium*), wild radish (*Raphanus sativus*), Himalayan blackberry (*Rubus armeniacus*), red Sesbania (*Sesbania punicea*), and tamarisk (*Tamarix* sp.). Additionally, water hyacinth (*Eichhornia*

crassipes) and Brazilian waterweed (*Egeria densa*) have been found in waters adjacent to Prospect Island.
2016 DEIR Section 2.2.3 *[Proposed Project Description] Description of Proposed Project components and construction activities*, Activity 2 of the Proposed Project actions, describes dewatering of the site. In addition, existing vegetation would be cleared and grubbed within the construction footprint, and all above ground vegetation would be cleared within moderate subtidal areas, as well as within a 100 ft buffer outside of the construction footprint.

Invasive plant species control measures, described in EIR Section 2.2.3 *[Proposed Project Description] Description of Proposed Project components and construction activities*, Activity 3, will be initiated prior to site restoration construction and will continue during construction and post-construction site monitoring. The purpose of this activity would be to remove existing non-native, invasive plants found at Prospect Island. Invasive plant control will help to promote restoration success, and it will help to prevent the site from becoming a source of invasive plant species dispersal into the surrounding tidal waterways. This activity would involve removing existing invasive plants with a focus on controlling those species with the potential to: (1) interfere with Proposed Project ecological objectives and/or (2) to spread outside the site and degrade surrounding habitats. To ensure their efficacy, herbicides will be applied to dewatered areas of Prospect Island previously colonized by invasive plant species following initial drawdown. Further details regarding implementation the invasive species control will be specified in a Revegetation Strategy developed as part of project implementation. Implementation is expected to include appropriate species-specific time periods, and to focus on plants rated highly or moderately invasive by Cal-IPC, including yellow star-thistle.

Minimization of Future Invasive Plant Species Establishment

The restoration has been designed to minimize establishment of invasive plant populations and avoid colonization by invasive plant species following tidal restoration. The existing velocities in Miner Slough are reflective of a largely riverine environment, with low suitability for floating and submerged aquatic vegetation. Some of the proposed actions that are intended to suppress invasive plant establishment after restoration include (1) channel geometry that enhances tidal exchange and creates velocities that impede macrophyte growth and establishment, (2) water depths that exceed the rooting depths for many invasive plant species (e.g., water primrose), and (3) tidal hydrology that results in water level fluctuations that control some invasive plant species (e.g., curlyleaf pondweed and Eurasian water-milfoil). These actions will ensure that the

Proposed Project would not cause excess accumulation of invasive aquatic plant species at pump intakes.

In addition, as discussed in **General Response H**, an AMMP, required by the Delta Stewardship Council, will be developed. The AMMP will provide for comprehensive and ongoing surveys, including surveys for submerged and floating aquatic plant coverage. The AAMP will also include eradication and control measures to reduce the invasive plant coverage to an acceptable level that is similar to nearby tidal wetlands, which will only be necessary if invasive species coverages are found to be substantially greater than found in similar tidal wetlands in the Cache Slough Complex five years post-project implementation.

Potential Impacts of Invasive Plant Species Control Measures

Potential impacts of aquatic herbicide application to control invasive species are addressed in Impacts 3.2-3 (short-term effects of aquatic herbicides), 3.3-8 (fish), 3.4-1 (perennial aquatic habitats and wetland communities), 3.4-4 (sensitive plants), 3.4-8 (valley elderberry longhorn beetle), 3.4-10 (giant garter snakes), 3.4-14 (special status and migratory birds), 3.4-17 (western red bats), 3.6-7 (human health), 3.7-1 (air quality), and in section 3.19 (cumulative impacts) of the EIR. Mitigation Measures 3.2-3.1 and 3.2-3.2 include best management practices to minimize potential for impacts and accidental spills, and to minimize off-target spray drift. One of the requirements is that herbicide applicators develop an application plan, including maps of application areas to be approved by the Lead Agency. The relevant mitigation measures describe best management practices that will achieve the performance standards incorporated in the mitigation measure. The Revegetation Strategy that will be developed as part of project implementation is expected to set forth requirements for a Weed Management Plan to be prepared by the construction contractor.

Planting and Revegetation

Planting and revegetation are discussed in EIR Section 2.2.3, Activity 13. Levee repair sites, portions of the constructed toe berm and bench, upland staging areas, and upper slopes along the interior of the DWSC levee, are subject to revegetation activities. Native wetland vegetation may be planted in areas that would form open-water edge habitat following breaching of the Miner Slough – Prospect Island levee. In addition, a larger experimental plot of wetland vegetation would be planted along the intertidal bench, to provide information on the relative success of planting methods and to compare vegetation establishment between planted and unplanted areas. The remainder of the intertidal bench would be left unplanted to allow for natural colonization.

Following construction, hydro-seeding of native grass species will be used for erosion control of any areas of bare soil resulting from construction activities. Planting of native riparian vegetation would occur along upper slopes of the eastern toe berm, within the upland staging area to the north of the Proposed Project site, as well as along the interior of the DWSC levee.

Further details regarding planting and revegetation activities will be specified in final design documents and the Revegetation Strategy that is being developed as part of project implementation. This is expected to include plot locations, extent of different vegetation zones, plant species composition and density, dimensions, planting methods and initiation requirements. Currently planned planting zones include experimental nursery plantings (tules) between 2.1–5 ft (NAVD88), lower riparian forest between 5–6.5 ft (NAVD88), upper riparian forest from 6.5–9 ft (NAVD88), and upland valley foothill riparian plantings above 9 ft (NAVD88). Plant species used in the revegetation design are native to the Sacramento Valley subregion of the Great Valley region within the California Floristic Province (Jepson Online Interchange 2019; Calflora 2019), many of which are already documented within the Proposed Project and are known to be easy to establish, have relatively high rates of survival, and are commercially available (California Native Plant Link Exchange 2019, CNPS 2019). Selected plant species currently include tule, bulrush, various willow species, mule fat, box elder, Oregon ash, western sycamore, Fremont cottonwood, and live oak, to name a few, in addition to other woody plants, perennial grasses, and forbs. In addition, all other upland areas that are cleared of vegetation as part of restoration construction activities will be seeded with native grasses and forbs to control erosion. Passive revegetation is planned for the lower elevation portions of the bench, and includes infill between bands of experimental tule plantings and the use of stockpiled tule rhizomes to help initiate the establishment of native wetland vegetation within the lower intertidal zone. Irrigation of plantings, as well as monitoring and management of plant survival, plant health and vigor, and cover of invasive weeds, will occur, at a minimum, during the first year after planting.

In addition, as discussed in **General Response H**, an AMMP, required by the Delta Stewardship Council, will be developed. It is expected that the AMMP will provide for comprehensive and ongoing surveys relating to revegetation, until the wetland habitat has established as planned.

G. Future and Cumulative Impacts

Where an individual project is a necessary precedent for action on a larger project, or commits the Lead Agency to a larger project, with one or more significant environmental effects, an EIR must relate to the scope of the larger project. However, where a project is one of several similar projects of a public agency, but is not deemed a part of a larger undertaking or a larger project, the agency may prepare one EIR for all projects, or one for each project, but shall in either case comment upon the cumulative effects (CEQA Guidelines Section 15165).

CEQA does not require DWR to analyze, in one EIR, the proposed Prospect Island Tidal Habitat Restoration Project, in combination with all the other potential projects that may be implemented to meet the 8,000 ac requirement in the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion, or to meet other habitat restoration goals, because:

(1) Although the Proposed Project and the other tidal restoration projects are related in that they are all projects designed to meet habitat restoration goals, future potential projects are not a reasonably foreseeable consequence of the Proposed Project and it is not, therefore, a necessary precedent to action on any other project.

(2) The Proposed Project has significant independent utility, including independent benefits that do not depend on any other project.

DWR could have decided to prepare a Master EIR pursuant Section 15169 of the CEQA Guidelines, or a Program EIR pursuant to Section 15168(a)(4) of the CEQA Guidelines, that included some or all of the potential regional tidal habitat restoration projects needed to meet the USFWS Delta Smelt Biological Opinion, or that met other restoration goals, but was not required to do so.

CEQA requires a discussion of cumulatively considerable effects, which, by definition, means that “the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects” (CEQA Guidelines Sections 15065(a)(3) and 15130).

Section 3.19 of the 2016 DEIR includes a comprehensive assessment of cumulative impacts, which has been carried forward into the 2019 FEIR. A cumulative impact is considered significant if the combined impact is significant and the incremental effect of the Proposed Project is found to be cumulatively

considerable, in the context of impact intensity and sensitivity of the resource. This EIR uses a CEQA-recommended "List Approach", which involved developing a list of past, present, and probable future projects potentially producing related or cumulative impacts (refer to Table 3.19-1 of the EIR for the list). The 2016 DEIR included a comprehensive summary of all known, or likely anticipated, projects that existed at the time of the Notice of Preparation in 2013. This list included several tidal habitat restoration projects that could potentially interact with the Proposed Project, and analyzed the cumulative impacts of implementing these projects. Although the original cumulative impact analysis in the 2016 DEIR was not subject to recirculation in the 2019 Partial Recirculated DEIR, additional detail regarding consideration of additional projects has been included in the 2019 FEIR to address comments. While not exhaustive, the 2019 FEIR list of projects includes additional projects not in the original 2016 DEIR list that were identified by commenters and that DWR considered relevant (i.e. other tidal restoration projects that have come online or are in the process of being permitted). Additional discussion regarding potential cumulative impacts is also included General Response H in **Appendix E** regarding cumulative salinity impacts, as well as in other specific responses to comments in Section 3 of this document. This additional information confirms and supports the original significance conclusions in the 2016 DEIR that there are no cumulatively considerable impacts from the Proposed Project.

In summary, although DWR could have developed a master or programmatic EIR to cover other potential projects that may be implemented to meet the 8,000 ac requirement in the USFWS Delta Smelt Biological Opinion, or to meet other habitat restoration goals, DWR was not required to. DWR was required to, and did, discuss the cumulative effect of the Proposed Project and the Alternatives with other past, present, and probable future restoration projects.

H. Monitoring and Management Plans Associated with the Proposed Project

Several comments were received regarding information that will be covered in the various monitoring and management plans for the proposed restoration. Monitoring and management plans will include a Mitigation, Monitoring, and Reporting Program (MMRP); Adaptive Management and Monitoring Plan (AMMP); and a Revegetation Strategy. There is also an existing Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary (2017). While there will be overlap and linkages between the monitoring and management plans, each of these plans has a different purpose, as described below. While some of

these plans are still in the development stage, they can be obtained from DWR on request.

MMRP: The MMRP is required by CEQA (Section 15097) and will be included with any decision documents. It assures that the mitigation measures identified in the EIR are implemented and monitored to avoid potentially significant environmental effects of the Proposed Project. The MMRP identifies mitigation measures in the EIR, the entity responsible for implementing each mitigation measure, when the mitigation will take place, and the entity that is responsible for monitoring and reporting.

AMMP: DWR will submit a Certification of Consistency with the Delta Plan. General Policy 1 of the Delta Plan requires an AMMP, consistent with the Adaptive Management Framework found in Appendix 1C of the Delta Plan EIR, which adequately plans and provides resolutions for unforeseen impacts or outcomes of the proposed restoration. This AMMP will draw from the Tidal Wetland Monitoring Framework (see below) and conceptual models developed by an interagency work team of wetland and monitoring specialists.

The AMMP will include a description of monitoring designed to determine the effectiveness of the proposed restoration at meeting the requirements of the USFWS Delta Smelt Biological Opinion (BiOp) for the long-term coordinated operations of the State Water Project (SWP) and the federal Central Valley Project (CVP) (USFWS 2008) and the National Marine Fisheries Service (NMFS) Salmonid BiOp for CVP and SWP operations (NMFS 2009). The AMMP will also consider compliance monitoring required by permitting agencies, as well as routine management, such as vegetation and infrastructure.

Revegetation Strategy: Invasive plant management and revegetation are activities included in the Proposed Project description. A Revegetation Strategy is currently being prepared as part of project implementation, which will provide further detail regarding these activities, including standards for survival and vigor of installed plants, vegetative cover of native grasses and forb species, and threshold cover of target invasive plants (i.e., invasive plants with a California Invasive Plant Council rating of “high”). Implementation of the Revegetation Strategy is expected to include appropriate species-specific time periods, and to focus on plants rated highly or moderately invasive by California Invasive Plant Council (Cal-IPC), including yellow star-thistle.

Tidal Wetland Monitoring Framework (Framework): The Framework is prepared by the Interagency Ecological Program (IEP) to facilitate the development of site-specific monitoring plans to assess the effectiveness of tidal wetland restoration projects, the Framework has been developed to ensure integrity of scientific methods and quality of data and reporting. Elements of the Framework would support preparation of the MMRP, AMMP, and Revegetation Strategy discussed above, providing confidence that monitoring procedures are scientifically sound and regionally consistent. The Framework is available as Volume I (Monitoring Plan Guidance) and Volume II (Standard Operating Procedures) (IEP TWM PWT 2017a,b).

3 SPECIFIC RESPONSES TO AGENCY, TRIBAL, AND INDIVIDUAL COMMENTS

a. Specific Responses to Agencies and Tribes

Agencies and tribes submitted comments on the 2016 DEIR. Original comment letters are presented in **Attachment B** to this Appendix. As noted in Table 1, DWR identifies each comment letter with a unique identifier code. DWR's response to comments is provided below, following a summary of each comment.

Contra Costa Water District (CCWD)

CCWD-1: Phase 2 Hydrodynamic Modeling

Commenter states that the document referenced in the 2016 DEIR regarding Phase 2 hydrodynamic modeling (Appendix D in WWR and SWS 2014) should have been included as part of the 2016 DEIR to substantiate and corroborate the impact analyses. Commenter states that DWR provided WWR and SWS (2014) to CCWD upon request, and review of that document has shown that the modeling analyses performed were insufficient to support the findings in the 2016 DEIR.

DWR Response

Although **General Response A** applies to the EIR salinity analysis, the information below should provide clarity for the commenter.

For availability of reference documents, please see **General Response C**. As noted by the commenter, the report was provided to CCWD upon request.

A description of local and regional salinity modeling is provided in the supporting modeling report used to develop 2016 DEIR Impact 3.2-5 (cited as Appendix D in WWR and SWS (2014) in the 2016 DEIR), as well as in a more recent modeling report specific to Alternative 2 (RMA 2018) .The modeling included a variety of configurations with varying numbers and locations of weirs and breaches along both Miner Slough and the DWSC, with impacts modeled at different locations and for different types of water years.

Subsequent to receiving this comment letter, updates were made to Impact 3.2-5 *Long-term effects on salinity in waterbodies near Prospect Island*, including supplemental timeseries of modeled electrical conductivity (EC) at CCWD's municipal intakes (Rock Slough, Mallard Slough, Old River, and Victoria Canal). An opportunity to comment on this updated information was provided via the 2019 Partial Recirculated DEIR. CCWD did not submit comments on the 2019 Partial Recirculated DEIR.

DWR considers the modeling analyses to be comprehensive and adequate to support the findings of the EIR. Please also refer to General Responses G and H in 2019 FEIR **Appendix E** relating to potential project-specific and cumulative salinity impacts.

CCWD-2: Salinity Modeling of Project Alternatives

Commenter states that the modeling used to analyze the potential impacts of the alternatives must be consistent with the alternatives description in the 2016 DEIR, because the water quality effects of Delta habitat restoration projects depend strongly on the details of the project configuration, such as the size and location of the levee breaches. Commenter states that although the 2016 DEIR connects the Proposed Project with the modeling work performed, it is not clear whether the other alternatives described in the 2016 DEIR are included in the modeling to date.

DWR Response

Although **General Response A** applies to the EIR salinity analysis, the information below should provide clarity for the commenter.

Recognizing that small changes in breach dimensions and locations can occur during final project design, a description of the alternatives considered in assessing local and regional salinity impacts is provided in the supporting

modeling report used to develop Impact 3.2-5 (cited as Appendix D in WWR and SWS 2014 in the 2016 DEIR). The Proposed Project (two breaches), 2016 DEIR Alternative 2 (two breaches and weir), and Alternative 3 (three breaches), correspond to Phase 2 modeling Alternatives 26, 4, and 31, respectively. The EIR was updated in the 2019 Partial Circulated DEIR to clarify these alternatives.

CCWD-3: Potential Water Quality Impacts Related to Salinity

Commenter states that the modeling shows increases of salinity throughout the Delta. Commenter further states that the 2016 DEIR and WWR and SWS (2014) do not analyze how the increases in salinity throughout the Delta may affect other beneficial uses, nor do they analyze changes in salinity at CCWD's four drinking water intakes.

DWR Response

Please refer to **General Response A**. Please also refer to the response to CCWD-1 with regard to supplemental timeseries of modeled electrical conductivity at CCWD's municipal intakes, and to General Response G of 2019 FEIR **Appendix E** with regard to the potential small increases and decreases in salinity.

CCWD-4: Potential Impacts to CCWD Related to Salinity Increases

Commenter states that salinity increases described for the Proposed Project (i.e., a potential increase in salinity up to 3% at CCWD's Rock Slough intake and up to 2% at the SWP and CVP export facilities), may have a significant impact on CCWD's water supply, water quality, and the cost of operation. Commenter states that similar water quality modeling performed for other habitat restoration projects (described in the Tule Red Salinity Analysis) indicates that salinity increases at CCWD's intakes of less than 4% on average would lead to a decrease in Los Vaqueros Reservoir storage of over 10,000 acre-feet; given that CCWD's annual demands are on the order of 100,000 acre-feet, a loss of water stored on the order of tens of thousands of acre-feet would be a significant impact. Without a timeseries of water quality at CCWD intakes, the commenter states that it is impossible to estimate the extent the Proposed Project will impact CCWD water supply, water quality, and water operations. The 2016 DEIR should include an evaluation of the changes in salinity at all Delta drinking water intakes so that the full suite of potential impacts is disclosed and mitigated to the extent necessary.

DWR Response

Please refer to **General Response A**. Please also refer to the response to CCWD-1 with regard to timeseries modeling.

In relation to the Prospect Island modeling results and the D-1641 standards, please refer to General Response G of 2019 FEIR **Appendix E**.

In relation to the Tule Red Salinity Analysis, please refer to General Response H of 2019 FEIR **Appendix E**.

CCWD-5: Potential Salinity Impacts at CCWD Intakes

Commenter states that the 2016 DEIR should include an evaluation of the changes in salinity at all Delta drinking water intakes, so that the full suite of potential impacts to CCWD water supply, water quality, and water operations, is disclosed and mitigated to the extent necessary.

DWR Response

Please refer to **General Response A**. Please also refer to the response to CCWD-1 above, as well as to the response to General Response G of 2019 FEIR **Appendix E**.

CCWD-6: Cumulative Salinity Impacts Analysis

Commenter states that the 2016 DEIR and the WWR and SWS (2014) report did not analyze the cumulative impacts of the Proposed Project. The 2016 DEIR inappropriately relies on draft environmental documentation for the Bay Delta Conservation Plan (BDCP)/California WaterFix to determine the potential cumulative impacts of the Proposed Project. The California WaterFix contains a programmatic evaluation of water quality impacts associated with Conservation Measure 4, and does not include a project-specific evaluation of the environmental impacts associated with the Proposed Project, or any other specific project implemented to satisfy the BiOp obligations. Commenter requests that the cumulative salinity impacts of the Proposed Project be properly re-evaluated.

DWR Response

Please refer to **General Response A**. Please also refer to General Responses G and H of 2019 FEIR **Appendix E** for the relevance of the BDCP analysis and the EIR's project specific analysis.

CCWD-7: Cumulative Impacts Analysis for Water Quality

Commenter states that cumulative impacts of the Proposed Project using the most current available RMA model, and information regarding other restoration projects, must be properly evaluated because there is evidence that the Proposed Project could have significant cumulative impacts even in the absence of standards violations. Commenter notes that the modeling results in the WWR and SWS (2014) report indicate that the Proposed Project will increase salinity east of Prospect Island near San Andreas and Terminous on the Mokelumne. Also, based on cumulative impact modeling done for the Tule Red Project, the Proposed Project will increase salinity at times, and in locations, that are already expected to increase with implementation of the McCormack Williamson Project. Commenter states that these two projects together could significantly increase salinity in the interior of the Delta.

DWR Response

Although **General Response A** applies to the EIR salinity analysis, the information below should provide clarity for the commenter.

Cumulative Impacts (Tule Red and McCormack Williamson Projects)

Please refer to General Response H in 2019 FEIR **Appendix E**.

Potential Salinity Impacts at San Andreas and Terminous on the Mokelumne River

With regards to the 'San Andreas and Terminous on the Mokelumne' locations, this comment goes to the question of whether the proposed restoration has a potential impact. These locations are discussed under 'Mokelumne River at Terminous (C-13)' and 'San Joaquin river at San Andreas (C-4)' on pages 96-97 of Appendix D in WWR and SWS 2014. Both the C-4 and C-13 compliance monitoring locations were part of supplementary modeling conducted in support of the initial environmental screening analysis, but were not selected in the spatial distribution of locations used for determining compliance of the Proposed Project with water quality objectives, or ultimately used for Phase 2 alternative selection (Figure 13 of Appendix D in WWR and SWS 2014). For these locations,

results were modeled and reported for a design configuration equivalent to the Proposed Project, but not for EIR Alternatives 2 or 3. Both the C-13 and C-4 locations are *agricultural beneficial use* sites within the Interior Delta, and neither of them are near CCWD's intakes. The D-1641 standard is a 450 uS/cm maximum 14-day running average of mean daily EC for both locations. For a dry-year hydrology, the D-1641 compliance period for this average is April 1 to August 15 for the C-13 location, and April 1 to June 25 for the C-4 location.

Modeling undertaken captured a dry-year hydrology in 2009 and below- or near-normal year hydrology in 2010. Modeling did not show any potentially significant increase of salinity at the C-13 location near Terminous, CA, with predicted increases in Base EC of no more than 0.4% for Alternatives 3, 23, and 26 (Proposed Project) during the D-1641 compliance period, and an overall maximum Base EC increase of 0.5% for the modeling period (see Table 37 of Appendix D in WWR and SWS 2014). Base EC does not exceed 250 uS/cm during the modeling period, and therefore in addition to the very small modeled increases of EC, there is no potential non-compliance with D-1641 at the C-13 location.

At the C-4 location, during a below- or near-normal year hydrology all months modeled except October and November showed decreases of EC, or increases less than 1%. Modeling showed that EC may increase by up to a maximum of 4% in November. During a dry-year hydrology, modeling showed decreases of EC, or increases less than 2% for the months of February through August. Modeling showed that in Fall (from September to November) of a dry-year hydrology Base EC could increase by 4% to 10% for Alternatives 3, 23, and 26 (Proposed Project) at the C-4 location. Appendix D in WWR and SWS 2014 explains that the EC for the C-4 location may have been overestimated because:

1. The RMA-Delta EC model over-predicts the observed EC at the C-4 location for the summer of 2009;
2. The salinity calibration/verification generally showed the RMA-Delta EC model overpredicted 2009 dry-season EC for the central Delta;
3. There is a plausible mechanism for the model overestimation of EC at the C4 location, which involves over-mixing of freshwater out of the mouth of the North Fork Mokelumne River with the higher EC water of the main San Joaquin River channel.

Therefore, the percentage changes in monthly averaged EC modeled for this C-4 location are considered to be conservative. At the C-4 location, modeled EC follows a similar pattern to Base EC, and is only modeled to increase by up to a

maximum of 0.8% during the D-1641 compliance period (refer to Table 38 and Figure 45 of Appendix D in WWR and SWS 2014). During a below- or near-normal year hydrology, Base EC is below 300 uS/cm for all months during the compliance period (April–August). The modeled changes of up to 0.2% EC during a near-normal year hydrology would not result in non-compliance with the D-1641 standard of 450 uS/cm 14-day running average of mean daily EC. During the compliance period for a dry-year hydrology (April–June), Base EC is less than 200 uS/cm for each compliance month. Similarly, the modeled changes of up to 0.8% EC would not result in non-compliance with the D-1641 standard of 450 uS/cm 14-day running average of mean daily EC. Therefore, the small potential increases of EC at the C-4 location following implementation of the restoration project would not have a significant adverse impact on *agricultural beneficial uses*, and would not impact CCWD's *municipal beneficial uses* at other locations on the Delta.

CCWD-8: Mitigation for Significant Impacts

Commenter states that the 2016 DEIR must identify appropriate mitigation for significant impacts due to the Proposed Project, including a design configuration that minimizes salinity increases in the Delta. Commenter states that significant cumulative water quality and supply impacts could be avoided if habitat restoration projects throughout the Delta are sequenced so that there is no net significant water quality degradation at any time. If the significant water quality impacts cannot be fully mitigated by alterations of the habitat design and coordinating the implementation schedule of the Proposed Project with other restoration projects, the commenter requests that additional mitigation be identified to ensure the impacts are fully mitigated.

DWR Response

Please refer to **General Response A**. Please also refer to General Responses G and H of 2019 FEIR **Appendix E** for information on various salinity impacts, including cumulative impacts. Short- and long-term salinity impacts are assessed as *less than significant* without mitigation for all Alternatives considered in the EIR.

Central Delta Water Agency (CDWA)

CDWA-1: Piecemealing the 8,000 Acre Biological Opinion Requirement

Commenter states that DWR has produced a piecemealed analysis of the project, relative to the 8,000 ac Biological Opinion requirement.

DWR Response

Please refer to **General Response G**.

CDWA-2: Delta Water Flow and Water Quality

Commenter states that DWR has failed to adequately analyze the site-specific and cumulative impacts on water flow and quality in the Delta.

DWR Response

Specific impacts upon regional flows in the Delta are analyzed in EIR Impacts 3.1-1, 3.1-2, and 3.1-7. Specific impacts on water quality in the Delta are analyzed in EIR Impacts 3.2-5, 3.2-6, 3.2-7, and 3.2-8. In addition, cumulative impacts on hydrology and water quality (dissolved organic carbon, methylmercury, and salinity) are provided in Section 3.19.3 *Summary of cumulative impacts*. Since all the above listed impacts have been determined to be *beneficial*, *no impact,* or *less than significant* for the Proposed Project and Alternatives, there is no need to address offsets for these impacts.

Regarding potential increases in salinity, please refer to **General Response A**. Please also refer to General Responses G and H of 2019 FEIR **Appendix E.**

CDWA-3: Water Quality and Flow Analysis for Drought Conditions

Commenter states that DWR failed to analyze the potential effect of the Proposed Project to the tidal prism, or other impacts, under drought conditions.

DWR Response

Hydrodynamic modeling (Appendix D in WWR and SWS 2014) referenced in Impact 3.5-2 considered low flow, dry year conditions at Water Rights Decision 1641 (D-1641) (SWRCB 2000) compliance locations throughout the Delta for the Proposed Project and Alternatives. Please also refer to the response to CDWA-2.

CDWA-4: Groundwater and Surface Water Monitoring

Commenter states that the EIR should describe and explain the specifics of the groundwater and surface water monitoring that will continue during and after implementation of the Proposed Project, as well as what events would trigger the need for a response by DWR to address any increased seepage, and what that response would entail.

DWR Response

Please refer to **General Response A**. Please also refer to General Responses F and G of 2019 FEIR **Appendix E**. As discussed in the 2019 Partial Recirculated DEIR and General Response I of **Appendix E**, the text quoted by the commenter ["Additionally, DWR would continue groundwater and surface water monitoring during and after implementation of the Proposed Project, which would allow for assessment of conditions following restoration."] was removed from the EIR because the potential impacts for which the monitoring was proposed were determined to be *less than significant* with no need for mitigation.

CDWA-5: Unintended Levee Breaching

Commenter states the 2016 DEIR does not adequately cover future levee maintenance and operation. Commenter is concerned with wind-wave erosion, scour, and seepage impacts, regarding unintended levee breaches.

DWR Response

Please refer to **General Response A**. Please also refer to General Responses E, F, and G of 2019 FEIR **Appendix E**.

CDWA-6: Potential Levee Impacts during Storm Events

Commenter states that thus far the 2016 DEIR does not appear to analyze impacts such as wind-waves, scour, seepage, altered hydrodynamics/flow, on adjacent levees/islands during extreme storm events (high flows and wind), and thereby significantly underestimates the potential significance of such impacts.

DWR Response

Please refer to **General Response A**.

For potential wind-wave impacts, please also refer to Impact 3.1-4 of the EIR and General Response E in 2019 FEIR **Appendix E**.

For potential scour impacts, please refer to Impact 3.1-5 of the EIR and General Response E in 2019 FEIR **Appendix E**.

For potential seepage impacts, please refer to Impact 3.1-6 of the EIR and General Response F in 2019 FEIR **Appendix E**.

For information on regional hydrodynamics, please refer to Impact 3.1-2 in the EIR and General Response E of 2019 FEIR **Appendix E**. Collectively, alterations to the topography and vegetation on Prospect Island, and breaches to the levees around Prospect Island, as defined under the various conceptual alternatives, would not have flood conveyance impacts to the Yolo Bypass, or to the rivers and sloughs protected by the SRFCP (Appendix H of SWS and WWR 2012; RMA 2016).

CDWA-7: Water Rights and Diverting Water

Commenter states that DWR will be diverting water through the proposed breaches and must therefore state its water rights.

DWR Response

Water that flows uncontrolled, such as through the proposed open-water breaches on Prospect Island, does not qualify as a diversion; therefore, implementation of the Proposed Project or any of the Alternatives would not need a water right.

CDWA-8: Predation Impacts from Non-Fish Predators

Commenter states that DWR failed to evaluate the potential increased predation on fish by avian and terrestrial predators.

DWR Response

Prospect Island is currently a perennial freshwater emergent marsh with avian (e.g., pelicans, egrets, herons, osprey) and mammal species (e.g., river otters, raccoons, mink) that prey on fish. Please refer to **General Response E**, which explains that terrestrial and avian species will likely be of similar abundance to the status quo following implementation of the proposed restoration. Under the Proposed Project, predation by avian and terrestrial species would continue at similar levels as predation currently occurring at the site.

CDWA-9: Relevant Scientific Studies for Special-Status Fish

Commenter states that the narrative in the 2016 DEIR is not supported by the science cited in the document. Commenter includes two scientific studies (Sommer et al. 2005, and Vogel 2011) that they believe provide evidence that

Prospect Island, and the current methods of habitat restoration in the Delta in general, are detrimental to the survival of special-status fish species.

DWR Response

Section 1.2 of the EIR discusses the objective of the proposed restoration, which is to create improved habitat for Delta smelt and salmon, as required by the USFWS and NMFS Biological Opinions. The technical basis of the restoration action was established by the USFWS Delta Smelt BiOp (USFWS 2008) and the NMFS Salmonid BiOp (NMFS 2009), and the USFWS Delta Smelt BiOp (USFWS 2008) justifies the restoration. It is generally accepted that intertidal and shallow subtidal habitats, such as the Proposed Project, are dominated by intertidal wetland, a habitat type that, like floodplains, provide an aquatic-terrestrial transition zone. These transitions zones are an important food producing and rearing habitat for juvenile fish. As discussed below, the Sommer et al. (2005) and Vogel (2011) studies are not inconsistent with this view. Please also see the responses to LAND-3 and CDWA-10 in relation to the premise for, and objectives of, the proposed tidal habitat restoration.

Sommer et al. 2005

Sommer et al. (2005) discusses the benefits of floodplain habitat and expresses concern over the benefits of other types of flooded habitats. The commenter raised concerns that the studies cited in the 2016 DEIR are focused on Yolo Bypass floodplain habitat, and that since Prospect Island will not be floodplain habitat, the cited studies in the 2016 DEIR are inappropriate. The full citations list used in the 2016 DEIR can be found in the References section, but for convenience, the citations in question are summarized below:

- Junk et al. 1989, *The Flood Pulse Concept in River-Floodplain Systems*
- Lundvall et al. 1999, *Size-dependent Predation in Piscivores: Interactions Between Predator Foraging and Prey Avoidance Abilities*
- Moyle et al. 2007, *Patterns in the Use of Restored California Floodplain by Native and Alien Fishes*
- Nobriga and Feyrer 2007, S*hallow-Water Piscivore-Prey Dynamics in California's Sacramento-San Joaquin Delta*
- Sommer et al. 2001a, *California's Yolo Bypass: Evidence that Flood Control can be Compatible with Fisheries, Wetlands, Wildlife, and Agriculture*
- Sommer et al. 2001b, *Floodplain Rearing of Juvenile Chinook Salmon: Evidence of Enhanced Growth and Survival*

Indeed, Prospect Island does not possess floodplain habitat. However, with over 1,000 acres of intertidal and shallow subtidal habitat, the Proposed Project would be dominated by intertidal wetland, a habitat type that, like floodplains, provides an aquatic-terrestrial transition zone. These transition zones are theorized by Junk et al. (1989) to be an important food producing and rearing habitat for juvenile fish. The cited studies by Sommer et al. (2001a) and Moyle et al. (2007), while focused in the Yolo Bypass and Cosumnes River Preserve floodplain habitats, conclude that the likely explanation for observed enhancements to fish growth on floodplains was an abundance of high quality food. Other studies show that provided that food is of similar quality and abundance, shallow water and intertidal wetland habitat can exhibit similar growth rates among rearing fish (Hartman et al. 2017).

The cited Lundvall et al. (1999) is just one example of numerous studies that discuss the relationship between mouth gape, swimming ability, and predation success, and reinforces the idea that faster growth rates can compete with predation rates. Lundvall et al. (1999) also explains a further reduction in predation rates when enhanced growth rates are combined with adequate cover for prey fish. Nobriga and Feyrer (2007) concluded that piscivorous fish are widespread throughout the entire Delta. This fact was known during design, and features are incorporated into the design for the Proposed Project (see 2016 DEIR Section 2.2.3.2b *Clearing*, on page 2-29) that would provide cover for juvenile salmonids and other native fish to reduce the potential for predation. The cited studies were selected to illustrate an analogous, though more studied, habitat type to discuss the potential benefits of the proposed restoration. The proposed restoration is designed to have favorable production and export rates to provide high quality food for fish on- and off- site. The *less than significant* impact determination for Impact 3.3-9 is adequately supported by the cited studies. The Proposed Project would not cause a significant adverse impact to the extent that it would cause a reduction in species abundance or long-term population levels.

Vogel 2011

Vogel (2011) was a large-scale telemetry study conducted throughout the Sacramento and San Joaquin River and Delta systems. The commenter quoted text from the study that expressed concern over breaches in the Delta and potential advection of salmon farther up the river system.

The Vogel (2011) study was included as a citation in the 2016 DEIR and was relied upon heavily during design of the Proposed Project to limit potential

impacts of fish predation. The section of Vogel (2011) referenced by the commenter concludes that there may be significant adverse impacts due to breaching levees in the Delta. Narrow breaches can create disorienting velocity changes and carve deep scour holes that become predator havens. This was known during design for the proposed restoration cited in the 2016 DEIR, and several project elements are specifically included to alleviate the problems identified in Vogel (2011). For example, wide (300 ft) breaches are designed to reduce incoming velocities and reduce the potential for scour holes and disorienting velocities. A breach velocity dissipation feature (see 2016 DEIR Section 2.2.3.11) was also included to further reduce incoming velocities. Channel geometry was designed to achieve water velocities sufficient to naturally limit in-channel sedimentation and submerged aquatic vegetation growth.

The commenter's second concern related to the Vogel (2011) study was that the Proposed Project would create a larger tidal prism and advert salmon farther up the system than would otherwise be expected, and would create a predatory attraction spot at the proposed breach locations. The Delta is a tidal environment; advection of salmon would occur whether the alternatives are constructed or not. Salmon are known to naturally move upstream and downstream with the tides. In addition to the predation limiting project elements discussed above, the Proposed Project would provide rearing habitat for salmon emigrating downstream or advected upstream. The impact significance determination of *less than significant* is correct since the Proposed Project would not cause a significant adverse impact to the extent that would cause a reduction in species abundance or long-term population levels.

Finally, the commenter includes an excerpt from the Vogel (2011) study that suggests that flooding on Prospect Island was previously implemented under the auspices of creating shallow water habitat to benefit native fishes; however, the referenced CALFED project was never implemented. Previous flooding of Prospect Island was the result of unintentional levee breaches due to flooding in January 1997. A three-week sampling effort in October 1998, targeting specific fish species, captured 184 Striped Bass and 12 Largemouth Bass, as well as many other non-native fish species (Christophel et al. 1999). Catch of these two predator species represented approximately 5% of the total number of fish caught in Prospect Island. Overall, approximately 93% of the total catch was non-native primarily due to the large number (2,116) of Threadfin Shad caught in the sampling gear. The lack of native salmonids and smelt captured during the October 1998 efforts was likely due to warm, fall water temperatures present at the time. Juvenile salmonids and Delta Smelt are significantly more abundant in

the Cache Slough Complex, especially in Miner Slough, during the winter and early spring months (CDFW 2019).

CDWA-10: Biological Objectives and Monitoring Goals

Commenter states that DWR did not include quantifiable biological goals or objectives to evaluate the success of the Proposed Project.

DWR Response

The objectives of the Proposed Project are set forth in Section 1.2 *Proposed Project Objectives* of the EIR and, as explained in **General Response H**, draw from the Tidal Wetland Monitoring Framework (IEP TWM PWT 2017a,b). This Framework, prepared by the Interagency Ecological Program (IEP) to facilitate the development of site-specific monitoring plans to assess the effectiveness of tidal wetland restoration projects, has been developed to ensure integrity of scientific methods and quality of data and reporting. Elements of the Framework support preparation of the MMRP, AMMP, and Revegetation Strategy also discussed above in **General Response H**, providing confidence that monitoring procedures are scientifically sound and regionally consistent. Representatives from the California Department of Fish and Wildlife, Department of Water Resources, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Metropolitan Water District, Delta Stewardship Council, ICF, ESA Associates, State and Federal Contractors Water Agency, San Francisco Estuary Institute, U.S. Geological Survey, the Central Valley Water Quality Control Board, and UC Davis all contributed to updated conceptual models developed by an interagency work team of wetland and monitoring specialists that incorporate the most recent and best available science (Sherman et al. 2017). The Tidal Wetland Monitoring Framework provides monitoring guidance to determine the effectiveness of tidal wetland restoration for at-risk species and includes suggestions for hypotheses, metrics, and sampling design, data management, analysis, quality assurance, and reporting protocols.

California Farm Bureau Federation (CFBF)

CFBF-1: Restoration Site Selection

Commenter states that the position of Prospect Island in the landscape *may* have significant potential to provide the biological and water supply benefits mentioned in the comment.

DWR Response

Comment noted.

CFBF-2: Model for Success of Future Restoration Projects

Commenter states that the Proposed Project may provide a unique opportunity to meaningfully address concerns and impacts of similar future projects in the Delta.

DWR Response

Comment noted.

CFBF-3: General Impacts of Prospect Island and other Projects

Commenter identifies concerns over impacts related to 1) direct or indirect losses of farmland, 2) potential under-seepage and erosion effects on adjacent islands, 3) potential effects on adjacent diversions (including water quality/salinity effects and potential restrictions associated with the presence of protected species), and 4) potential cumulative effects with other similar projects over time.

DWR Response

Although the comment refers to impact topics analyzed in the 2016 DEIR, no specific issues with the impact analyses are raised (refer to **General Response B**). Information with regards to each point can be found in the following locations:

1. Impacts 3.12-1 and 3.1-1 of the EIR, and **General Response D** above.
2. Impacts 3.1-3, 3.1-4, 3.1-5 and 3.1-6 of the EIR, and General Responses E and F in 2019 FEIR **Appendix E**.
3. Impacts 3.3-1 and 3.1-9, and 3.2-5 through 3.2-9, and **General Response E** above.
4. Section 3.19 *Cumulative Impacts* of the EIR and **General Response G**, as well as General Response H in 2019 FEIR **Appendix E**.

CFBF-4: Cumulative Impacts of Tidal Habitat Restoration Projects

Commenter states that the potential combined effects of multiple projects over time, all in the same geographic area, may be cumulatively more significant than the effect any one project alone. Commenter requests that environmental analyses, monitoring programs, and mitigation approaches robustly and

forthrightly address local concerns, and take all reasonable and practicable steps to address those concerns in good faith.

DWR Response

Please refer to **General Responses G and H**.

CFBF-5: Potential Impacts on Agricultural Lands and Economies

Commenter suggests DWR should pursue a robust regional Agricultural Lands Stewardship Plan approach in cooperation with a broad cross-section of the affected stakeholder community. This would help provide an agricultural mitigation blueprint and build greater support (or at least less opposition) and a more stable long-term implementation program for an entire region. In addition to agricultural impacts, under-seepage, erosion, and salinity intrusion are additional major concerns in the Delta that the Department would do well to address forthrightly, robustly, and consistently from the outset.

DWR Response

Although the comment refers to impact topics analyzed in the 2016 DEIR, no specific issues with the impact analyses are raised (see **General Response B**).

Section 3.12 of the 2016 DEIR describes agricultural resources on and near the proposed restoration site. Potential agricultural resource issues considered include conversion of agricultural lands to other uses, impacts to Williamson Act properties, and other possible effects to agricultural resources on or off the site. For the reasons set out in the EIR, these impacts are assessed as *less than significant*. Furthermore, DWR did pursue a robust agricultural lands stewardship approach in cooperation with a broad cross-section of the affected stakeholder community for the proposed restoration (see **General Response D** regarding outreach efforts).

The 2016 DEIR addressed the questions of under-seepage, erosion, and salinity intrusion with changing tidal patterns. Please see General Response F of 2019 FEIR **Appendix E** with regards to potential seepage impacts, General Response E of 2019 FEIR **Appendix E** with regards to potential erosion impacts, and General Responses G and H of 2019 FEIR **Appendix E** with regards to potential salinity intrusion. With regards to potential cumulative impacts, please refer to **General Response G**. Please also refer to **General Response H** regarding monitoring.

CFBF-6: Impacts to Levees and Diversions

Commenter expressed concerns about potential impacts to levees and diversions on Ryer Island, and potential impacts to other neighboring lands, levees, and water users.

DWR Response

Please see **General Response D**, and General Responses D, E, and F of 2019 FEIR **Appendix E**.

CFBF-7: Predation as a Stressor on Habitat Restoration

Commenter states that habitat restoration projects, like Prospect Island, should consider the separate stressor of predation. If this stressor is not considered, it may cancel out beneficial effects of restoration projects.

DWR Response

Piscivorous fish (fish that eat other fish) are widespread and abundant in the Delta. Accordingly, several design elements are included in the proposed restoration to discourage piscivorous fish from using the site; these design elements are discussed in EIR Impact 3.3-9. More detailed information on the design elements can be found in EIR Section 2 *Project Description*. The 2016 DEIR determined that post-construction increases in predation would be *less than significant* due to the benefits of the new habitat, and the design elements that would discourage the presence of piscivorous fish.

California State Lands Commission (CSLC)

CSLC-1: Sovereign Land of the State of California

Commenter states that although a full boundary investigation has not yet been undertaken, the portion of the project in Miner Slough is under the jurisdiction of the CSLC. Commenter states that on tidal waterways, the CSLC's jurisdiction extends to the mean high tide line, and a lease or agreement will be required for works on State-owned sovereign land.

DWR Response

Comment noted. DWR will coordinate with the CSLC, as required. If Alternative 2 is moved forward, no dredging in the Miner Slough Spur Channel would occur.

CSLC-2: Navigable Waters of the State

Commenter states that the waterways of the Proposed Project area are subject to a public navigational easement. Activities completed as part of the Proposed Project must not restrict or impede this easement.

DWR Response

This is not an issue relating to the adequacy of the environmental impact analysis (see **General Response B**). DWR will coordinate with the CSLC, as required, with regards to navigation.

CSLC-3: Introduction of Invasive Species through Equipment Barges

Commenter states that invasive aquatic species may be introduced via barge due to hull water intake during equipment transport and other Proposed Project activities. Commenter recommends contractor required hull cleaning, or use of local barges.

DWR Response

If the construction contractor uses barge-based transportation, local barges will be utilized. As a result, no further impact analysis is necessary.

CSLC-4: Non-Native Fish Species

Commenter states that the 2016 DEIR should analyze if Proposed Project elements would favor non-native fish species.

DWR Response

The 2016 DEIR determined in Impact 3.3-2 that the proposed restoration would be *beneficial* to aquatic resources, including fish species. Non-native fish are abundant and widespread in the Delta, in part because of their occupation of a similar habitat niche as native species. A project that selects specifically for native fish is not possible for this reason. However, the proposed restoration does include several design elements that discourage the use of the site by piscivorous fish, most of which are non-native (see the response to CFBF-7 above).

CSLC-5: Planned Levee Maintenance

Commenter states that more information should be provided in the hydrology section to: disclose other planned levee maintenance projects in the Proposed Project area; identify what existing sections of the levee are most vulnerable to future repair and maintenance by DWR from Project-related impacts; and explain why these areas of the levee are not proposed for improvement during site preparation for the Proposed Project.

DWR Response

The proposed restoration is not designed as a levee maintenance project, but rather as a tidal habitat restoration project to benefit endangered fish species. Therefore, the 2016 DEIR only described levee maintenance activities related to the proposed restoration. To dewater the south property, thus facilitating internal construction activities, DWR would repair the Miner Slough levee at three locations along the eastern boundary of the site, including where a previous breach was repaired (and is currently leaking) (see EIR Section 2.2.3 *Description of Proposed Project components and construction activities, 1. South Property Levee Repairs*).

Regarding consideration of future levee monitoring and repairs, please refer to General Response I in 2019 FEIR **Appendix E**. Please also refer to **General Responses D** and **H** of this appendix.

CSLC-6: Armoring of the Breached Levee End Points

Commenter states that Figure 2.2-9 does not appear to illustrate the armoring design explained on page 2-50. Commenter requests that the *Hydrology* section is updated to provide further justification for why armoring of the breached levee end points is not directly proposed and why levee erosion is not of concern.

DWR Response

Armoring is proposed on the exposed levee ends of the northern breach of the Proposed Project. Armor protection would also be used at the breach central to Prospect Island and the weir for Alternative 2. The purpose of Figure 2.2-9 in the 2016 DEIR is to show how the proposed breach velocity dissipation feature would function to reduce velocities near the breach, not to show erosion protection. Please refer to Impacts 3.1-4 and 3.1-5 of the EIR for assessments of erosion impacts, and General Response E of 2019 FEIR **Appendix E** with regards to potential wind-wave erosion impacts. Erosion impacts are assessed

as *less than significant* without need for mitigation. Please also refer to General Response I of 2019 FEIR **Appendix E** regarding consideration of future levee monitoring and repairs.

CSLC-7: Potential for Increased Sedimentation Downstream of Miner Slough

Commenter states that the *Hydrology* section does not directly evaluate potential for increased sedimentation to receiving waters downstream of Miner Slough. Commenter requests a discussion of the level of significance of this potential impact and the relation to potential methylmercury contamination.

DWR Response

Impact 3.5-2 *Long-term effect on sediment deposition and erosion in Prospect Island* was not subject to recirculation; please refer to **General Response A**. A description of local and regional sediment dynamics is provided in the supporting sediment and turbidity modeling report (*Evaluation of Effects of Prospect Island Restoration on Sediment Transport and Turbidity*, cited as Appendix C in WWR and SWS 2014 in the EIR) used to develop Impact 3.5-2. Please see **General Response C** for availability of the report. Impact 3.5-2 has been expanded in the 2019 FEIR to include a more detailed summary of turbidity modeling, but the significance assessment is not changed and is *beneficial* overall. Analysis of future changes in regional sediment supply, as well as site elevations, are presented in Section 3.19.3 *Summary of cumulative impacts: Geology and soils* of the EIR, and assessed as cumulatively *beneficial*. Given that the project site lies at intertidal elevations and will support plant litter and peat accumulation in the emergent wetland habitat, future changes in regional sediment supply may result in accretion within Prospect Island, which would be *beneficial* with regard to subsidence. Annual sediment loads in Miner Slough are large, and dominated by Sacramento River sources during winter (Wright and Schoellhamer 2005). All the design alternatives modeled are predicted to decrease turbidity at the Cache Slough, Sacramento River DWSC, and Liberty Island monitoring stations (Appendix C in WWR and SWS 2014), and ongoing deposition and scour of these upstream sources occurs on a seasonal basis in Miner Slough. Therefore, it is not expected that any additional bed scour that may occur with the Proposed Project would result in measurable increases in deposition downstream of the Cache Slough confluence, increases in methylmercury production relative to existing conditions, or reduce habitat suitability for Delta Smelt. Impact 3.2-8 of the EIR discusses long-term methylmercury production, bioaccumulation, and export, including consideration of sediment deposition, and the impact is assessed as *less than significant*.

CSLC-8: Sediment Contaminant Testing

Commenter states that sediment contaminant testing be conducted now and evaluated in the 2016 DEIR given the potential for known legacy pollutants, such as methylmercury and other toxins, and reliance on dredging spoils for proposed fill activities. The Commenter recommends the *Water Quality* section be updated to include this analysis.

DWR Response

No dredging will take place for Alternative 2. However, DWR has undertaken sediment sampling and analysis of the Miner Slough Spur Channel and interior of Prospect Island (Kinnetic Laboratories, 2016a,b; refer to **General Response C** for the availability of these reports). Potential Impacts 3.2-2, 3.2-8, 3.6-2, and 3.6-3 have been updated to reflect results of these analyses, and are assessed as *less than significant*, or *less than significant with mitigation*. Please also see the response to CSLC-9 below.

CSLC-9: Methylmercury Management

Commenter requests that the methylmercury discussion on page 3-46 and Impact 3.2-8 on page 3-81 be updated to note the role of CSLC as both a State agency that manages open-water areas in the Sacramento-San Joaquin Delta Estuary and a non-point source discharger of methylmercury, and that the CSLC is required to fund studies to identify potential mercury/methylmercury control methods in the Delta and to participate in an Exposure Reduction Program. Furthermore, CSLC requests that DWR note its subsequent obligation to minimize or avoid releases of methylmercury from dredging and sedimentation impacts associated with the Proposed Project.

DWR Response

Please refer to **General Response A**. The methylmercury discussion in Section 3.2.1 *[Water Quality (Surface and Groundwater)] Setting* and Impact 3.2-8 of the EIR have been updated to reflect the role of CSLC, and the updates were made available for review in the 2019 Partial Recirculated DEIR. Please refer to the 2019 FEIR and the response to LAND-34 in 2019 FEIR **Appendix E** for further information regarding methylmercury.

CSLC-10: Mitigation Monitoring Program

Commenter notes the absence of a Mitigation Monitoring and Reporting Program (MMRP) in the 2016 DEIR.

DWR Response

Please refer to **General Response H**. DWR will include an MMRP with any decision documents.

Central Valley Regional Water Quality Control Board (CVRWQCB)

CVRWQCB-1: Informational Letter

Commenter sets forth information about possible permits that may apply to implementation of the Proposed Project or Alternatives.

DWR Response

Although this comment does not raise concerns with the 2016 DEIR (see **General Response B**), the comments are similar to those received from CVRWQCB on the 2019 Partial Recirculated DEIR, and due consideration to the matters raised is provided in the CVRWQCB responses portion of 2019 FEIR **Appendix E**.

Delta Stewardship Council (DSC)

DSC-1: Certification of Consistency with the Delta Plan

Commenter states that the lead agency must file a Certification of Consistency with the Delta Plan for “covered actions”. The Delta Plan includes 14 regulatory policies that are applicable to covered actions. Commenter provides information relating to General Policy 1, Ecosystem Restoration Policies 2 and 5, Delta as Place Policy 2, as well as other general information, including information on Delta Plan recommendations.

DWR Response

Although this comment does not raise concerns with the 2016 DEIR (see **General Response B**), the comments are similar to those received from the DSC on the 2019 Partial Recirculated DEIR, and due consideration to the matters raised is provided in the DSC responses portion of 2019 FEIR **Appendix E**.

Local Agencies of the North Delta (LAND)

LAND-1: Comments on the Notice of Preparation

Commenter states that they are disappointed that DWR did not respond to their comments on the Notice of Preparation (NOP), which were submitted on November 4, 2014. LAND would like to meet with the DWR Project Team to discuss their concerns and address them in a mutually beneficial manner.

DWR Response

The 2016 DEIR and the 2019 Partial Recirculated DEIR responded to issues raised in the NOP. Please refer to **General Response D** regarding meetings with LAND and good neighbor actions taken, or planned, in response to concerns raised in more recent correspondence.

LAND-2: Communications

Commenter states that restoration efforts in the Delta have been poorly documented, poorly monitored, and ecologically uncertain. Commenter states that DWR began the project by communicating directly with local RD's and LAND but has since stopped. They assert that DWR has "failed to respond systematically" to some of their comments and state "long-term success of the Proposed Project will require the clear communication with neighboring landowners and RDs."

DWR Response

Regarding restoration efforts in the Delta generally, please refer to **General Response B**. Please also specifically refer to the response to LAND-3 below, response to CDWA-9 with regard to the tidal restoration projects, and **General Response H** with regard to ongoing monitoring and studies.

DWR believes that regular, direct communication with LAND, local RDs, and landowners is necessary. DWR met with LAND on November 1, 2016 and has been in regular communication with them since. Please refer to **General Response D**. DWR and the commenter disagree on some of the potential impacts of the Proposed Project. While DWR did not agree to all the measures that commenters have requested, DWR did carry out, or did agree to carry out, some of the actions requested as a good neighbor. Please refer to the additional

responses below and to the responses to LANDs letter on the 2019 Partial Recirculated DEIR.

LAND-3: Technical Premises for Restoration

Commenter states the importance of articulating the technical basis of restoration. Commenter also states that the tradeoffs between current site uses by wildlife and projected future benefits for other wildlife need to be identified, with reference to birds.

DWR Response

The technical basis of the restoration action was established by the USFWS Delta Smelt BiOp (USFWS 2008) and the NMFS Salmonid BiOp (NMFS 2009), and is summarized below. Please also refer to the responses to CDWA-9 and CDWA-10.

Since it was introduced into the estuary in 1988, the zooplankton *Pseudodiaptomus forbesi* has been the dominant summertime prey for Delta Smelt (Lott 1998; Nobriga 2002; Hobbs et al. 2006). There is evidence suggesting that the co-occurrence of Delta Smelt and *Pseudodiaptomus forbesi* has a strong influence on the survival of young Delta Smelt from summer to fall.

The near complete loss of tidal wetlands from the Delta threatens Delta Smelt by reducing productivity at the base of the pelagic foodweb. Primary production in tidal wetlands of the Northern San Francisco Estuary has been shown to support high zooplankton growth (Müller-Solger et al. 2002). The proposed restoration is expected to enhance the foodweb on which Delta Smelt depend. The proposed restoration is designed to increase high quality primary and secondary production in the Delta and Suisun Marsh through an increase in tidal wetlands. Exchange of water between the tidal wetlands and surrounding channels is intended to distribute primary and secondary production from the wetlands to adjacent pelagic habitats where Delta Smelt occur. This exchange will be optimized through intertidal habitat restoration designed to incorporate extensive tidal channels, supported by an appropriately sized vegetated marsh plain, which will provide the necessary tidal prism to maintain large tidal exchange.

New evidence indicates how tidal marsh may benefit Delta Smelt, even if they do not occur extensively within the marsh itself. Specifically, monitoring suggests this species is taking advantage of recently created tidal marsh and open-water habitat on Liberty Island. The fact that Delta Smelt make heavy use of habitat in

the Cache Slough complex has been evident in sampling by the DFG's Spring Kodiak trawl and 20 mm surveys (CDFW 2019). The Spring Kodiak trawls show that Delta Smelt are present in channels of the Cache Slough complex during winter and spring; the collection of larval Delta Smelt in subsequent 20-mm surveys indicates that these adult Delta Smelt eventually spawn in the vicinity. In addition, the use of Cache Slough complex by Delta Smelt includes habitat on Liberty Island.

The island flooded in 1998 and has evolved rapidly into a system of open-water and tidal marsh habitat. Recent sampling of Liberty Island by USFWS biologists revealed that Delta Smelt both spawn and rear on Liberty Island (Sommer and Mejia 2013). Light traps collected relatively high numbers of larval Delta Smelt in several locations of Liberty Island during the 2003 spawning period for this species. Moreover, subsequent beach seine sampling showed that older Delta Smelt were present at all ten of their sampling stations during 2002-2004 and in all seasons of the year. These results are particularly striking because they are from a period when Delta Smelt was at record low abundance. Collection of Delta Smelt from shallow inshore areas using seines indicates that the fish do not occupy deeper pelagic habitat exclusively. These results seem reasonable considering the area's consistently high turbidity (Nobriga et al. 2005) and zooplankton abundance (e.g., Sommer et al. 2004), both of which are important habitat characteristics for Delta Smelt (Bennett 2005; Feyrer et al. 2007). Furthermore, the results suggest that freshwater tidal wetlands can be an important habitat type to Delta Smelt with proper design and location.

Regarding impacts to bird species and the tradeoffs between the pre-project and post-project habitats, Page 3-165 of the DEIR contains a table that covers all listed bird species and whether tidal restoration of the site will benefit the species. Impacts to groups of non-listed birds are addressed in Impact 3.4-15 and Impact 3.4-16 of the EIR. Please also refer to Section 3.3 *Aquatic Biological Resources* and Section 3.4 *Wetland and Terrestrial Biological Resources* of the EIR generally for information on potential impacts to wildlife.

LAND-4: Design Elevations

Commenter states that review of several LiDAR elevation figures show discrepancies, and requests that an independent licensed surveyor review the survey, bathymetry, and LiDAR data to ensure that the vertical datum and the control points for these data are correct and consistent.

DWR Response

Although the comment does not identify which 2016 DEIR figures show erroneous elevations, it is acknowledged that the topographic and bathymetric digital elevation model (DEM) used for impact analyses was constructed from a range of several data sources dating back to 2007 LiDAR surveys collected by DWR. Vegetation returns from these surveys were corrected by updated surveys of levee crowns by DWR in 2009 and 2010, surveys of the interior marsh by WWR in 2011, as well as bathymetric surveys of the surrounding waterways by DWR in 2012. During preparation of the preliminary design, DWR collected high resolution LiDAR and point survey data (in 2015) and found no significant discrepancies with the DEM used in the 2016 DEIR analyses.

LAND-5: Sediment, Salinity, Nutrients, and Toxins

Commenter states that the Proposed Project design has a high possibility of altering local tidal dynamics, altering sediment deposition in and around Cache Slough, reducing available nitrogen, and increasing salinity. Commenter also states that when the tidal and salinity effects of the Suisun Marsh projects and their operations are combined with the Proposed Project and other DWR Delta projects, there are confounding effects that should be planned for.

DWR Response

As discussed in 2016 DEIR Impacts 3.2-5 *Long-term effects on salinity in waterbodies near Prospect Island* and 3.5-2 *Long-term effect on sediment deposition and erosion in Prospect Island*, hydrodynamic modeling that simulated tidal ranges was conducted over a range of alternatives in planning phases of the project, including one alternative similar to the Proposed Project (Phase 2, Alternative 26) and one similar to Alternative 2 (Phase 2, Alternative 4). Modeling was undertaken to better understand potential variations in sediment transport and deposition and salinity dynamics within the Proposed Project vicinity and broader Cache Slough region.

Tidal Dynamics

The purpose of the project is to restore tidal action to Prospect Island, meaning that consideration of tidal dynamics underpins the EIR. Changes in tidal range are discussed throughout Section 3.1 *Hydrology* of the EIR.

Sediment Transport and Deposition

Please see the response to CSLC-7.

Salinity

Please refer to **General Response A**, as well as to General Responses G and H of 2019 FEIR **Appendix E**, and Impact 3.2-5 in the EIR.

Nitrogen

Spatial and temporal modeling of a non-conservative water quality constituent such as nitrogen is beyond the scope of the modeling conducted during planning phases of the alternatives. Models indicated only minor changes in regional hydrodynamics due to the "build" alternatives, and because the implementation of the restoration would result in a net export of algal productivity (see Impact 3.2-7 in EIR Section 3.2 *[Water Quality (Surface and Groundwater)] Impacts and mitigation*, no adverse impacts to regional nutrient levels from a reduction of nitrogen are expected. Nor are adverse impacts expected due to nitrogen export, since the nitrogen content of algae exported from Prospect Island is expected to be on the order of 2 to 5% (Horne and Goldman 1994).

Cumulative Impacts

Please refer to **General Response G**, and to Section 3.19 of the EIR, regarding potential cumulative impacts.

LAND-6: Nutrient Export

Commenter states that the tradeoffs between existing and Proposed Project conditions in relation to greenhouse gases (GHG), algal toxins, and nitrogen depletion should be analyzed.

DWR Response

Because the site currently lacks tidal connectivity on the northern property and provides only muted tidal connectivity on the southern property, the alternatives are expected to increase tidal habitat functions including sediment deposition, nutrient exchange, and food-web export over existing conditions.

GHGs

Land-use change affects the exchange of GHGs between ecosystems and the atmosphere. Open water generally releases less GHGs than wetlands with emergent vegetation. The restoration project will increase open-water tidal aquatic habitat by 122 ac, and decrease wetlands and uplands habitat overall

(see Table 2.1-2 of the EIR). Restored open-water areas are not expected to have increased methane emissions compared to pre-restoration upland and seasonal wetland conditions. This is because, without vegetation cover, the substrate for methanogenesis (organic carbon) is limiting in the underlying sediment and not provided by living plants. There is a possibility that where there is abundant floating invasive aquatic vegetation, organic material may be created along with pockets of low redox conditions that would be conducive to methanogenesis, with methane emitted through ebullition or hydrodynamic transport. However, upon implementation of the Proposed Project, GHG emissions are expected to be lower than those occurring under existing conditions. Additionally, invasive plant management is part of the Proposed Project, as described in **General Response F**.

Algal Toxins

Regarding the potential for the export of algal toxins from cyanobacteria, hydrodynamic modeling conducted during planning phases of the Proposed Project was used to identify alternatives with greater tidal exchange rates, to support beneficial algae species, and to limit the potential for cyanobacterial blooms. Please refer to **General Response C** for availability of the Prospect Island Tidal Restoration Project Analysis of Primary Productivity Enhancement and Export for Phase 2 Alternatives Evaluation, cited as Appendix A in WWR and SWS 2014 in the EIR. Long-term effects on algal species are also discussed in Impact 3.2-7 of the EIR. Overall, export would generally be dominated by preferred diatom-based algal species, rather than blue-green (cyanobacteria) species, and the diatom-based algal species are of high food value to pelagic species (SWS and WWR 2012).

Nitrogen and Nutrients

Please see the response to LAND-5 above.

LAND-7: Invasive Aquatic Weeds, Clams, Mussel Invasions, and Methylmercury Bioaccumulation

Commenter states that the Proposed Project's potential to facilitate invasive aquatic weeds and invasive clams, as well as new mussel invasions, must be fully analyzed, including effects of exported methylmercury (dissolved and sediment associated) bioaccumulating in the food chain.

DWR Response

Invasive Aquatic (and Terrestrial) Plants

Please refer to **General Response F**.

Invasive Clams and Mussels

The potential for the proposed restoration to increase clam populations is analyzed in Impact 3.3-11 and assessed as *less than significant*. For clams, as well as any future mussel invasions, implementation of the proposed restoration would result in an overall increase in exported productivity compared to existing conditions, and would not result in adverse individual or population-level effects on the survival of special status fish, or their associated habitats. Mussel invasions (both Quagga and Zebra) were not analyzed for the Alternatives because the risk of invasion is low. These mussels are not currently established in the Delta or near the Delta; the closest known occurrence was an observation in San Justo Reservoir in San Benito County.

Methylmercury

Regarding methylmercury, please refer to **General Response A**. The potential food web impacts of methylmercury exported from the Proposed Project site are analyzed in EIR Impacts 3.2-8 and 3.3-12 as *less than significant*. Upon implementation of the Proposed Project, the small increase in the area of infrequently flooded habitat associated with higher methylmercury production would be offset by a large increase in open-water habitat associated with lower methylmercury production and little, if any, increases in methylmercury export and bioaccumulation would occur as a result of the Proposed Project. For further information on potential methylmercury bioaccumulation, please refer to the response to LAND-34 in 2019 FEIR **Appendix E**.

LAND-8: Sediment Dynamics

Commenter states that sediment dynamics at the Proposed Project site need to be described from a seasonal and other perspectives, and the implications on nearby locations described. The local-regional sediment balance should also be identified, and the implications of the long-term decline of sediment in the Sacramento River system on Proposed Project performance should be fully described. Further, Proposed Project sediment-related impacts on vegetation recruitment and turbidity levels supporting native fish species, such as Delta smelt, should also be described.

DWR Response

Please see the response to CSLC-7 regarding sediment dynamics and turbidity, **General Response F** regarding invasive aquatic plants, and General Response E in 2019 FEIR **Appendix E** regarding scour.

Although it is recognized that sediment supplies to the Delta have declined in the past century due to the construction of tributary dams to the central valley, connectivity between the proposed restoration site and the surrounding sediment sources from the Yolo Bypass and Cache Slough region will ensure high turbidity conditions important to Delta Smelt (Morgan-King and Schoellhamer 2013). Long-term conversion and enhancement of aquatic habitat, including considerations of vegetation impacts on Delta Smelt, are assessed in Impact 3.3-2 of the EIR as *beneficial*. Post-construction increased predation on native fish, including consideration of long-term changes to turbidity levels, are assessed in Impact 3.3-9 of the 2019 FEIR as *less than significant*. Additionally, short-term impairment of essential fish behaviors due to potential increases in turbidity during underwater sediment sampling activities is assessed in Impact 3.3-5 of the EIR as *less than significant*; short-term impairment of essential fish behaviors due to construction-related increases in turbidity is assessed in Impact 3.3-6 of the EIR as *less than significant* with mitigation; and the temporary effects of bottom sediment removal on fish are assessed in Impact 3.3-1 as *less than significant*.

LAND-9: Seepage and Erosion

Commenter states that the extent and impact of Proposed Project-associated seepage and wave run-up at any levee breaks is unclear and recommends supplemental analyses and mitigation. Commenter requests a seepage tracer study, optimization of intake locations, operable levee gates, construction cutoff walls, interception wells, levee maintenance funds for neighboring islands, and monitoring of wind fetch with bank pins.

DWR Response

Please refer to **General Response A**. Additionally, please refer to General Responses E, F and G of 2019 FEIR **Appendix E**. Optimization of intake locations to minimize hydraulic effects was part of the hydrology analysis done for the restoration project in the analysis for Impact 3.1-3. A tracer study is not considered necessary given available information and the *less than significant* determinations for Impacts 3.1-3 and 3.1-6 of the EIR.

With regards to the use of operable gates and other engineered structures, please see the response to LAND-17.

LAND-10: Long-term Weed Maintenance

Commenter states control of terrestrial and aquatic weeds is important, and the 2016 DEIR includes no weed management following Proposed Project construction.

DWR Response

Please refer to the response to **General Response F**.

LAND-11: MMRP and Funding

Commenter states that DWR must produce a Mitigation, Monitoring, and Reporting Plan (MMRP), along with proof of adequate funding for the expected types and extents of impacts with a contingency. Typical small claims of road and fence damage, damage to irrigation and drainage facilities, localized groundwater impacts from dewatering or restoration, weed management issues, and loss of access to property can be handled in an expeditious and fair manner by maintaining a mitigation fund for the project. Funding for levee stability if erosion of neighboring levees occurs, and weed maintenance, should be identified. Commenter also states that the *less than significant* conclusions for impacts of concern to local interests has led to a lack of mitigation in the 2016 DEIR.

DWR Response

An MMRP required by CEQA (described in **General Response H**) will accompany any decision documents relating to this 2019 FEIR. Funding is provided by the SWP, as part of its obligation to comply with the USFWS Delta Smelt BiOp (USFWS 2008).

- Potential for damage to local roads was recognized in the 2019 Partial Recirculated DEIR, and Mitigation Measure 3.17-1.2 ensures that should deterioration from construction vehicles occur, roads will be repaired to pre-Proposed Project conditions.
- Regarding irrigation and drainage facilities, please refer to **General Responses E** and **F**, which explain that CDFW shares funding of necessary fish screens, and invasive plants would not accumulate at pump intakes. Given that Prospect Island does not currently utilize

diversion pumps and potential dewatering flows will be well below baseflows, no changes in diversion and pumping practices on Prospect Island are anticipated with implementation of the Proposed Project. As noted in Impact 3.1-10, potential groundwater extraction from the shallow subsurface of the proposed restoration site for dewatering purposes would not result in overdraft of local groundwater supplies, nor would it impact the water levels or yield of any third-party wells within the vicinity of Prospect Island.

- For potential groundwater impacts, please refer to **General Response A**, as well as to General Response F of 2019 FEIR **Appendix E**.
- For weed management, please refer to **General Response F**.
- Regarding loss of property access, please refer to Section 4.7 *Transportation and Traffic* of the 2019 Partial Recirculated DEIR, which explains that there are no privately-owned residences that loss of access to the interior levee would impact. Terrestrial access along the Miner Slough levee would be retained to the first breach location, and the Proposed Project would not affect potential future waterside access along Miner Slough.
- Regarding levee stability, please refer to **General Response A**, as well as to General Response E in 2019 FEIR **Appendix E**. See also General Response I in 2019 FEIR **Appendix E** with regard to the need for levee maintenance.

LAND-12: Operations and Maintenance

Commenter states that DWR must produce a long-term management plan and associated funding to ensure the goals and objectives of the Proposed Project are met. Commenter states that the current condition of the island is a direct result of a passive management approach and lack of funding.

DWR Response

Please refer to **General Response H** and the response to LAND-11 above.

LAND-13: Water Rights and New Diversion

Commenter states that DWR should identify the source and legal rights to water, and the location and impact of diverting water away from Miner Slough. Commenter also states that open-water and riparian vegetation consume a lot of

water, and references a table of evapotranspiration rates from an appendix to DWR Bulletin 168 (October 1978).

DWR Response

Please see the response to CDWA-7 regarding water rights, which states that there would be no water diversion under the Proposed Project. Please also refer to Impact 3.1-9 in the EIR, which reaches the conclusion that consumptive use would be similar to existing conditions.

Although evapotranspiration rates of different vegetation types could be referenced, along with local pan evaporation rates, it is well known that open-water evaporation rates are much lower than evapotranspiration rates of wetland and riparian vegetation (Hussey and Odum 1992), as explained further in Impact 3.1-9.

LAND-14: Good Neighbor Policies

Commenter states that DWR should employ "good neighbor policies" to avoid negatively impacting adjacent and nearby land uses.

DWR Response

Please refer to **General Response D** and to General Response G in 2019 FEIR **Appendix E.**

LAND-15: Neighboring Landowner Impacts

Commenter states that neighboring landowner impacts requiring special attention are: seepage impacts to agriculture; wind-wave action to levees; flood risk; water quality and quantity; weeds; endangered species take jeopardy; noise, dust, and traffic; and damage to roads and levees.

DWR Response

Please refer to **General Response D** regarding good neighbor policies. Additionally, the specific issues raised in the comment are discussed in the EIR and appendices, as follows:

- Loss of agricultural productivity/crop damage from seepage – please see **General Response A** and General Response F of 2019 FEIR **Appendix E**.

- Damage to levees from wind fetch, increased wave action, and changes in flow patterns – please see **General Response A** and General Response E of 2019 FEIR **Appendix E**.
- Increased flood risks from levee damage and changes in flow patterns – please see **General Response A**, General Response E of 2019 FEIR **Appendix E,** and Impacts 3.1-2, 3.1-4, and 3.1-5 of the EIR.
- Impairment of water quality and reduced surface water availability – please see Section 3.2 *Water Quality (Surface and Groundwater)* of the EIR, as well as Impact 3.1-1 in Section 3.1 *Hydrology (Surface and Groundwater)* of the EIR with regard to agricultural water supply.
- Increased terrestrial and aquatic weeds leading to crop damage and damage to water diversions – please see **General Response F**.
- Endangered Species take jeopardy by listed species introduction/ enhancement of habitat – please see **General Response E**.
- Sound, dust, and traffic from construction and ongoing maintenance – please see Sections 3.7 *Air Quality*, 3.10 *Noise*, and 3.17 *Transportation and Traffic* of the 2019 FEIR.
- Damage to roads and levees along the travel route to the site from heavy equipment needed for construction and ongoing maintenance – please see Section 3.17 *Transportation and Traffic* of the 2019 FEIR, including Mitigation Measure 3.17-1.2.

LAND-16: Listed Fish Take Liability for Existing Water Diversions

Commenter states that if the Proposed Project is successful in improving conditions for listed fish species, these listed species may become more locally abundant. Commenter is concerned about future take issues at existing water diversions in the vicinity of the Proposed Project.

DWR Response

Please refer to **General Response E**.

LAND-17: Operable Gate for Adaptive Management

Commenter states that to mitigate for salinity intrusion and methylmercury production, as well as weeds, the Proposed Project needs to include functional adaptive management features, such as an operable gate to control the connection of the slough to the restoration. Commenter states that incoming water to the island is currently managed through a controlled gate, and to apply

adaptive management in any substantive sense, gates and/or other operable structures will be necessary. Commenter also requests input on the development of the adaptive management plan (AMMP) for the Proposed Project.

DWR Response

The EIR did not find any significant impacts relating to salinity intrusion (Impact 3.2-5) nor methylmercury production (Impact 3.2-8). Therefore, there is no need to mitigate for salinity or methylmercury under CEQA. Furthermore, implementation of an operable or controlled gate would be inconsistent with the overarching goal of the Fish Restoration Program (FRP), which, as stated in the FRP Implementation Strategy, is to create resilient, dynamic, and sustainable restoration projects, guided by eight overarching principles, including: 1) “Minimize the use of artificial, highly engineered systems and features to achieve restoration goals. Focus instead on restoration of historic physical, ecological, and biological processes to achieve desired results" and 2) “Minimize intervention and impacts caused by the restoration action.” FRP seeks to restore natural ecological functional processes and minimize active management, such as the use of operable gates. Operable gates are artificial, engineered features that would introduce new impacts, risks, and artificial selection pressures that would be in conflict with the FRP overarching guiding principles. The risks and impacts to listed fish from operable gates include mortality associated with stranding and dewatering, blocked migration, poor water quality conditions, increased predator habitat and enhanced predator success, and obstructing movement in and out of the restored habitat. For other floodplain and tidal habitat restoration projects planned in the Cache Slough area and Yolo Bypass, volitional passage for juvenile salmonids in and out of the restored habitat is a part of project objectives (pages 1-2 and 1-3 of the 2016 DEIR). In addition, recent communications with the NMFS indicate that the agency would grant lesser or possibly no acreage credit for the Proposed Project if operable gates are used in place of passive breaches. Thus, operable gates are contrary to the tidal habitat restoration project objectives.

For information on invasive plant management (i.e., weeds), please see **General Response F**.

With regards to the AMMP, please see **General Response H**.

Finally, weighing all information that has contributed to the EIR and comment responses, DWR considers that the Proposed Project will be successful in

practice, with substantial beneficial ecological functions and minimal other impacts.

Reclamation District 501 (RD 501 HBOCT / KSN)

Please note that comments on behalf of RD 501 were received in two parts: Hanson Bridgett LLP in October 2016 (HBOCT), and Kjeldsen Sinnock Neudeck Inc. Civil Engineers and Land Surveyors (KSN) in September 2016. Note that Hanson Bridgett LLP also provided an ENGEO Seepage Impact Analysis in September 2015, prior to the public release of the 2016 DEIR. This analysis is identified in **General Response D** and considered in General Response F of 2019 FEIR **Appendix E**.

RD501 HBOCT-1: Potential Groundwater Seepage Impacts

Commenter states that RD 501 has observed increased soil saturation and groundwater seepage on Ryer Island on every occasion when Prospect Island has been substantially inundated. Commenter also summarizes findings from an ENGEO Seepage Impact Analysis (2015), and is concerned that when sand lenses are included in the model, the model demonstrates that there is passage of water from Prospect Island to Ryer Island through the sand lenses, causing seepage. Commenter is also concerned that the 2016 DEIR does not refer to ENGEO (2015).

DWR Response

Please refer to **General Response A** and General Response F of 2019 FEIR **Appendix E**. Based upon the results of DWR studies, and considering the ENGEO Seepage Impact Analysis, the proposed restoration project is not expected to have any substantial seepage effects on Ryer Island, and no changes to the impact analysis or significance determination are recommended.

RD501 HBOCT-2: Potential Scour and Erosion Impacts

Commenter states that (1) DWR did not collect or analyze channel-bed grain-size data to support its conclusions that the potential for erosion of the toe of Miner Slough levees from channel bed scour is *less than significant*; (2) the 2016 DEIR fails to account for storm flows in its model calculations, which can create an additional ten feet of water in the system during high flood conditions and saturate levees protecting Ryer Island, making them vulnerable to erosion; and (3) the 2016 DEIR fails to examine the potential for scour effects caused by

changes in surface water flow related to changes in diversion and pumping practices on Prospect Island as a result of the habitat restoration. Commenter states that effects will be exacerbated by climate change and rising sea levels.

DWR Response

Please refer to **General Response A**, and to General Response E in 2019 FEIR **Appendix E** for information on erosion and scour. Please also refer to the response to LAND-11 above regarding pumping practices.

Regarding available grain size information, Impact 3.1-5 was updated in the 2019 Partial Recirculated DEIR to summarize the conclusions of approximately 24 bed sediment samples from Miner Slough (cited as Data Collection Summary [Appendix J in DWR 2013] within DWR 2014). Examination of the lithology of the channel bed (Figure 8-9 in DWR 2014) and soil texture results confirms the initial soil texture associations with scour velocity thresholds used in Impact 3.1-5 (i.e., the bed is composed of fine-grained materials).

Regarding climate change, please refer to General Response J of 2019 FEIR **Appendix E**.

RD501 HBOCT-3: Potential Wind-Wave Erosion

Commenter is concerned that the Proposed Project would expose Prospect Island's interior levees to larger, erosive waves, and that the wind-wave erosion model underestimates wind speeds during major storm events. Commenter states that the 2016 DEIR underestimates high river stages in the Delta during storm events by at least 10 ft. Commenter is also concerned that access to Prospect Island's interior by land-based equipment will become impossible, making rip-rap installation difficult.

DWR Response

Please refer to **General Response A**. Please also refer to General Response E of 2019 FEIR **Appendix E** with regards to wind-wave erosion impacts. Armoring is proposed on the exposed levee ends of the northern breach of the Proposed Project. Armor protection would also be used at the breach central to Prospect Island and the weir for Alternative 2. Terrestrial access along the Miner Slough levee would be retained to the first breach location, and the Proposed Project would not affect potential future waterside access along Miner Slough.

RD501 HBOCT-4: Water Temperature and Habitat

Commenter states that DWR failed to address impacts to Ryer Island irrigation pumping operations that could result from increased habitat for sensitive fish species. Commenter also states that the 2016 DEIR failed to discuss the potential creation of warm zones that could develop in shallow water habitat created on Prospect Island.

DWR Response

Regarding a potential increased abundance of listed fish species, please refer to **General Response E**.

Effects from potential changes to water temperature are evaluated in Impact 3.3-10. Temperatures within Prospect Island would be *beneficial* to the growth and survival of special-status fish upon implementation of the Proposed Project. The 2016 DEIR determined that the Proposed Project would not result in temperature changes within Prospect Island, Miner Slough, or the Cache Slough Complex that would cause adverse individual or population level effects on the survival of special-status fish species or their associated habitat. Additional information can be found in the temperature modeling report (Appendix E in WWR-SWS 2014).

RD501 HBOCT-5: New EIR Requested

Commenter states that DWR should issue a new EIR, develop mitigation measures, and allow further public comment.

DWR Response

DWR issued a 2019 Partial Recirculated DEIR, which included new mitigation measures relating to potential local road deterioration and air quality. DWR provided the public with a meaningful opportunity to comment on updated sections of the 2016 DEIR containing significant new information through the 2019 Partial Recirculated DEIR process. Responses to comments on the 2019 Partial Recirculated DEIR are provided in 2019 FEIR **Appendix E**. Please also refer to **General Response D**.

RD501 KSN-1: Potential Groundwater Seepage Impacts

Commenter disagrees with the conclusions reached in the 2016 DEIR, with no mitigation measures being included for seepage impacts on Ryer Island, for the reasons set forth in ENGEO's Seepage Impact Analysis.

DWR Response

Please refer to **General Response A**. Please refer to General Response F in 2019 FEIR **Appendix E**.

RD501 KSN-2: Mitigation Measures to Address Potential Wind-Wave Erosion

Commenter disagrees with the conclusions reached, with no mitigation measures being included, in the 2016 DEIR for potential wind-wave erosion on interior levee slopes of Prospect Island. Commenter states that the interior banks/slopes of flooded Delta Islands are highly susceptible to erosion due to never having had water against them or highly compacted soils.

DWR Response

Please refer to **General Response A**. Please also refer to General Response E of 2019 FEIR **Appendix E**.

RD501 KSN-3: Potential Scour-Related Impacts

Commenter disagrees with the conclusions reached, with no mitigation measures being included, in the 2016 DEIR for potential seepage on adjacent lands due to Miner Slough bed scour. Commenter states that any bed scour has a significant likelihood of intersecting and exposing interconnected sand lenses with areas within Ryer Island inside the levee system, thus increasing seepage from Miner Slough beneath the levees and onto Ryer Island.

DWR Response

Please refer to **General Response A.** For the reasons set out in Impact 3.1-6 of the EIR, potential bed scour impacts are *less than significant* without need for mitigation. Please also refer to General Response F of 2019 FEIR **Appendix E**.

RD501 KSN-4: Potential Long-term Salinity Effects

Commenter disagrees with the conclusions reached, with no mitigation measures being included, in the 2016 DEIR for long-term salinity effects in adjacent water bodies. Commenter states that any increase to the Delta tidal prism has the potential to increase salinity in the Delta Channels and that additional flooded islands will require greater releases of freshwater from upstream reservoirs during certain flow conditions.

DWR Response

Please refer to **General Response A**. Please also refer General Responses G and H in 2019 FEIR **Appendix E**.

RD501 KSN-5: Potential Long-term Effects in Water Temperature

Commenter disagrees with the conclusions reached, with no mitigation measures being included, in the 2016 DEIR for long-term effects on water temperature. Commenter states that shallow water habitat will result in warm zones throughout the proposed flooded Prospect Island, and that it is not true that the design of this Proposed Project will not result in water temperature differences.

DWR Response

Please refer to the response to HBOCT-12.

RD501 KSN-6: Potential Sediment Deposition and Erosion

Commenter disagrees the conclusions reached, with no mitigation measures being included, in the 2016 DEIR for the long-term effects on sediment deposition. Commenter states that wind-wave erosion on interior levee slopes and bed scour will create sediment suspension that will deposit somewhere in the vicinity of Prospect Island.

DWR Response

Please refer to **General Response A**. Please refer to General Response E of 2019 FEIR **Appendix E** with regards to wind-wave erosion, General Response F of 2019 FEIR **Appendix E** with regards to bed scour, and the response to CSLC-7 with regards to sediment erosion and deposition impacts.

RD501 KSN-7: Potential Groundwater Seepage Impacts

Commenter disagrees with the conclusions reached, with no mitigation measures being included, in the 2016 DEIR for the potential effects to agricultural uses on adjacent lands. Commenter states that seepage beneath Miner Slough to Ryer Island is shown on Figure 3.1-7, and the authors of the 2016 DEIR do not understand the true lithologic model of underlying formations as they relate to seepage.

DWR Response

Please refer to **General Response A**. Please also refer to General Response F of 2019 FEIR **Appendix E**.

RD501 KSN-8: ENGEO Seepage Impact Analysis

Commenter states that the 2016 DEIR does not reference the ENGEO Seepage Impact Analysis, which clearly shows the potential correlation between the observed seepage on Ryer Island and the proposed flooding of Prospect Island.

DWR Response

Please refer to **General Response A**. This analysis is identified in **General Response D** and considered in General Response F of 2019 FEIR **Appendix E**.

RD501 KSN-9: Intertidal Bench

Commenter states that the depiction of this intertidal bench needs to include the Base Flood Elevation (1% annual probability flood elevation), so that one can see how high the water can actually get in the system around Prospect Island, and the likelihood of severe erosion from wind whipped waves on the interior slopes of the Prospect Island during storm events. Commenter states that the likelihood of wind-waves on the Prospect Island interior levee slopes is a high certainty during storm events and that the absence of erosion protection in the form of quarry stone rip-rap on these slopes will result in breaching of the levee.

DWR Response

Mean High High Water (MHHW) is shown on the intertidal bench figure (Figure 2.2-7 of the EIR). Please see General Response E in 2019 FEIR **Appendix E** for a discussion of wind waves and erosion. The analysis in the EIR is focused on the difference between baseline conditions and the Proposed Project, rather than the difference between baseflow and flood flow. Since the 2016 DEIR, additional modeling has been made available as part of the 2019 Partial Recirculated DEIR. Please refer to RMA (2016) for a discussion of flood conditions (see **General Response C** for the availability of technical reports).

RD501 KSN-10: Regional Groundwater Flow Gradient

Commenter states that Section 3.1 *Hydrology (Surface and Groundwater)* correctly states that the regional groundwater flow gradient is from the west to

the east – toward the lower elevations of the central delta, which supports their findings in ENGEO's Seepage Impact Analysis Report.

DWR Response

DWR concurs that the groundwater level data reported in the 2016 DEIR indicates that the regional groundwater flow in the area of the Proposed Project site is generally from the west to the east. Please also refer to General Response F of 2019 FEIR **Appendix E**.

RD501 KSN-11: Regional Groundwater Flow Gradient

Commenter refers to ENGEO's Seepage Impact Analysis.

DWR Response

Please refer to **General Response A**. This analysis is identified in **General Response D** and considered in General Response F of 2019 FEIR **Appendix E**.

RD501 KSN-12: Copy of Comments to CVFPB

Commenter notes that a copy of their comments should be sent to the CVFPB.

DWR Response

Please refer to **General Response B**.

RD501 KSN-13: Potential Groundwater Seepage Impacts

Commenter states that the potential for seepage has been studied and reported in ENGEO's Seepage Impact Analysis Report. Commenter states that Tom Hester, Islands Inc. General Manager has years of empirical data characterizing seepage impacts on the farming operations proximal to Prospect Island. Commenter also states that they have observed the seepage phenomenon during multiple flood events.

DWR Response

Please refer to **General Response A**. This analysis is identified in **General Response D** and considered in General Response F of 2019 FEIR **Appendix E**.

RD501 KSN-14: Wind Speed and High River Stage

Commenter states that the Prospect Island model does not use high enough wind speeds, such as those experienced during major storms, nor do they take into account the high river stages in the Delta during storm events, which would translate to water 10 ft deeper than what was modeled.

DWR Response

Please refer to **General Response A**. Please also refer to the response to RD501 KSN-9, above.

RD501 KSN-15: Armoring to Prevent Levee Breaching

Commenter states that erosion protection must be placed preemptively along the inland slopes of Prospect Island to prevent further breaching of the levees along Miner Slough; placement of riprap during storm events is not always an option due to the conditions within the waterway.

DWR Response

Please refer to the responses to RD501 HBOCT-3 and RD501 KSN-9.

RD501 KSN-16: Potential Toe-scour and Erosion

Commenter states that the 2016 DEIR does not consider storm flows in the model calculations and should model for an additional 10 ft of water in the system during storm flows, and consider how this impacts RD 501's levee that is typically unsaturated.

DWR Response

Please refer to **General Response A**. Please also refer to the response to RD501 KSN-9, above.

RD501 KSN-17: Potential Scour-Related Seepage Impacts

Commenter states that Prospect and Ryer islands are located in an area of former freshwater marsh, traversed by numerous existing and former Delta distributary channels. The distributary channels were covered by man-made levees, leaving non-homogenous seepage pathways. Accordingly, the commenter considers that findings that scour of these historic dendritic channels

will not cause additional seepage onto Ryer Island is preposterous and unfounded.

DWR Response

Please refer to **General Response A**. Please also refer to General Response F of 2019 FEIR **Appendix E**.

Solano County Water Agency (SCWA)

SCWA-1: Potential Water Quality Impacts to North Bay Aqueduct Facilities

Commenter states that the 2016 DEIR understates the potential for water quality and endangered species (i.e., fish entrainment) impacts on the North Bay Aqueduct (NBA) drinking water supply. Commenter cites results from the 2015 Recirculated Bay Delta Conservation Project (BDCP) Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS), which states that habitat restoration projects will contribute to the already elevated levels of dissolved organic carbon (DOC) and other water quality constituents, and increase potential for Delta Smelt entrainment.

DWR Response

A description of potential water quality impacts due to exported productivity and DOC is provided in EIR Section 3.2 *Water Quality (Surface and Groundwater)*, Impact 3.2-7, as well as in Section 3.19.3 *[Summary of Cumulative Impacts, Water Quality] Dissolved Organic Carbon*. Particle transport modeling was used to simulate DOC export from Prospect Island (cited as Appendix G in WWR and SWS 2014 in the 2016 DEIR). Regional changes in primary productivity and DOC export were not explicitly modeled for the Recirculated BDCP RDEIR/SDEIS; however, modeling results for Prospect Island indicated that only a very small amount (0.9–1.6%) of the total simulated DOC generated by the Proposed Project would be transported to Barker Slough. Therefore, the DOC effects would not be individually significant or cumulatively considerable.

EIR Section 3.3 *Aquatic Biological Resources*, Impacts 3.3-2 and 3.3-10 also include analyses of effects upon local populations of endangered fish species. Because Barker Slough has historically supported habitat for endangered fish species such as Delta Smelt, implementation of the Proposed Project or Alternatives would not change the need for protective measures to reduce fish

entrainment (i.e., fish screens). Please refer to **General Response E** for further information on potential fish entrainment.

SCWA-2: Availability of Technical Water Quality Analyses

Commenter states that the analysis of long-term water quality impacts in the 2016 DEIR is inadequately supported. Comment states that SWS and WWR 2012 and WWR and SWS 2014 were not made available for review.

DWR Response

Please refer to the 2019 Partial Recirculated DEIR and **General Response C**.

SCWA-3: Cumulative Water Quality Impacts

SCWA does not accept the conclusion that the Proposed Project's incremental water quality impacts to the NBA would not be cumulatively significant. The Recirculated BDCP RDEIR/SDEIS concludes that tidal habitat restoration projects would increase, or at least have potential to increase, bromide, chloride, and organic carbon concentrations in the northwestern Delta, including the NBA intake at Barker Slough.

DWR Response

With regards to potential salinity impacts (bromide / chloride), please refer to **General Response A**, and see General Responses G and H in 2019 FEIR **Appendix E**. Please refer to SCWA-1 with regards to potential DOC impacts.

SCWA-4: Delta Reform Act

Commenter states that potential endangered species entrainment and water quality impacts mean that the Proposed Project is not consistent with the 2009 Delta Reform Act, California Water Action Plan, or Delta Stewardship Council's Delta Plan. The 2009 Delta Reform Act sets forth the goals of protecting, restoring and enhancing the Delta ecosystem, while simultaneously improving water supply reliability, and the associated policies are carried forward into the California Water Action Plan and Delta Plan. Commenter states that it is uncertain whether the Proposed Project would provide ecological benefits without adversely impacting NBA facilities.

DWR Response

DWR will file a Delta Plan Certification of Consistency with the Delta Stewardship Council for the Project (see the DSC responses in 2019 FEIR **Appendix E**). This is a separate certification process from CEQA compliance, thus is not part of this EIR. Please also see the response to SCWA-1 above.

Solano County (SOLC)

SOLC-1: Water Quality Enhancement for Beneficial Uses

Commenter states that while water quality for fish may be different than water quality for other purposes (e.g., agricultural, municipal), the Goals and Objectives section of the 2016 DEIR only references water quality enhancement for fish.

DWR Response

While the Proposed Project goals and objectives are stated in terms of broad tidal habitat restoration goals for fish, the 2016 DEIR also analyzed potential water quality changes to salinity (Impact 3.2-5 of the EIR) and dissolved organic carbon (DOC) (Impact 3.2-7 of the EIR) as they relate to *agricultural, municipal and industrial* beneficial uses. Please also refer to General Responses G and H in 2019 FEIR **Appendix E**.

SOLC-2: Impacts to Agricultural Landowners from Increasing Avian, Terrestrial Species, and Listed Fish Species

Commenter states that the impacts to agriculture from avian and terrestrial species, as well as impacts to agricultural water supply from increasing numbers of listed fish species, need to be addressed in the 2016 DEIR.

DWR Response

Please refer to **General Response E**.

SOLC-3: Potential Impacts of Dewatering, Dredging, and Soil Excavation

Commenter requests specification regarding impacts that may occur to other users of surface and groundwater supply as a result of dewatering, dredging and other soil excavation.

DWR Response

Because the hydrogeologic investigation has found no significant connectivity with groundwater conditions on adjacent lands, no potential construction related impacts to groundwater supplies and third-party wells are identified (see EIR Impact 3.1-10). Potential short-term construction-related water quality impacts to surface water, including dewatering, dredging, and other soil excavation activities are analyzed in Impact 3.2-1. Mitigation measures, which include a Dewatering Plan, Stormwater Pollution Prevention Plan (SWPPP), and a Spill Prevention, Control, and Response Plan, would reduce the potential impact to *less than significant*.

Note that DWR is considering moving forward with Alternative 2, which does not include dredging of the Miner Slough Spur Channel.

SOLC-4: Agricultural Impacts to Ryer Island

Commenter states that the 2016 DEIR did not address potential impacts to agriculture on Ryer Island, including water quality and water supply impacts, and increasing numbers of endangered species and other species that may impact agricultural operations.

DWR Response

Water quality impacts are described in Section 3.2 of the EIR, and no adverse impacts to local water quality of agricultural water supplies have been identified. Potential water supply impacts to Ryer Island agriculture are addressed in EIR Impact 3.1-9 and *no impact* has been found. Please refer to **General Response E** regarding potential impacts related to increased presence of Endangered Species Act listed species in the Proposed Project vicinity.

SOLC-5: Potential Groundwater Seepage Impacts

Commenter states that future impacts associated with the Proposed Project should be considered, including increased inundation acreage and/or longer periods of inundation in seepage areas within Prospect Island that may impact Ryer Island levees, and potential levee failure. Adaptive management practices should be applied.

DWR Response

For seepage impacts, please refer to **General Response A**, and also to General Response F of 2019 FEIR **Appendix E**. Regarding adaptive management, please see **General Response H**.

SOLC-6: Potential Effects of Unintended Levee Breaches and Scour

Commenter requests that DWR reexamines the effects of unintended levee breaches, scour, and other potential hydraulic redesign elements on adjacent lands and infrastructure that could be impacted.

DWR Response

Please refer to **General Response A** in relation to potential scour and erosion impacts. Please also refer to EIR Impacts 3.1-4 and 3.1-5, and General Response E of 2019 FEIR **Appendix E**.

SOLC-7: Potential Impacts to Highway 84

Commenter states that potential impacts to the levee (from seepage, scour or other potential impacts) would impact Highway 84 and the people who utilize it. Commenter therefore requests the following clarifications: (1) how transport of aggregate and fill via barge would occur and how roadways would not be used; (2) if there is appropriate depth and unloading facilities to allow for barge transport; (3) if unloading facilities need to be built; (4) and how much additional construction-related traffic would occur.

DWR Response

Please refer to **General Response A** and the 2019 Partial Recirculated DEIR which clarified the transportation impact analysis and included new information.

SOLC-8: Inclusion of a Deep Water Ship Channel (DWSC) Breach

Commenter states that DWR should consider a potential breach to the DWSC, to reunite Prospect Island with the Yolo Bypass, should the opportunity present itself in the future.

DWR Response

Comment noted. The reason that breaching the DWSC is not feasible at this time is discussed in Section 4.2.5 *Alternatives considered and rejected* of the EIR.

SOLC-9: Cumulative Impacts to Agricultural Lands

Commenter disagrees with the 2016 DEIR's conclusion that the Proposed Project would have no cumulative impact to land uses as described on page 3-369. Commenter states that the cumulative effects of habitat restoration projects in the region will be significant, relative to the ability of agriculture to remain economically viable and with respect to the ability of agriculture and habitat projects to co-exist. The environmental document should evaluate the cumulative impact of this Proposed Project with other habitat projects in the region relative to agriculture, water supply, water quality, other existing land uses and infrastructure.

DWR Response

DWR concurs that Delta restoration projects, and other land use activities, have the potential to result in a cumulatively significant loss of agricultural resources. However, as described on page 3-369 of the 2016 DEIR, the Proposed Project's contribution to that cumulative loss would be less than cumulatively considerable. The 2019 FEIR has been updated to reflect that only 6.8 ac of viable agricultural land that is not currently used for agriculture, and is not Prime, Unique, or Important Agricultural Land, would be replaced with habitat restoration. This would be only a very small portion of total local agricultural lands (<0.5%) (Impact 3.12-1). Please also refer to 2019 FEIR Section 3.19 *Cumulative Impacts* for further assessment of cumulative effects of the Proposed Project, as well as to **General Response G**.

SOLC-10: Federal Environmental Impact Statement (EIS)

Commenter states that DWR has failed to include the Federal EIS as a component of the Proposed Project.

DWR Response

A Section 408 Environmental Assessment has been submitted to the U.S. Army Corps of Engineers (USACE) pursuant to the National Environmental Policy Act (NEPA). While both CEQA and NEPA encourage joint federal/state documents, there is no requirement that they be combined.

U.S. Bureau of Reclamation (USBR)

USBR-1: Acronyms

Commenter requests that all acronyms are reintroduced in Section 3.

DWR Response

Please refer to **General Response B**. Suggested edits have been made to the 2019 FEIR, as appropriate.

USBR-2: Defining Tides and Tidal Prism

Commenter states that DWR can assume the reader knows what tides are and, therefore, a definition is not necessary. Commenter states that 'tidal prism' should be defined.

DWR Response

Tidal prism has been defined in the 2019 FEIR as the volume of water differential between mean low-tide and mean high-tide.

USBR-3: Consistency of Units and Numbers

Commenter states that there is a general lack of consistency in the 2016 DEIR and specifically requests that the 2016 DEIR be consistent regarding display of units, using a dash between numbers and units, and the display of numbers.

DWR Response

Please refer to **General Response B**. Suggested edits have been made to the 2019 FEIR, as appropriate.

USBR-4: Tide Ranges

Commenter requests that "Generally, tide range reductions varied under 1 inch up to 3 inches (Table 3.1-3)" be reworded.

DWR Response

Suggested edits have been made to the 2019 FEIR, as appropriate.

USBR-5: Channel Bed Characterization

Commenter states that in the section relating to bed scour (2016 DEIR page 3-29), the second sentence should have a reference to why it can be assumed the channel bed is mostly fine-grained materials.

DWR Response

Suggested edits have been made to the 2019 FEIR, as appropriate.

USBR-6: Stylistic Suggestion

Commenter requests that instead of using 'about' maybe use '≈' or 'approximately.'

DWR Response

Please refer to **General Response B**. The terminology change suggested would not affect the conclusions of the EIR.

USBR-7: Consistency Regarding 'Project' Reference

Commenter requests that the project be consistently referred to as 'Project'; currently it is listed as 'the Project' and 'Proposed Project' in other places.

DWR Response

The 2019 FEIR generally uses the term 'Proposed Project'. As stated above, in these responses to comments, the use of the term Proposed Project includes the other two "build" Alternatives unless a distinction is made with regard to Alternative 2.

USBR-8: Clarifications Regarding Delta Smelt and Chinook

Commenter requests that the 2016 DEIR properly introduce Delta Smelt and Chinook salmon by rewording the paragraph that starts "For Delta Smelt and Chinook" (2016 DEIR, page 3-78) to "Temperature sensitive fishes in the Delta (e.g., Delta Smelt, Chinook salmon, steelhead)". Commenter also requests clarification in the second part of the paragraph, as it is not clear that it is talking about Delta Smelt reproduction behavior, not Chinook, and a citation should be included.

DWR Response

Suggested edits have been made to the 2019 FEIR, as appropriate.

USBR-9: Consistency Regarding 'Project' Reference

Commenter states that in Section 3.3 *Aquatic Biological Resources* there needs to be consistency regarding the Project; in back-to-back sentences it changes between 'proposed project' and 'project'.

DWR Response

The 2019 FEIR generally uses the term 'Proposed Project'.

USBR-10: Central Valley Steelhead DPS

Commenter states that in Section 3.3.1 *[Aquatic Biological Resources] Setting*, the distinct population segment (DPS) name of the Central Valley steelhead should be included.

DWR Response

The opening text under the sub-heading *Fish resources* in Section 3.3.1 *[Aquatic Biological Resources] Setting* lists the species, not the DPS. The DPS is discussed under the sub-heading *Central Valley Steelhead*.

USBR-11: Fish Sampling Edits

Commenter requests deletion of the phrase "Although fish sampling does not regularly occur."

DWR Response

Suggested edits have been made to the 2019 FEIR, as appropriate.

USBR-12: Fish Sampling Edits

Commenter states that when describing fish sampling methods, the 2016 DEIR should stop pointing out the weaknesses and state the methods in a more confident way, such as, "Fish assemblage was sampled under different conditions to understand the species utilization under different conditions." Commenter requests that the fish species' latin names be included in-text, not just tables.

DWR Response

Suggested edits have been made to the 2019 FEIR, as appropriate. DWR considers that introduction of the latin names in tables is sufficient, and including the common name in-text helps with ease of reading.

USBR-13: Text Edits

Commenter requests that the fish descriptions be edited, including removal of all unnecessary 'fluff' in sentences, with citations added for bold statements. Commenter also requests that all fish have latin names upon first use, capitalization of common names be consistent, and words such as 'survey' are not capitalized unless it's in the name of the survey.

DWR Response

Suggested edits have been made to the 2019 FEIR, as appropriate.

USBR-14: Work Window

Commenter requests that the work window be described better, including as it relates to Delta Smelt, in Impact 3.3-3.

DWR Response

Suggested edits have been made to the 2019 FEIR, as appropriate.

USBR-15: Citation and Text Edits

Commenter requests citation of a fish rescue plan that has been approved for another, similar, project. Commenter also requests that a sentence relating to the example fish rescue plan be included.

DWR Response

The fish rescue and relocation effort will begin during the dewatering process. Although still in development, objectives of the fish rescue will likely be to:

- Remove fish from the areas being dewatered, with emphasis on minimizing adverse impacts on federally listed species and other native species;
- Handle fish in a manner that minimizes mortality; and

- Relocate captured fish to suitable wetted habitat nearby.

The fish rescue plan will be prepared in consultation with CDFW and will be reviewed by CDFW staff in accordance with their policies and procedures.

USBR-16: Giant Garter Snake (GGS) Survey Limitations

Commenter requests that a brief statement on how difficult it is to determine presence of GGS through surveys, because they are so elusive and rarely visible or trappable. Suitable habitat within the species range is often the only indicator of their presence; Eric Hansen and USFWS can be used for references.

DWR Response

The suitability of habitat for GGS is recognized in EIR Section 3.4.1 *[Wetland and Terrestrial Biological Resources] Setting*. Further explanation is provided in Impact 3.4-11.

Yocha Dehe Wintun Nation (YDWN)

YDWN-1: Yocha Dehe Wintun Nation Authority in the Project

Commenter states that the Proposed Project is within the aboriginal territories of the Yocha Dehe Wintun Nation, and therefore they have a cultural interest and authority in the Proposed Project area. The Yocha Dehe Wintun Nation is not aware of any known cultural resources near this project site and a Cultural Monitor is not needed; however, if any new information or cultural items are found, please contact Mr. James Sarmento.

DWR Response

DWR will contact the Yocha Dehe Wintun Nation if any new information or cultural items are located. Per the March 08, 2019 letter on the 2019 Partial Recirculated DEIR, DWR will contact Kristin Jensen.

b. Specific Responses to Individuals

Two individuals submitted comments on the 2016 DEIR, and one of them submitted two independent letters. Comment letters are presented in Attachment B to this Appendix. As noted in Section 1 *Introduction*, DWR identifies each comment letter with a unique identifier code. DWR's response to comments is provided below, following a summary of each comment.

Charles Chatfield (CC)

CC-2: Potential Impacts to Ryer Island Farming

Commenter states that the plan to flood Prospect Island will have a catastrophic effect on Ryer Island farming. Commenter invested in a tiling system to protect their vineyard from the high water table on the north side of Ryer Island and has invested over four million dollars to develop the vineyard. Commenter is concerned with that flooding of Prospect Island will affect the water table and cause salt-water intrusion. Commenter states that the State must be prepared to compensate the landowners affected, and perhaps purchase the land.

DWR Response

Please refer to **General Response A**. Please also refer to General Responses F, G, and H of 2019 FEIR **Appendix E**, as well as to **General Response D**.

Mia Brown for Chuck Chatfield (MSB)

MSB-1: Potential Groundwater Seepage Impacts

Commenter states that the 2016 DEIR does not acknowledge there is a likelihood that the Proposed Project will cause groundwater seepage impacts from Prospect Island to adjacent areas. Potential for groundwater seepage was identified in an Engineering Report performed by Kjeldsen, Sinnock & Neudeck, Inc. (KSN) in 2015. Generally, the commenter supports the comments submitted on behalf of RD 501.

DWR Response

Please refer to **General Response A**, and to General Response F of 2019 FEIR **Appendix E**.

Thomas Keeling for Lorraine Stringer (LS)

LS-1: Stringer Property Access

Commenter states that there are factual inaccuracies in the 2016 DEIR (Section 2.1.4) regarding access to the Stringer property. Mrs. Stringer owns legal access to her parcel by three separate routes, one of which is not currently usable.

DWR Response

DWR purchased the Stringer property on March 09, 2017, and plans to develop it as part of the Proposed Project. Therefore, access to the property is no longer an issue. The 2019 FEIR has been updated to remove assessments of potential impacts on the Stringers' and their property.

LS-2: PG&E Power Lines

Commenter states that the PG&E power lines are not abandoned as stated in the 2016 DEIR, but rather the State directed that the lines be shut off in 2007 and the power is still off.

DWR Response

Comment noted. References to the power lines being abandoned have been removed from the 2019 FEIR.

LS-3: Use Permit for Stringer Property

Commenter states that the Stringer property was given a Use Permit for a floating restaurant and boat, consistent with California Boating and Waterways (CBW) recreational use for the Delta.

DWR Response

Comment noted. Please refer to **General Response B**.

4 REFERENCES

Bennett, W. A. 2005. Critical assessment of the Delta Smelt population in the San Francisco Estuary, California. San Francisco Estuary and Watershed Science 3(2). DOI: https://doi.org/10.15447/sfews.2005v3iss2art1

CAL FIRE. 2007. Solano County Fire Hazard Severity Zone map. http://www.fire.ca.gov/fire_prevention/fhsz_maps_solano (Accessed: December 2016).

Calflora. 2019. Information on California plants for education, research and conservation. The Calflora Database (web application). Berkeley, California. https://www.calflora.org/ (Accessed: February 2019).

CDFW (California Department of Fish and Wildlife). 2019. Bay Delta Region: Surveys and Studies [20-mm Survey and Spring Kodiak Trawl Survey]. https://www.wildlife.ca.gov/Conservation/Delta (Accessed: July 2019).

California Native Plant Link Exchange. 2019. Information on California plants for education, research and conservation. The CNPLX Database (web application). Version 2.62. Berkeley, California. http://www.cnplx.info/index.html (Accessed: February 2019).

CNPS (California Native Plant Society). 2019. Inventory of Rare and Endangered Plants of California. Rare Plants Database (web application). Version v8-03 0.39. California Native Plant Society, Rare Plant Program. Sacramento, CA. http://www.rareplants.cnps.org (Accessed: February 2019).

Christophel, D., G. Lawley, and L. Winternitz. 1999. Prospect Island fish sampling results--some thoughts on shallow water habitat restoration. IEP Newsletter 12(1).

Dege, M., and L. R. Brown. 2004. Effect of outflow on spring and summertime distribution and abundance of larval and juvenile fishes in the upper San Francisco Estuary. American Fisheries Society Symposium 39: 49-65.

DWR. 2014. Site Characterization and Groundwater Monitoring Data Analysis Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, CA. Memorandum Report. DWR, North Central Region Office.

DWR 2018. Prospect and Ryer Island Hydrologic Data Analysis, October 1, 2013 to April 1, 2017, Prospect Island Tidal Habitat Restoration Project, Solano County, CA. Memorandum Report. DWR, North Central Region Office, CA.

DWR 2019. Agriculture and Land Stewardship Framework. Website. https://water.ca.gov/Programs/California-Water-Plan/Water-Resource-Management-Strategies/Agriculture-and-Land-Stewardship-Framework (Accessed: August 2019).

DWR and CDFW. 2013. Prospect Island Tidal Habitat Restoration Project Communications and Engagement Plan. Fish Restoration Program Agreement. North Central Region, San Francisco, CA. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects/Files/Prospect-Island-Communications--Engagement-Plan.pdf?la=en&hash=EE638C398AE1D157047D4EFC4E3C102DD69AD056 (Accessed: July 2019).

ENGEO. 2015. Seepage Impact Analysis, Reclamation District 501, Prospect and Ryer Islands, Solano County, California. ENGEO Incorporated, Ripon, CA.

Feyrer, F., M. L. Nobriga, T. R. Sommer. 2007. Multi-decadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA. Canadian Journal of Fisheries and Aquatic Sciences 64: 723-734. DOI: https://doi.org/10.1139/f07-048

Hartman R., Brown L., and Hobbs J. 2017. Food Web Conceptual Model. In S. Sherman, R. Hartman, & D Contreras (Eds.), *Effects of Tidal Wetland Restoration on Fish: A Suite of Conceptual Models* (pp. 143-180). Department of Water Resources, Sacramento, CA: IEP Technical Report 91.

Hobbs, J. A., W.A. Bennett, and J. Burton. 2006. Assessing nursery habitat quality for native smelts (Osmeridae) in the low-salinity zone of the San Francisco Estuary. Journal of Fish Biology 69: 907-922. DOI: https://doi.org/10.1111/j.1095-8649.2006.01176.x

Horne, A.J., and Goldman, C.R. 1994. Limnology. McGraw-Hill biological science series. Minnesota.

Hussey, B. H., and W. E. Odum. 1992. Evapotranspiration in tidal marshes. Estuaries 15: 59-67. DOI: https://doi.org/10.2307/1352710

IEP TWM PWT (Interagency Ecological Program Tidal Wetlands Monitoring Project Work Team). 2017a. Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary Volume I: Monitoring Plan Guidance. Version 1.0.

IEP TWM PWT. 2017b. Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary Volume II: Standard Operating Procedures. Version 1.0.

Jepson Online Interchange. 2019. Information on California plants for education, research and conservation. Jepson Flora Project, University of California, Berkeley. http://ucjeps.berkeley.edu/eflora/ (Accessed: February 2019).

Junk, W. J., P. B. Bayley, and R. E. Sparks. 1989. The flood pulse concept in river-floodplain systems. *In* D. P. Dodge, editor. Proceedings of the international large river symposium. Canadian Special Publication of Fisheries and Aquatic Science 106: 110-127.

Kinnetic Laboratories, Inc. 2016a. Sediment Testing Results for Prospect Island. Letter to Joseph Heavin, Hultgren-Tillis Engineers. Prepared by Kinnetic Laboratories, Inc., Santa Cruz, CA.

Kinnetic Laboratories, Inc. 2016b. Evaluation of Miner Slough Spur Channel Dredge Material, Prospect Island Tidal Habitat Restoration Project. Sampling and Analysis Report. Contract No. C51464. Kinnetic Laboratories, Inc., Santa Cruz, CA.

Lott, J. 1998. Feeding Habits of Juvenile and Adult Delta Smelt from the Sacramento-San Joaquin River Estuary. Interagency Ecological Program Newsletter 11(1): 14-19.

Lundvall, D., R. Svanback, L. Persson, and P. Bystrom. 1999. Size-dependent predation in piscivores: interactions between predator foraging and prey avoidance abilities. Canadian Journal of Fisheries and Aquatic Sciences 56: 1,285-1,292. DOI: https://doi.org/10.1139/cjfas-56-7-1285

Merz, J. E., S. Hamilton, P. S. Bergman, and B. Cavallo. 2011. Spatial perspective for Delta Smelt: a summary of contemporary survey data. California Fish and Game 97: 164–189.

Morgan-King, T. L., and D. H. Schoellhamer. 2013. Suspended-sediment flux and retention in a backwater tidal slough complex near the landward boundary of an estuary. Estuaries and Coasts 36: 300–318. DOI: https://doi.org/10.1007/s12237-012-9574-z

Moyle, P. B., and J. A. Israel. 2005. Untested assumptions. Fisheries 30: 20–28. DOI: https://doi.org/10.1577/1548-8446(2005)30[20:UA]2.0.CO;2

Moyle, P. B., P. K. Crain, and K. Whitener. 2007. Patterns in the use of a restored California floodplain by native and alien fishes. San Francisco Estuary and Watershed Science 5(3). DOI: https://doi.org/10.15447/sfews.2007v5iss3art1

Müller-Solger, A.B., A.D. Jassby, and D.C. Müller-Navarra. 2002. Nutritional quality of food resources for zooplankton (Daphnia) in a tidal freshwater system (Sacramento–San Joaquin River Delta). Limnology and Oceanography 47: 1468–1476.

NMFS (National Marine Fisheries Service). 2009. Biological opinion and conference opinion on the long-term operations of the Central Valley Project and the State Water Project. Prepared for U.S. Bureau of Reclamation. National Marine Fisheries Service, Southwest Region, Long Beach, California.

NMFS. 2014. Recovery Plan for the Evolutionary Significant Units of Sacramento Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. Prepared by NMFS, California Central Valley Area Office, Sacramento, California. July.

Nobriga, M. L. 2002. Larval delta smelt diet composition and feeding incidence: environmental and ontogenetic influences. California Fish and Game 88: 149-164.

Nobriga, M. L., Z. Matica, and Z. P. Hymanson. 2004. Evaluating entrainment vulnerability to agricultural irrigation diversions: a comparison among open-water fishes. American Fisheries Society Symposium 39: 281-295.

Nobriga, M. L., Feyrer, F, Baxter, RD, Chotkowski, M. 2005. Fish community ecology in an altered river delta: spatial patterns in species composition, life history strategies and biomass. Estuaries 28: 776-785. DOI: https://doi.org/10.1007/BF02732915

Nobriga, M. L., and F. Feyrer. 2007. Shallow-water piscivore-prey dynamics in California's Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science: 5(2). DOI: https://doi.org/10.15447/sfews.2007v5iss2art4

RMA (Resource Management Associates, Inc.). 2016. Prospect Island Tidal Habitat Restoration Project, Hydrodynamic Modeling Analysis for 100-year and 200-year Flood Events. Technical Memorandum. Contract No. 4200009291. RMA, Davis, CA.

RMA. 2018. Prospect Island Tidal Restoration Project, Modeling Evaluation for Alternative 2 Flow and Salinity Changes. Technical Memorandum. Contract No. 4200009291. RMA, Davis, CA.

Sherman, S., R. Hartman, and D. Contreras. 2017. Effects of tidal wetland restoration on fish: A suite of conceptual models. IEP Technical Report 91. Department of Water Resources, Sacramento, California.

Sommer, T., B. Harrell, M. Nobriga, R. Brown, P. Moyle, W. Kimmerer, and L. Schemel. 2001a. California's Yolo Bypass: evidence that flood control can be compatible with fisheries, wetlands, wildlife, and agriculture. Fisheries 26: 6-16. DOI: https://doi.org/10.1577/1548-8446(2001)026<0006:CYB>2.0.CO;2

Sommer, T., M. L. Nobriga, B. Harrell, W. Batham, and W. J. Kimmerer. 2001b. Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58: 325-333. DOI: https://doi.org/10.1139/cjfas-58-2-325

Sommer, T., W. C. Harrell., A. Mueller-Solger., B. Tom., W. Kimmerer. 2004. Effects of flow variation on channel and floodplain biota and habitats of the Sacramento River, California, USA. *Aquatic Conservation: Marine and Freshwater Ecosystems* 14: 247-261. DOI: https://doi.org/10.1002/aqc.620

Sommer, TR., W. C. Harrell., and M. L. Nobriga. 2005. Habitat Use and Stranding Risk of Juvenile Chinook Salmon on a Seasonal Floodplain. *North American Journal of Fisheries Management* 25: 1493-1504. DOI: https://doi.org/10.1577/M04-208.1

Sommer, T., F. H. Mejia, M. L. Nobriga, F. Feyrer, and L. Grimaldo. 2011. The spawning migration of Delta Smelt in the upper San Francisco Estuary. San

Francisco Estuary & Watershed Science 9(2): 1-16. DOI: https://doi.org/10.15447/sfews.2011v9iss2art2

Sommer, T., and F. Mejia. 2013. A place to call home: a synthesis of delta smelt habitat in the upper San Francisco Estuary. San Francisco Estuary and Watershed Science 11: 1-25. DOI: http://www.escholarship.org/uc/item/32c8t244

SWRCB (State Water Resources Control Board). 2000. Revised Water Right Decision 1641. December 29, 1999. Revised March 15, 2000. http://www.waterboards.ca.gov/waterrights/board_decisions/adopted_orders/decisions/d1600_d1649.shtml (Accessed: July 2019).

SWS and WWR (Stillwater Sciences and Wetlands & Water Resources). 2012. Prospect Island Tidal Restoration: Synthesis of Phase 1 Screening-Level Modeling Evaluation of Conceptual Restoration Alternatives. Final Report. Prepared by Stillwater Sciences, Davis, CA, and Wetlands & Water Resources, Inc., San Rafael, CA, with assistance from Resource Management Associates, Fairfield, CA, and cbec eco-engineering, West Sacramento, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

WWR and SWS. 2014. Phase 2 Modeling Synthesis Report, Prospect Island Tidal Habitat Restoration Project. Final Report. Prepared by Wetlands and Water Resources, Inc., San Rafael, CA and Stillwater Sciences, Davis, CA, with assistance from Resource Management Associates, Fairfield, CA and Delta Modeling Associates, San Francisco, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

USFWS (U.S. Fish and Wildlife Service). 2008. Formal Endangered Species Act consultation on the proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP). Biological opinion. Prepared by USFWS, California and Nevada Region, Sacramento, California for U.S. Bureau of Reclamation, Central Valley Operations Office, Sacramento.

Vogel, D. 2011. Insights into the problems, progress, and potential solutions for Sacramento River Basin native anadromous fish restoration. Prepared for Northern California Water Association and Sacramento Valley Water Users by Natural Resource Scientists, Inc.

Wright, S. A., and D. H. Schoellhamer. 2005. Estimating sediment budgets at the interface between rivers and estuaries with application to the Sacramento-San Joaquin River Delta. Water Resources Research 41. DOI: https://doi.org/10.1029/2004WR003753

WWR and SWS. 2014. Phase 2 modeling synthesis report. Prospect Island Tidal Habitat Restoration Project. Final report, Contract No. 4200009291. Prepared by Wetlands and Water Resources, Inc., San Rafael and Stillwater Sciences, Davis, with assistance from Resource Management Associates, Fairfield, and Delta Modeling Associates, San Francisco, California for California Department of Water Resources, West Sacramento, California.

Attachment 1

Governor's Office of Planning and Research, State Clearinghouse and Planning Unit, DEIR Circulation (including agency comment letters received)

STATE OF CALIFORNIA

GOVERNOR'S OFFICE *of* PLANNING AND RESEARCH

STATE CLEARINGHOUSE AND PLANNING UNIT

EDMUND G. BROWN JR.
GOVERNOR

KEN ALEX
DIRECTOR

October 11, 2016

Dan Riordan
California Department of Water Resources
3500 Industrial Blvd
Sacramento, CA 95691

Subject: Prospect Island Tidal Habitat Restoration Project
SCH#: 2013052056

Dear Dan Riordan:

The State Clearinghouse submitted the above named Draft EIR to selected state agencies for review. On the enclosed Document Details Report please note that the Clearinghouse has listed the state agencies that reviewed your document. The review period closed on October 10, 2016, and the comments from the responding agency (ies) is (are) enclosed. If this comment package is not in order, please notify the State Clearinghouse immediately. Please refer to the project's ten-digit State Clearinghouse number in future correspondence so that we may respond promptly.

Please note that Section 21104(c) of the California Public Resources Code states that:

> "A responsible or other public agency shall only make substantive comments regarding those activities involved in a project which are within an area of expertise of the agency or which are required to be carried out or approved by the agency. Those comments shall be supported by specific documentation."

These comments are forwarded for use in preparing your final environmental document. Should you need more information or clarification of the enclosed comments, we recommend that you contact the commenting agency directly.

This letter acknowledges that you have complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act. Please contact the State Clearinghouse at (916) 445-0613 if you have any questions regarding the environmental review process.

Sincerely,

Scott Morgan
Director, State Clearinghouse

Enclosures
cc: Resources Agency

Document Details Report
State Clearinghouse Data Base

SCH# 2013052056
Project Title Prospect Island Tidal Habitat Restoration Project
Lead Agency Water Resources, Department of

Type EIR Draft EIR

Description The project proposes to restore tidal action to 1,528 acres on the currently flooded Prospect Island in the Sacramento River Delta to improve productivity for Delta smelt and salmonid species. Project activities would include clearing and invasive species control; excavation of tidal slough channels; removal of a portion of an internal cross levee; placement of excavated soils into remnant agricultural ditches and newly constructed berms and benches; dredging of the spur channel between Miner Slough and the southern portion of the site; limited planting and revegetation; and excavation of two levee breaches to establish tidal connectivity with Miner Slough.

Lead Agency Contact

Name Dan Riordan
Agency California Department of Water Resources
Phone 916 376 9738 **Fax**
email
Address 3500 Industrial Blvd
City Sacramento **State** CA **Zip** 95691

Project Location

County Sacramento
City Rio Vista
Region
Lat / Long 38° 15' 12.3" N / 121° 39' 24.9" W
Cross Streets
Parcel No. various
Township 5N **Range** 3E **Section** **Base**

Proximity to:

Highways 84
Airports
Railways
Waterways Miner Slough, Cache Slough, Sacramento DWSC
Schools
Land Use Open space/Miscellaneous

Project Issues Other Issues; Agricultural Land; Biological Resources; Geologic/Seismic; Soil Erosion/Compaction/Grading; Forest Land/Fire Hazard; Water Quality; Recreation/Parks; Aesthetic/Visual; Landuse; Minerals; Noise; Public Services; Population/Housing Balance; Traffic/Circulation; Air Quality; Archaeologic-Historic; Flood Plain/Flooding; Toxic/Hazardous; Vegetation; Wetland/Riparian; Cumulative Effects

Reviewing Agencies Resources Agency; Department of Boating and Waterways; Department of Fish and Wildlife, Region 3; Delta Protection Commission; Department of Parks and Recreation; Central Valley Flood Protection Board; Office of Emergency Services, California; California Highway Patrol; Caltrans, District 4; Native American Heritage Commission; State Lands Commission; Regional Water Quality Control Bd., Region 5 (Sacramento)

Date Received 08/25/2016 **Start of Review** 08/25/2016 **End of Review** 10/10/2016

Note: Blanks in data fields result from insufficient information provided by lead agency.

Central Valley Regional Water Quality Control Board

clear 10/7/16 E

30 September 2016

Governor's Office of Planning & Research
OCT 03 2016
STATE CLEARINGHOUSE

Dan Riordan
Department of Water Resources
3500 Industrial Boulevard
West Sacramento, CA 95691

CERTIFIED MAIL
91 7199 9991 7035 8362 8783

COMMENTS TO REQUEST FOR REVIEW FOR THE DRAFT ENVIRONMENTAL IMPACT REPORT, PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT, SCH# 2013052056, SOLANO COUNTY

Pursuant to the State Clearinghouse's 25 August 2016 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Request for Review for the Draft Environment Impact Report* for the Prospect Island Tidal Habitat Restoration Project, located in Solano County.

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues.

I. Regulatory Setting

Basin Plan

The Central Valley Water Board is required to formulate and adopt Basin Plans for all areas within the Central Valley region under Section 13240 of the Porter-Cologne Water Quality Control Act. Each Basin Plan must contain water quality objectives to ensure the reasonable protection of beneficial uses, as well as a program of implementation for achieving water quality objectives with the Basin Plans. Federal regulations require each state to adopt water quality standards to protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. In California, the beneficial uses, water quality objectives, and the Antidegradation Policy are the State's water quality standards. Water quality standards are also contained in the National Toxics Rule, 40 CFR Section 131.36, and the California Toxics Rule, 40 CFR Section 131.38.

The Basin Plan is subject to modification as necessary, considering applicable laws, policies, technologies, water quality conditions and priorities. The original Basin Plans were adopted in 1975, and have been updated and revised periodically as required, using Basin Plan amendments. Once the Central Valley Water Board has adopted a Basin Plan amendment in noticed public hearings, it must be approved by the State Water Resources Control Board (State Water Board), Office of Administrative Law (OAL) and in some cases,

the United States Environmental Protection Agency (USEPA). Basin Plan amendments only become effective after they have been approved by the OAL and in some cases, the USEPA. Every three (3) years, a review of the Basin Plan is completed that assesses the appropriateness of existing standards and evaluates and prioritizes Basin Planning issues.

For more information on the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins*, please visit our website:
http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/.

Antidegradation Considerations

All wastewater discharges must comply with the Antidegradation Policy (State Water Board Resolution 68-16) and the Antidegradation Implementation Policy contained in the Basin Plan. The Antidegradation Policy is available on page IV-15.01 at:
http://www.waterboards.ca.gov/centralvalleywater_issues/basin_plans/sacsjr.pdf

In part it states:

> *Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.*
>
> *This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives.*

The antidegradation analysis is a mandatory element in the National Pollutant Discharge Elimination System and land discharge Waste Discharge Requirements (WDRs) permitting processes. The environmental review document should evaluate potential impacts to both surface and groundwater quality.

II. Permitting Requirements

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit), Construction General Permit Order No. 2009-009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan

(SWPPP).

For more information on the Construction General Permit, visit the State Water Resources Control Board website at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml.

Phase I and II Municipal Separate Storm Sewer System (MS4) Permits[1]

The Phase I and II MS4 permits require the Permittees reduce pollutants and runoff flows from new development and redevelopment using Best Management Practices (BMPs) to the maximum extent practicable (MEP). MS4 Permittees have their own development standards, also known as Low Impact Development (LID)/post-construction standards that include a hydromodification component. The MS4 permits also require specific design concepts for LID/post-construction BMPs in the early stages of a project during the entitlement and CEQA process and the development plan review process.

For more information on which Phase I MS4 Permit this project applies to, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/municipal_permits/.

For more information on the Phase II MS4 permit and who it applies to, visit the State Water Resources Control Board at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/phase_ii_municipal.shtml

Industrial Storm Water General Permit

Storm water discharges associated with industrial sites must comply with the regulations contained in the Industrial Storm Water General Permit Order No. 2014-0057-DWQ.

For more information on the Industrial Storm Water General Permit, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/industrial_general_permits/index.shtml.

Clean Water Act Section 404 Permit

If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed from the United States Army Corps of Engineers (USACOE). If a Section 404 permit is required by the USACOE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water

[1] Municipal Permits = The Phase I Municipal Separate Storm Water System (MS4) Permit covers medium sized Municipalities (serving between 100,000 and 250,000 people) and large sized municipalities (serving over 250,000 people). The Phase II MS4 provides coverage for small municipalities, including non-traditional Small MS4s, which include military bases, public campuses, prisons and hospitals.

drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements.

If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACOE at (916) 557-5250.

Clean Water Act Section 401 Permit – Water Quality Certification

If an USACOE permit (e.g., Non-Reporting Nationwide Permit, Nationwide Permit, Letter of Permission, Individual Permit, Regional General Permit, Programmatic General Permit), or any other federal permit (e.g., Section 10 of the Rivers and Harbors Act or Section 9 from the United States Coast Guard), is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications.

Waste Discharge Requirements – Discharges to Waters of the State

If USACOE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project may require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation.

For more information on the Water Quality Certification and WDR processes, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/help/business_help/permit2.shtml.

Dewatering Permit

If the proposed project includes construction or groundwater dewatering to be discharged to land, the proponent may apply for coverage under State Water Board General Water Quality Order (Low Risk General Order) 2003-0003 or the Central Valley Water Board's Waiver of Report of Waste Discharge and Waste Discharge Requirements (Low Risk Waiver) R5-2013-0145. Small temporary construction dewatering projects are projects that discharge groundwater to land from excavation activities or dewatering of underground utility vaults. Dischargers seeking coverage under the General Order or Waiver must file a Notice of Intent with the Central Valley Water Board prior to beginning discharge.

For more information regarding the Low Risk General Order and the application process, visit the Central Valley Water Board website at:

http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2003/wqo/wqo2003-0003.pdf

For more information regarding the Low Risk Waiver and the application process, visit the Central Valley Water Board website at:

http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/waivers/r5-2013-0145_res.pdf

Regulatory Compliance for Commercially Irrigated Agriculture

If the property will be used for commercial irrigated agricultural, the discharger will be required to obtain regulatory coverage under the Irrigated Lands Regulatory Program. There are two options to comply:

1. **Obtain Coverage Under a Coalition Group.** Join the local Coalition Group that supports land owners with the implementation of the Irrigated Lands Regulatory Program. The Coalition Group conducts water quality monitoring and reporting to the Central Valley Water Board on behalf of its growers. The Coalition Groups charge an annual membership fee, which varies by Coalition Group. To find the Coalition Group in your area, visit the Central Valley Water Board's website at: http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/app_approval/index.shtml; or contact water board staff at (916) 464-4611 or via email at IrrLands@waterboards.ca.gov.

2. **Obtain Coverage Under the General Waste Discharge Requirements for Individual Growers, General Order R5-2013-0100.** Dischargers not participating in a third-party group (Coalition) are regulated individually. Depending on the specific site conditions, growers may be required to monitor runoff from their property, install monitoring wells, and submit a notice of intent, farm plan, and other action plans regarding their actions to comply with their General Order. Yearly costs would include State administrative fees (for example, annual fees for farm sizes from 10-100 acres are currently $1,084 + $6.70/Acre); the cost to prepare annual monitoring reports; and water quality monitoring costs. To enroll as an Individual Discharger under the Irrigated Lands Regulatory Program, call the Central Valley Water Board phone line at (916) 464-4611 or e-mail board staff at IrrLands@waterboards.ca.gov.

Low or Limited Threat General NPDES Permit

If the proposed project includes construction dewatering and it is necessary to discharge the groundwater to waters of the United States, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. Dewatering discharges are typically considered a low or limited threat to water quality and may be covered under the General Order for *Dewatering and Other Low Threat Discharges to Surface Waters* (Low Threat General Order) or the General Order for *Limited Threat Discharges of Treated/Untreated Groundwater from Cleanup Sites, Wastewater from Superchlorination Projects, and Other Limited Threat Wastewaters to Surface Water* (Limited Threat General Order). A complete application must be submitted to the Central Valley Water Board to obtain coverage under these General NPDES permits.

For more information regarding the Low Threat General Order and the application process, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2013-0074.pdf

For more information regarding the Limited Threat General Order and the application process, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2013-0073.pdf

NPDES Permit

If the proposed project discharges waste that could affect the quality of the waters of the State, other than into a community sewer system, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. A complete Report of Waste Discharge must be submitted with the Central Valley Water Board to obtain a NPDES Permit.

For more information regarding the NPDES Permit and the application process, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/help/business_help/permit3.shtml

If you have questions regarding these comments, please contact me at (916) 464-4644 or Stephanie.Tadlock@waterboards.ca.gov.

Stephanie Tadlock

Stephanie Tadlock
Environmental Scientist

cc: State Clearinghouse unit, Governor's Office of Planning and Research, Sacramento

CALIFORNIA STATE LANDS COMMISSION
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Sacramento, CA 95825-8202

JENNIFER LUCCHESI, *Executive Officer*
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Established in 1938

October 5, 2016

File Ref: SCH #2013052056

Dan Riordan
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

Governor's Office of Planning & Research
OCT 05 2016
STATE CLEARINGHOUSE

Subject: Draft Environmental Impact Report (EIR) for Prospect Island Tidal Habitat Restoration Project (Project) in the Sacramento-San Joaquin Delta, Solano County

Dear Mr. Riordan:

The California State Lands Commission (CSLC) staff has reviewed the Draft EIR prepared by the Department of Water Resources (DWR) for the subject Project. The DWR, as a public agency carrying out the Project, is the lead agency under the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.). The CSLC is a trustee agency because of its trust responsibility for projects that could directly or indirectly affect sovereign lands, their accompanying Public Trust resources or uses, and the public easement in navigable waters. Additionally, because the Project involves work on sovereign lands, the CSLC will act as a responsible agency.

CSLC Jurisdiction and Public Trust Lands

The CSLC has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways. The CSLC also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions (Pub. Resources Code, §§ 6009, subd. (c), 6301, 6306). All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the protections of the common law Public Trust.

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable lakes and waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all people of the State for statewide Public Trust purposes, which include but are not limited to waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation, and open space. On tidal waterways, the State's sovereign fee ownership extends landward to the mean high tide line, except for areas of fill or artificial accretion

or where the boundary has been fixed by agreement or a court. On navigable non-tidal waterways, including lakes, the State holds fee ownership of the bed of the waterway landward to the ordinary low water mark and a Public Trust easement landward to the ordinary high water mark, except where the boundary has been fixed by agreement or a court. Such boundaries may not be readily apparent from present day site inspections.

The CSLC has not yet made a full boundary investigation of the Project Area. However, after reviewing the information contained in the Draft EIR, CSLC staff has made a preliminary determination that the portion of the Project in Miner Slough will be located on State-owned sovereign land under the jurisdiction of the CSLC. Because a lease or other agreement with the CSLC will be required for DWR to implement the Project on sovereign land, please contact Wendy Hall (see contact information below) for further information about the extent of the CSLC's sovereign ownership and further coordination on leasing and other contractual and jurisdictional requirements.

Please also be advised that the waterways involved in the Project area are subject to a public navigational easement. This easement provides that the public has the right to navigate and exercise the incidences of navigation in a lawful manner on State waters that are capable of being physically navigated by oar or motor-propelled small craft. Such uses may include, but are not limited to, boating, rafting, sailing, rowing, fishing, fowling, bathing, skiing, and other water-related public uses. The activities completed under the Project must not restrict or impede the easement right of the public.

These comments are made without prejudice to any future assertion of State ownership or public rights, should circumstances change, or should additional information become available. This letter is not intended, nor should it be construed as a waiver or limitation of any right, title, or interest of the State of California in any lands under its jurisdiction.

Project Description

The overarching goal of the Project is to restore tidal action to the interior of Prospect Island as illustrated in Figure 2.2-1 of the Draft EIR. The following objectives are intended to meet tidal and biological restoration requirements pursuant to Biological Opinions from the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service:

- Enhance primary and secondary productivity and food availability for native fishes within Prospect Island and surrounding Delta waterways;
- Increase the quantity and quality of salmonid rearing habitat within and in the areas surrounding Prospect Island;
- Increase the amount and quality of habitats to support other listed species, to the extent they can be supported by site conditions and natural processes;
- Provide other ecosystem benefits associated with increased Delta freshwater tidal marsh habitat, including water quality enhancement, recreation, and carbon sequestration; and
- To the greatest extent practical, promote habitat resiliency to changes in future Delta conditions, such as land use conversions, climate change, sea-level rise, and invasive species.

Under the proposed Project, the Miner Slough levee would be breached in two locations: adjacent to the north property and adjacent to the south property as explained in Subsection 2.2.3 and illustrated in Figures 2.2-2 and 2.2-3 of the Draft EIR. A portion of the internal cross levee separating the north and south properties would also be removed. Once these breaches are completed, the north and south properties would be subject to daily tidal inundation. The Project would include the following actions:

- Invasive species control with herbicide application;
- Old infrastructure and debris removal;
- Excavation of tidal slough channels and placement of excavated soils into the Prospect Island site interior;
- Removal of a portion of the internal cross levee separating the north and south properties;
- Excavation of two levee breaches to Miner Slough; and
- Dredging of the spur channel between Miner Slough and the south property.

Two build alternatives and a No Project Alternative were selected to be analyzed in the Draft EIR. Alternative Two would include two breaches in the Miner Slough levee, and under Alternative Three, three breaches would be created on the Miner Slough levee as illustrated in Figures 4.5-1 and 4.6-1.

Environmental Review

For CSLC's jurisdictional area of the Project as explained above, Project activities include excavation of the breached levee locations and dredging of the spur channel between Miner Slough and the south property. CSLC staff requests that the following information and potential impacts be analyzed in the Draft EIR.

Biological Resources

1. The Project Description explains that use of barges are proposed for dredging activities. One of the major stressors in California waterways is introduced species. For example, construction boats and barges brought in from stays at distant projects may transport new species to the Project area via hull biofouling, wherein marine and aquatic organisms attach to and accumulate on the hull and other submerged parts of a vessel. Possible mitigation could include contracting vessels and barges from nearby, or requiring a certain degree of hull-cleaning from contractors. The CDFW's Invasive Species Program could assist with this analysis as well as with the development of appropriate mitigation (information at http://www.dfg.ca.gov/invasives/). Please update the Biological Resources section to disclose the above information with regard to proposed use of barges.

   In addition, in light of the recent decline of native pelagic organisms and in order to protect at-risk fish species, the Draft EIR should examine if any elements of the Project would favor non-native fisheries within the Sacramento-San Joaquin River Delta.

Hydrology/Water Quality

2. Levee Maintenance: The Hydrology section indicates that interior and exterior sections of the Miner Slough levee in the Project area could be subjected to long-term increased erosion potential due to changes in hydrology from the Project. This section also explains that areas of the levee system are currently in need of repair and are identified for future maintenance work. Part of the rationale for DWR's determination of less than significant with mitigation is that DWR will conduct long-term monitoring of the affected levee areas and provide any maintenance repairs as needed. More information should be provided in the Hydrology section to disclose other planned levee maintenance projects in the Project area, identify what existing sections of the levee are most vulnerable to future repair and maintenance by DWR from Project-related impacts, and explain why these areas of the levee are not proposed for improvement during site preparation for the Project. This information would further support the determination for less than significant with mitigation.

   Page 2-50 of the Project Description explains that armoring of the levee end points at the breached locations may be necessary for long-term erosion control and refers to Figure 2.2-9 for conceptual design of proposed armoring. However, the figure does not appear to illustrate the armoring design explained on page 2-50. Leaving the breached levee end points unarmored and exposing levee soils to the erosional velocities of the newly created discharges from Miner Slough would seem to have direct potential to erode levee foundations and compromise integrity of the levee system. Further, the Hydrology section does not appear to directly evaluate this impact concern. Please update the Hydrology section to provide further justification for why armoring of the breached levee end points is not directly proposed, and if armoring may not be proposed, explain why erosion potential for the levee is not an impact concern.

3. Sedimentation: The Hydrology section explains that flow velocity in Miner Slough will increase downstream of the breached levee locations with potential for increased bed scour, but does not seem to directly evaluate potential for increased sedimentation to downstream receiving waters. Please update this section to discuss the level of significance of this potential impact, and as related to potential methylmercury contamination as explained below.

4. Contaminant Testing: The Water Quality section explains that sediment sampling and testing will occur prior to proposed dredging activities. Given the potential for known legacy pollutants, such as methylmercury and other toxins, and reliance on dredging spoils for proposed fill activities, sediment contaminant testing should be conducted now and evaluated in the Draft EIR, as sediment quality may further influence Project planning and proposed fill activities. CSLC staff recommends the Water Quality section be updated to include this analysis.

   Please be advised that on April 22, 2010, the Central Valley Regional Water Quality Control Board (CVRWQCB) identified the CSLC as both a State agency that manages open water areas in the Sacramento-San Joaquin Delta Estuary and a nonpoint source discharger of methylmercury (Resolution No. R5-2010-0043),

because subsurface lands under the CSLC's jurisdiction are impacted by mercury from legacy mining activities dating back to California's Gold Rush. Pursuant to a CVRWQCB Total Maximum Daily Load (TMDL), the CVRWQCB is requiring the CSLC to fund studies to identify potential mercury/methylmercury control methods in the Delta and to participate in an Exposure Reduction Program. The goal of the studies is to evaluate existing control methods and evaluate options to reduce methylmercury in open waters under jurisdiction of the CSLC. Any action taken that may result in mercury/methylmercury suspension within the Sacramento-San Joaquin Delta Estuary may affect the CSLC's efforts to comply with the CVRWQCB TMDL. Please update the methylmercury discussion on page 3-46 and Impact 3.2-8 on page 3-81 with the above information, and to disclose DWR's obligations to minimize or avoid releases of methylmercury from dredging and sedimentation impacts associated with the Project.

5. Mitigation Monitoring Program: The Draft EIR includes a summary of mitigation measures in Table ES-1 (beginning at p. xxii), but does not appear to include a complete Mitigation Monitoring Program (MMP) identifying reporting, monitoring, and implementation responsibilities for all proposed mitigation measures. Pursuant to the State CEQA Guidelines (§ 21081.6), a public agency shall adopt a monitoring program of mitigation measures and ensure their enforceability. Therefore, CSLC staff recommends that the Final EIR include a clearly identified MMP.

Thank you for the opportunity to comment on the Draft EIR for the Project. As a responsible agency, CSLC staff requests that you consider our comments prior to certification of the Final EIR. Please send copies of future Project-related documents, including electronic copies of the Final EIR, MMP, Notice of Determination, DWR Approving Resolution, CEQA Findings and, if applicable, Statement of Overriding Considerations when they become available, and refer questions concerning environmental review to Jason Ramos, Senior Environmental Scientist, at (916) 574-1814 or via e-mail at Jason.Ramos@slc.ca.gov. For questions concerning CSLC leasing jurisdiction, please contact Wendy Hall, Public Land Management Specialist, at (916) 574-0994 or via e-mail at Wendy.Hall@slc.ca.gov.

Sincerely,

Cy R. Oggins, Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
W. Hall, CSLC
L. Calvo, CSLC
J. Ramos, CSLC

Attachment 2

2016 DEIR Comment Letters

Contra Costa Water District

(CCWD)

CONTRA COSTA
WATER DISTRICT

CCWD
Board of Directors
Lisa M. Borba, AICP
President
John A. Burgh
Vice President
Ernesto A. Avila, P.E.
Bette Boatmun
Connstance Holdaway

General Manager
Jerry Brown

October 7, 2016

Dan Riordan
California Department of Water Resources
3500 Industrial Blvd
West Sacramento, CA 95691

Subject: Comments Regarding the Draft Environmental Impact Report for the Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

Contra Costa Water District (CCWD) appreciates the opportunity to provide comments on the Draft Environmental Impact Report for the Prospect Island Tidal Habitat Restoration Project (DEIR). CCWD supports habitat restoration in the Delta, but we are concerned that the environmental impacts of the Prospect Island Tidal Habitat Restoration Project (the Project) have not been fully and properly evaluated.

CCWD provides water diverted at its four intakes in the Sacramento-San Joaquin Delta to approximately 500,000 people in Contra Costa County. Small changes in water quality at CCWD intakes, even in the absence of water quality objective violations, can impact operations, water supply, and the water quality served to customers. CEQA guidelines require that such impacts be analyzed both on a project and cumulative basis.

CCWD's June 14, 2013 letter on the Notice of Preparation of the DEIR requested an evaluation of potential water quality impacts including: changes in compliance with water quality objectives promulgated by the State Water Resources Control Board, changes in the position of X2, changes in upstream reservoir releases needed to meet water quality objectives, and changes in salinity at Delta drinking water intakes, including increases in salinity that could otherwise substantially degrade water quality in the absence of standards violations. CCWD-1 (Cont. below)

The assessment of the potential water quality impacts of the Project in the DEIR is not adequate, so the DEIR does not fully disclose the environmental impacts of the Project and does not offer appropriate mitigation. The following deficiencies in the DEIR must be corrected.

1. **The DEIR does not include the modeling used to support the impact assessment in the public record.**
The DEIR references modeling work used to assess salinity impacts of the alternatives but that work was not included as part of the DEIR document nor was it posted on the Project website. On page 3-75 the DEIR states *"[p]hase 2 hydrodynamic modeling for the Prospect Island Tidal Habitat Restoration Project was conducted to support selection of final restoration alternatives, inform environmental impact assessments, and inform engineering design of the selected alternative (Appendix D in WWR and SWS 2014)."*

The document referenced should have been included as part of the DEIR to substantiate and corroborate the impact analyses.

DWR provided *WWR and SWS 2014* to CCWD upon request, and review of that document has shown that the modeling analyses performed were insufficient to support the findings in the DEIR, for the reasons given below.

CCWD-1 (Cont.)

2. **The modeling performed may not correspond to the alternatives described in the DEIR.**

The *WWR and SWS 2014* report evaluated eight potential project configurations. However, it is not clear if a subset of those configurations represent the alternatives in the DEIR. The DEIR does not contain sufficient information indicating the relationship between the configurations evaluated in the *WWR and SWS 2014* report and the alternatives evaluated in the DEIR. On page 3-75 the DEIR connects the Proposed Project with the modeling worked performed, *"[t]he modeled conceptual alternatives included a variety of configurations with varying numbers and locations of weirs and breaches along both Miner Slough and the DWSC, one of which was similar to the Proposed Project (Phase 2 "Alt 26")"*. However, it is not clear whether the other alternatives described in the DEIR are not included in the modeling performed.

The water quality effects of Delta habitat restoration projects are depend strongly on the details of the project configuration such as the size and location of the levee breaches. (See for example, CCWD's comment letter on the Tule Red Project). Thus the modeling used to analyze the potential impacts of the alternatives must be consistent with the alternatives description in the DEIR

CCWD-2

3. **The DEIR does not asses the full suite of potential water quality impacts.**

The modeling in *WWR and SWS 2014* evaluated eight potential alternatives (not necessarily corresponding to the alternatives identified in the DEIR) to determine if compliance with D-1641 objectives would change. While the modeling demonstrates that there would not be any violations of D-1641 objectives for the eight alternatives evaluated, it also shows that salinity would increase in many locations throughout the Delta. The DEIR and the *WWR and SWS 2014* report did not analyze how the increases in salinity throughout the Delta may affect other beneficial uses. The DEIR and WWR and SWS 2014 report did not analyze changes in salinity at CCWD's four drinking water intakes as requested in our June 14, 2013letter and consistent with the requirements in the CEQA guidelines (Appendix G).

CCWD-3

Small changes in Delta water quality can have a significant impact on CCWD's water supply, water quality, and the cost of operation. Los Vaqueros Reservoir was built in 1998 and was expanded in 2012 to improve water quality delivered to CCWD's customers, improve drought and emergency supply reliability, and provide Delta fisheries benefits. The modeling in *WWR and SWS 2014* indicates that for Alternative 26, similar to the proposed project in the DEIR, salinity may increase by up to 3% at CCWD's Rock Slough intake and up to 2% at the State Water Project and Central Valley Project export

CCWD-4 (Cont. below)

facilities which are in close proximity to CCWD's Old and Middle River intakes. While such an increase may seem small, it can have a significant impact on CCWD. Similar water quality modeling performed for other habitat restoration projects indicates that salinity increases at CCWD's intakes of less than 4% on average would lead to a decrease in Los Vaqueros Reservoir storage of over 10,000 acre-feet. (See Attachment.) Given that CCWD's annual demands are on the order of 100,000 acre-feet, a loss of water stored on the order of tens of thousands of acre-feet would be a significant impact.

CCWD-4 (Cont.)

Without a time series of water quality at CCWD intakes it is impossible to estimate the extent the Project will impact CCWD water supply, water quality and water operations. The DEIR should include an evaluation of the changes in salinity at all Delta drinking water intakes so that the full suite of potential impacts is disclosed and mitigated to the extent necessary.

CCWD-5

4. **The DEIR did not properly evaluate the potential cumulative impacts.**

The DEIR and the *WWR and SWS 2014* report did not analyze the cumulative impacts of the Project. The DEIR inappropriately relies on draft environmental documentation for the Bay Delta Conservation Plan/California Water Fix to determine the potential cumulative impacts of the Project. Page 3-362 of the DEIR states *"[m]odeling conducted for California Water Fix effects analyses indicates that as Delta outflows decrease, the effect of regional mean sea level rise and tidal habitat restoration on increasing salinity becomes more prominent. At lower outflows, the combined effect of the Proposed Project in combination with other planned tidal habitat restoration projects on salinity in the Delta would be potentially significant".*

The Project is intended to partially fulfill the 8,000 acre tidal habitat restoration obligations of DWR under Reasonable and Prudent Alternative (RPA) 4 of the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion (BiOp) for long-term coordinated operations of the State Water Project (SWP) and the federal Central Valley Project (CVP) (USFWS 2008). The Partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement for the Bay Delta Conservation Plan/California WaterFix (the WaterFix DEIR/EIS) contains a programmatic evaluation of water quality impacts associated Conservation Measure 4 (tidal natural communities restoration) and does not include a project specific evaluation of the environmental impacts associated with the Project or any other specific project implemented to satisfy the BiOp obligations. Therefore, the WaterFix DEIR/EIS cannot provide the basis for the Project's cumulative impact analysis. The cumulative impacts of the Project must be re-evaluated properly.

CCWD-6

The new cumulative impact assessment for the Project should use the most current available RMA model, and information regarding other restoration projects, to analyze potential water quality impacts on a project and cumulative basis. The modeling results in the *WWR and SWS 2014* report indicate the Project will increase salinity east of Prospect Island near San Andreas and Terminous on the Mokelumne. Based on cumulative impact modeling done for the Tule Red Project, the Project will increase salinity at times and in

CCWD-7 (Cont. below)

locations that are already expected to increase with implementation of the McCormack-Williamson Project. (See Attachment.) These two projects together could significantly increase salinity in the interior of the Delta. The cumulative impacts of the Project in combination with other reasonably foreseeable restoration projects must be properly evaluated because there is evidence that the Project could have significant cumulative impacts even in the absence of standards violations.

CCWD-7 (Cont.)

5. **The Project cannot redirect impacts and the DEIR must identify appropriate mitigation for significant impacts due to the Project**

Although the DEIR does not contain a proper analysis of the potential cumulative impacts, if the Project is found to have cumulatively significant impacts, the Project must identify appropriate and feasible ways that the impacts can be avoided, minimized or otherwise mitigated to a less than significant level. Page of the DEIR 3-362 states *"[a]ssuming that D-1641 would still be in place, DWR would be required to comply with salinity standards, which would mitigate for this potential impact. Therefore, the projected incremental effect on salinity due to the Proposed Project would not be cumulatively considerable."*

The Project may have significant impacts on CCWD's water supply and water quality even in the absence of standards violations. The incremental effects of the Project may also contribute to significant cumulative impacts on CCWD caused by impacts to water quality at CCWD's intakes. If the water quality analysis, corrected as described above, reveals such impacts, they must be avoided or mitigated. The Project should select a design configuration that minimizes salinity increases in the Delta. Significant cumulative water quality and supply impacts could be avoided if habitat restoration projects throughout the Delta were sequenced so that there is no net significant water quality degradation at any time. If the significant water quality impacts cannot be fully mitigated by alterations of the habitat design, and coordinating the implementation schedule of the Project with other restoration projects, additional mitigation must be identified to ensure the impacts are fully mitigated.

CCWD-8

CCWD would be happy to meet with you to discuss this information further, and we look forward to reviewing the revised analysis of the environmental impacts of the Project. If you have any questions about this letter, please call me at 925-688-8083 or call Maureen Martin at 925-688-8323.

Sincerely,

Leah Orloff
Water Resources Manager

LO\MM:wec

Start of attachments to CCWD

Attachments: CCWD comment letters on other restoration projects: 2011 Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/ Environmental Impact Report, the 2013 Notice of Preparation for the Prospect Island Tidal Habitat Restoration Project, the 2013 Initial Study/Mitigated Negative Declaration for the Mallard Farms Conservation Bank, the 2014 Dutch Slough Tidal Marsh Restoration Project Supplemental Environmental Impact Report, the 2014 Initial Study/Mitigated Negative Declaration for the Honker Bay Conservation Bank, and the 2015 Tule Red Addendum to the Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/ Environmental Impact Report, and Decker Island Restoration Project IS/MND.

CONTRA COSTA
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Lisa M. Borba
John A. Burgh

Jerry Brown
General Manager

December 29, 2010

Ms. Becky Victorine
Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

Subject: Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/ Environmental Impact Report

Dear Ms. Victorine:

Contra Costa Water District (CCWD) appreciates the opportunity to comment on the Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/Environmental Impact Report (EIS/EIR). CCWD supports the restoration objectives outlined in the EIS/EIR and looks forward to reviewing more analyses as specific restoration sites are selected and restoration moves forward.

Although specific restoration sites were not identified in the EIS/EIR, the modeling done for the EIS/EIR shows that site selection is important when considering water quality effects in Suisun Marsh and the Delta. Based on the modeling done to date, we suggest the implementing agencies prioritize restoration sites in the northern marsh (such as Set 1 modeled) that would tend to decrease Delta salinity over sites in the southern marsh (Set 2) that would tend to increase salinity. Restoring sites in the northern portion of the Marsh first, then following with sites in the southern portion of the Marsh, as appropriate, would help ensure that water quality in the Delta and Suisun Bay is not degraded at any point in project implementation. Alternatively, the actual location of the connections of the restoration sites to adjacent channels can alter the tidal hydrodynamics in a way that avoids undesirable water quality changes.

Maintaining Delta water quality without increasing western Delta salinity can be desirable with respect to maintaining the position of X2, the two parts per thousand isohaline, which is an ecological parameter. Based on the data in this EIS/EIR, potential adverse impacts can be avoided by scheduling and appropriate implementation of projects. This should be examined as each project is implemented.

As individual restoration projects are chosen, we look forward to reviewing site-specific water quality modeling. Important components of the water quality analysis will include the following:

- Effect on X2 position;
- Effect on upstream reservoir releases made to meet water quality standards; and
- Effect on Delta drinking water quality, including changes in salinity that could "otherwise substantially degrade water quality" in the absence of standards violations (California Code of Regulations, Division 6, Chapter 3, Article 20, Appendix G).

Please call me at 925-688-8083 or call Maureen Martin at 925-688-8323 if you have any questions. We would be happy to meet with you to discuss water quality modeling as the plan goes forward.

Sincerely,

Leah Orloff
Water Resources Manager

LO/MM:cmn

cc: Ms. Cay Goude, United States Fish and Wildlife Service
Mr. Scott Wilson, Department of Fish and Game
Mr. Russ Grimes, United States Bureau of Reclamation

CONTRA COSTA
WATER DISTRICT

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December 15, 2011

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General Manager

James Starr
California Department of Fish and Game
4001 North Wilson Way
Stockton, CA 95205

Dear Mr. Starr: Jim,

Thank you for your Dec. 5, 2011 transmittal of the responses to Contra Costa Water District's (CCWD's) comments on the Suisun Marsh Habitat Management, Preservation, and Restoration Plan Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR). CCWD supports the restoration objectives outlined in the draft and final EIS/EIRs and looks forward to reviewing more analyses as specific restoration sites are selected and restoration moves forward.

CCWD submitted comments on the Draft EIR/EIS (December 29, 2010, L. Orloff to B. Victorine) requesting more analysis whenever a particular restoration site is chosen for implementation, to address potential water quality and water supply impacts. The Final EIR/EIS addressed CCWD's comments with Master Response 1; however, the commitments made in this response do not fully address our concerns. CCWD appreciates that the EIS/EIR states that "as part of each site-specific tidal restoration action, project proponents will use an accurate tidal hydraulics and salinity model (e.g., the RMA Bay-Delta model or other appropriate model) to simulate the proposed action to ensure that impacts on scour, changes in tidal stage, sedimentation, salinity, and other hydraulic processes do not exceed those described in this EIS/EIR". An accurate salinity model is necessary, but the results from that modeling must be interpreted within the context of existing regulations and water supply operations to fully understand the action's effects. The number of exceedences of water quality objectives is not a sufficient metric to assess the full impacts a restoration action could have on water quality, water supply, and the ecosystem. For example, X2 can be substantially moved without necessarily exceeding a water quality objective. CCWD requests a commitment for a more thorough analysis of the potential water quality impacts of each project that is selected for implementation, and for public disclosure of the results of that analysis, including the project's effects on:

- compliance with D-1641 objectives
- changes in X2 position
- changes in upstream reservoir releases needed to meet water quality objectives
- changes in salinity at Delta drinking water intakes, including increases in salinity that could "otherwise substantially degrade water quality" in the absence of standards violations (California Code of Regulations, Division 6, Chapter 3, Article 20, Appendix G).

Some specific actions (such as the Set 2 actions modeled for the EIR/EIS) will tend to increase salinity intrusion into the Delta and move X2 eastward, to the detriment of fish and drinking water quality, while others (such as Set 1) will have the opposite effect. The results of the water quality analyses should be used to insure that project implementation is staged so that there is no net increase in salinity intrusion.

CCWD requests that the commitments we describe above – to more complete water quality analysis of specific actions and to staging the projects so that there is no net water quality impact – be made in the Department of Fish and Game's CEQA findings and included as additional mitigation measures to ensure that impacts remain less than significant. The attachment to this letter contains suggested language for those findings.

Thank you for your consideration of these comments. Please call me at (925) 688-8083 or call Maureen Martin at (925) 688-8323 if you have any questions. We would be happy to meet with you to discuss water quality impacts and modeling as the plan goes forward.

Sincerely,

Leah Orloff
Water Resources Manager

LO/MM:wec

Attachment

cc: Cay Goude, USFWS
Russ Grimes, USBR
Becky Victorine, USBR

Proposed CEQA Findings and Additional Mitigation Measures
Suisun Marsh Habitat Management, Preservation, and Restoration Plan Draft Environmental Impact Statement/Environmental Impact Report

1. Water quality analysis for each specific tidal restoration action shall include evaluation and public disclosure of the action's effect on:

    - compliance with D-1641 objectives
    - changes in X2 position
    - changes in upstream reservoir releases needed to meet water quality objectives
    - changes in salinity at Delta drinking water intakes, including increases in salinity that could "otherwise substantially degrade water quality" in the absence of standards violations (California Code of Regulations, Division 6, Chapter 3, Article 20, Appendix G).

2. The water quality analyses shall be used to stage implementation of specific actions so that their net effect does not cause a temporary or permanent increased salinity intrusion into the Delta and an eastward shift in X2.

SETTLEMENT AGREEMENT REGARDING PROPOSED MALLARD FARMS CONSERVATION BANK

This Settlement Agreement Regarding Mallard Farms Conservation Bank (Agreement) is entered into and shall become effective this 23rd day of June, 2014, between the Contra Costa Water District (CCWD) and Reclamation District 2130 (RD 2130).

RECITALS

A. In April 2013, RD 2130 issued for public review and comment an Initial Study/ Mitigated Negative Declaration for the Mallard Farms Conservation Bank (the Bank, also referred to as "the Mallard Farms Restoration project") regarding the potential environmental effects that would result from the breaching of levees on seven contiguous parcels in Suisun Marsh bordering Honker Bay, pursuant to RD 2130's obligation under the California Environmental Quality Act.

B. As described in the IS/MND, the Bank will breach the outer levees of the seven contiguous parcels at three locations with the goal of creating habitat appropriate for a wide range of wildlife, including fish species protected under U.S. Endangered Species Act and California Endangered Species Act.

C. CCWD provides drinking water to approximately 500,000 customers in northern and central Contra Costa County and relies entirely on the Delta for its supply. CCWD has made nearly $1Billion in investments in the past 15 years to protect its source water quality and thus improve the quality of the water it serves to its customers. CCWD's operations and facilities are highly sensitive to Delta salinity.

D. CCWD believes that water quality at CCWD drinking water intakes could be significantly and adversely impacted by the Bank, individually and in combination with other similar types of restoration projects planned in the vicinity.

E. On May 2, 2013, CCWD submitted a comment letter asserting that the IS/MND prepared for the Bank was inadequate because it did not contain any analysis of the Bank's potential to increase seawater intrusion into the Sacramento-San Joaquin Delta, or any analysis, disclosure, or mitigation of potentially significant water quality impacts caused by increased seawater intrusion.

F. On March 26, 2014 RD 2130 provided CCWD with results from the proprietary RMA hydrodynamic model predicting potential changes in seawater intrusion in the Sacramento-San Joaquin Delta associated with the construction of the Bank and the Dutch Slough Tidal Marsh Restoration Project.

G. In the past the lack of publicly available modeling for habitat restoration projects has prevented some habitat restoration projects from fully evaluating water

quality impacts on an individual and cumulative basis; the public release of the proprietary RMA modeling inputs and results provides a foundation that future restoration projects can use to identify water quality impacts on an individual and cumulative basis so that they can be mitigated to the extent necessary.

Therefore, in consideration of the foregoing, the Parties agree as follows:

1. The Parties agree that the modeling performed to date provides the analysis requested in CCWD's May 2, 2013 comment letter and thereby satisfies the deficiencies of the IS/MND initially identified by CCWD.
2. In exchange for the performance of the obligations undertaken by RD 2130 under this Agreement, CCWD agrees to forego bringing one or more legal challenges to the sufficiency of the IS/MND.
3. RD 2130 agrees to make publicly available, without restriction as to use, the following information from the RMA modeling study of the proposed Mallard Farms Restoration project:
    a. Input (boundary condition) time series including the tidal boundary, river inflows, Delta Island Consumptive Use, and water exports for the periods simulated in the RMA modeling study (2002, 2003, 2011).
    b. RMA model result times series at Delta monitoring stations for the base condition, three Mallard Farms breach configurations, and cumulative impact simulation that included the proposed Dutch Slough Tidal Marsh Restoration Project.
    c. Bathymetric data and levee configurations (Geo-referenced x-y-z point data) for the existing condition and modeled breached conditions of the Mallard Farms Restoration project site.

    RD 2130 further agrees to allow RMA to utilize the model geometry prepared for the Mallard Farms study, including the proposed Dutch Slough Tidal Marsh Restoration Project in other studies of cumulative effects of habitat restoration projects.
4. Each party hereto hereby releases and forever discharges the other party, and its respective boards, departments, divisions, related agencies and entities, current and former officers, current and former employees, directors, principals, attorneys, agents, administrators, trustors, trustees, beneficiaries, shareholders, parent companies, partners, associates, subsidiaries, affiliates, predecessors, insurers, landowners, consultants, successors and assigns from any and all claims, including attorney's fees and costs, arising from the dispute regarding the sufficiency of the Initial Study/ Mitigated Negative Declaration for the Mallard Farms Conservation Bank.
5. The Parties understand and agree that this Agreement memorializes a

compromise of disputed claims, and that the consideration herein is not, in any manner, to be construed at any time or for any purpose, as an admission or concession about the merit or lack thereof of any Party's position concerning these claims, or as an admission of liability by either party, which liability is expressly denied and controverted.

6. This Agreement contains the entire agreement between the Parties with respect to the subject matter hereof and supersedes all prior and contemporaneous agreements, representations, and understandings of the Parties.
7. This Agreement is the product of negotiation and preparation of the Parties. Any rule of construction to the effect that any ambiguity is to be resolved against the drafting party shall not be applied to the interpretation of this Agreement.
8. The Parties have freely and voluntarily executed this Agreement and are not acting under coercion, fraud, duress, menace, economic compulsion or undue influence, or because of any supposed disparity of bargaining power; rather, the Parties are freely and voluntarily signing this Agreement for their own benefit.

By affixing his/her signature below, each of the persons signing this Agreement warrants and represents that he/she has read and understands this Agreement, that in signing on behalf of a Party he/she has full and complete authority from that Party to bind said Party to perform and comply with each and every term, obligation, condition and covenant set forth in this Agreement, and that the Party on behalf of whom he/she signs agrees to be bound by its terms.

RECLAMATION DISTRICT NO. 2130

By: _____
President, Board of Trustees

ATTEST:

_____
District ~~Secretary~~ Treasure

APPROVED AS TO FORM:

_____
David Aladjem, Attorneys for District Reclamation District No. 2130

CONTRA COSTA WATER DISTRICT

By: _____
Jerry Brown, General Manager

ATTEST:

Mary A. Neher
District Secretary , Mary A. Neher

APPROVED AS TO FORM:

Carl P A Nelson 6/10/14
Carl P. A. Nelson, Attorneys for District Contra Costa Water District

NOTICE OF SPECIAL MEETING
RECLAMATION DISTRICT NO. 2130

NOTICE IS HEREBY GIVEN that the Board of Trustees of Reclamation District No. 2130 calls a special meeting to consider the approval of a settlement agreement between Reclamation District No. 2130 and Contra Costa Water District. The special meeting is open to the public and will be held on June 6, 2014, at 10 a.m. at the following address: 4171 Suisun Valley Rd., Fairfield, California.

Any documents that are made available to the Board of Trustees before the meeting shall be available for public review, by appointment, by calling the following number: (707) 864-0681.

DATED: June 6, 2014

Steve Murariu
Secretary/Treasurer, Board of Trustees
Reclamation District No. 2130

CONTRA COSTA
WATER DISTRICT

Board of Directors
Joseph L. Campbell
President
Lisa M. Borba
Vice President
Bette Boatmun
John A. Burgh
Connstance Holdaway

General Manager
Jerry Brown

November 5, 2015

Byron Buck
State and Federal Contractors Water Agency
1121 L Street, Suite 806
Sacramento, CA 95814

Dear Mr. Buck,

The State and Federal Contractors Water Agency is proposing to prepare an addendum to the Suisun Marsh Habitat Management, Preservation, and Restoration Plan EIS/EIR to implement the Tule Red Tidal Restoration Project (proposed Project). The proposed Project would convert approximately 420 acres of existing managed wetlands to tidal habitat to benefit federal and state-listed Delta smelt, longfin smelt, and salmonids. The proposed Project would introduce full, daily tidal exchange to an existing managed marsh duck club owned by Westervelt Ecological Services and to a portion of a Grizzly Island Wildlife Area which is owned and operated by the California Department of Fish and Wildlife.

Contra Costa Water District (CCWD) has previously commented on the Suisun Marsh Habitat Management, Preservation, and Restoration Plan EIS/EIR and the Mallard Farms Habitat Conservation Bank (Attached) requesting that prior to implementing a specific project, such as the proposed Project, project proponents do the following:

- conduct a robust water quality analysis to determine potential water quality impacts in the Delta, including but not limited to changes in X2 position, changes in upstream reservoir releases made to meet water quality objectives, changes in Delta drinking water quality.
- conduct a cumulative impact analysis containing all relevant and foreseeable habitat restoration projects in the Delta
- select a site design that minimizes water quality impacts
- avoid, minimize or mitigate adverse water quality impacts to a less than significant level

The Final Suisun Marsh Habitat Management, Preservation, and Restoration Plan EIS/EIR states on page 2-19 "*as part of each site-specific tidal restoration action, project proponents will use an accurate tidal hydraulics and salinity model (e.g., the RMA Bay-Delta model or other appropriate model) to simulate the proposed action to ensure that impacts on scour, changes in tidal stage, sedimentation, salinity, and other hydraulic processes do not exceed those described in this EIS/EIR*". An accurate salinity model is necessary but the results from that modeling must be interpreted within the context of existing regulations and water supply operations to fully disclose potential project impacts.

In 2014, CCWD reached a settlement agreement with the Mallard Farms Habitat Conservation Bank guaranteeing the public release of the proprietary RMA modeling inputs and results that future restoration projects can use to identify water quality impacts on an individual and cumulative basis so that they can be mitigated to the extent necessary. The settlement agreement includes information related to the Mallard Farms Habitat Conservation Bank and the Dutch Slough Tidal Marsh Restoration Project.

CCWD requests that the addendum for the proposed Project utilizes the RMA model, and information regarding other restoration projects, to analyze potential water quality impacts on an individual and cumulative basis. We look forward to reviewing the results of the impact analyses and working with you to ensure that any water quality impacts are minimized or otherwise mitigated to a less than significant level.

Thank you for your consideration of these comments. Please call me at (925) 688-8083 or call Maureen Martin at (925) 688-8323 if you have any questions. We would be happy to meet with you to discuss water quality modeling as the proposed Project goes forward.

Sincerely,

Leah Orloff
Water Resources Manager

LO/MM:wec

Attachment

CONTRA COSTA WATER DISTRICT

Board of Directors
Joseph L. Campbell
President
Lisa M. Borba
Vice President
Bette Boatmun
John A. Burgh
Connstance Holdaway

General Manager
Jerry Brown

March 2, 2016

Byron Buck
State and Federal Contractors Water Agency
1121 L Street, Suite 806
Sacramento, CA 95814

SUBJECT: Tule Red Restoration Project CEQA Addendum

Dear Mr. Buck:

Contra Costa Water District (CCWD) appreciates the opportunity to comment on the Tule Red Restoration Project CEQA Addendum (Addendum). CCWD provides water diverted at its four intakes in the Sacramento-San Joaquin Delta to approximately 500,000 people in Contra Costa County. Small changes in water quality at CCWD intakes, even in the absence of water quality objective violations, can impact operations, water supply, and water quality served to customers. Given CCWD's dependence on the Delta, it is vital to understand how projects such as the Tule Red Restoration Project could change Delta water quality.

Modeling results included in the Addendum show that the Tule Red Project will increase Delta salinity but will not result in significant water quality impacts at CCWD's intakes. An analysis of the effects on CCWD is provided as an attachment to this letter, showing de minimis impacts to salinity at CCWD's intakes and storage in CCWD's Los Vaqueros Reservoir.

However, the cumulative assessment of Tule Red with other foreseeable restoration projects shows significant increases in Delta salinity and significant impacts on CCWD.

Depending on location and configuration, tidal habitat restoration projects in the Delta and Suisun Marsh can increase or decrease Delta salinity. To avoid cumulative water quality and supply impacts, the restoration projects should be sequenced so that there is no net significant water quality degradation at any time. CCWD has made this comment on environmental documents for Delta tidal restoration projects such as the 2011 Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/ Environmental Impact Report, the 2013 Notice of Preparation for the Prospect Island Tidal Habitat Restoration Project, the 2013 Initial Study/Mitigated Negative Declaration for the Mallard Farms Conservation Bank, the 2014 Dutch Slough Tidal Marsh Restoration Project Supplemental Environmental Impact Report, and the 2014 Initial Study/Mitigated Negative Declaration for the Honker Bay Conservation Bank, and we reiterate it here.

In our meeting on February 12th, you expressed the State and Federal Contractors Water Agency's (SFCWA) agreement with this approach to sequencing restoration projects. We look forward to working with you to ensure that all such projects undertaken by SFCWA, the

Department of Water Resources, the California Department of Fish and Wildlife, and others proceed in a sequence that preserves Delta water quality at all times.

The analysis required to help achieve this goal will be similar to the Addendum analysis, which used the Resource Management Associates two-dimensional hydrodynamics and water quality model to look at the effects of an individual project and also at the cumulative effects of projects done to date and reasonably foreseeable future projects.

Thank you for your consideration of these comments. Please call me at (925) 688-8083 or call Maureen Martin at (925) 688-8323 if you have any questions. We look forward to working with you in the future to ensure ecosystem restoration goals are achieved while preserving Delta water quality.

Sincerely,

Leah Orloff
Water Resources Manager

LO/MM:wec

Attachment

Copies to: David Okita
Carl Torgerson
Dean Messer
Carl Wilcox
Jim Starr
Kim Turner
Maria Rea

Attachment

Tule Red Water Quality Modeling and Impacts to Contra Costa Water District

In a November 5, 2015 letter to the State and Federal Contractors Water Agency, CCWD requested that the Tule Red Restoration Project CEQA Addendum (Addendum) utilize the RMA model and information regarding other restoration projects to analyze potential Delta water quality impacts on an individual and cumulative basis. In response, the Addendum included four habitat restoration scenarios:

- base case (no restoration, serves as basis to measure change)
- Tule Red only
- cumulative, no McCormack-Williamson (Tule Red plus five other projects)
- cumulative, all (Tule Red plus six other projects)

CCWD appreciates that the requested analyses were performed and applauds the modeling effort. The Delta water quality output from the Tule Red only scenario was examined and then used as input to the CCWD operations model to determine impacts on storage in CCWD's Los Vaqueros Reservoir. Results indicate that the Tule Red project will increase Delta salinity but will not result in significant impacts to water quality at CCWD's intakes or to storage in Los Vaqueros.

. However, the cumulative assessment of Tule Red with other foreseeable restoration projects shows significant increases in Delta salinity and significant impacts on CCWD. The figures presented below illustrate that the habitat restoration scenarios modeled could have significant impacts to CCWD operations, water supply and water quality.

CEQA requires an evaluation of project effects that could "otherwise substantially degrade water quality" in the absence of standards violations (California Code of Regulations, Division 6, Chapter 3, Article 20, Appendix G). Figure 1, below, shows the average percent change in salinity at CCWD's intake for the three restoration scenarios modeled. Salinity increases were found at all four intakes under all three scenarios modeled.

While the Tule Red only scenario indicates very small changes in salinity, the cumulative scenarios indicate significant degradation of water quality at CCWD's intakes and significant decreases in storage levels in Los Vaqueros Reservoir.

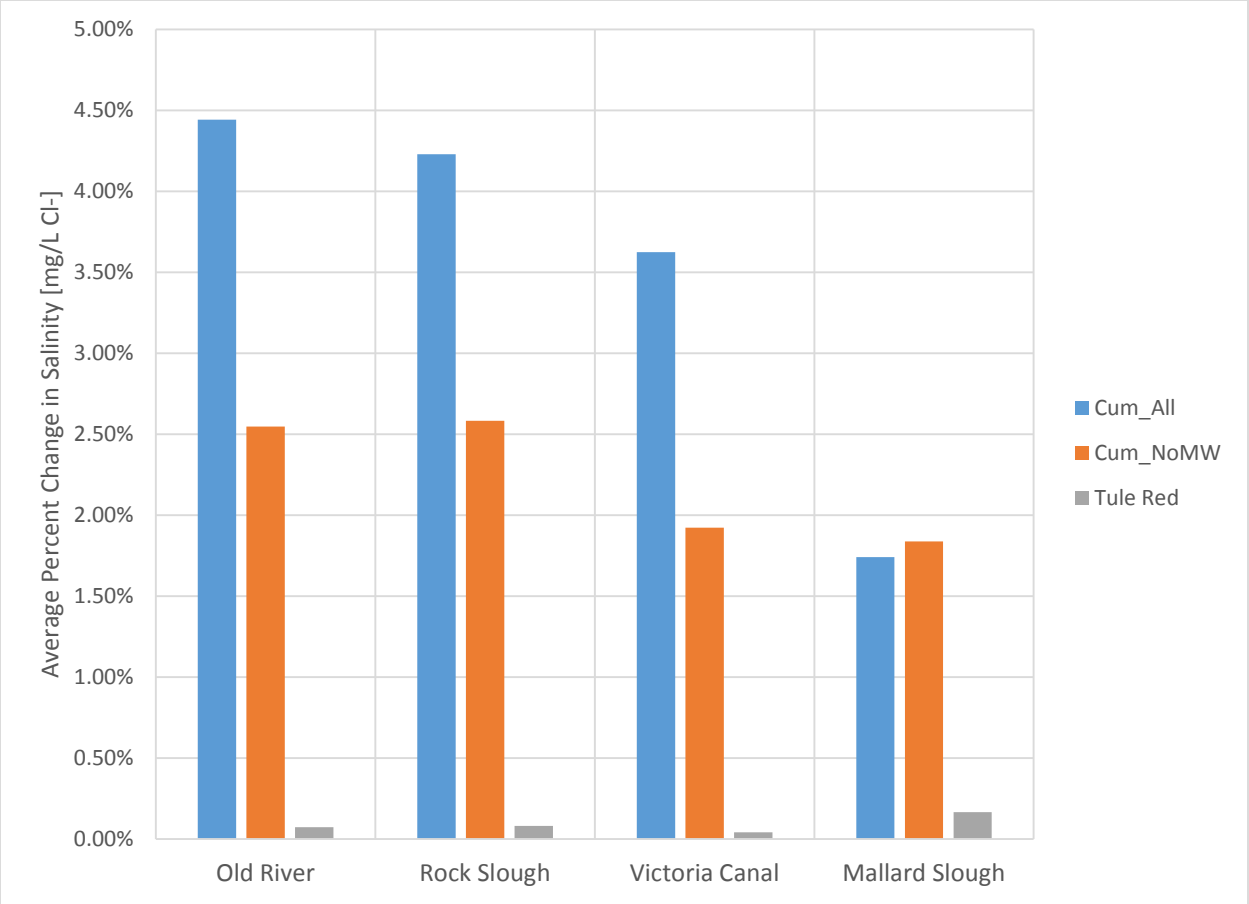

Figure 1. Average change in water quality at CCWD intakes for the three restoration scenarios modeled.

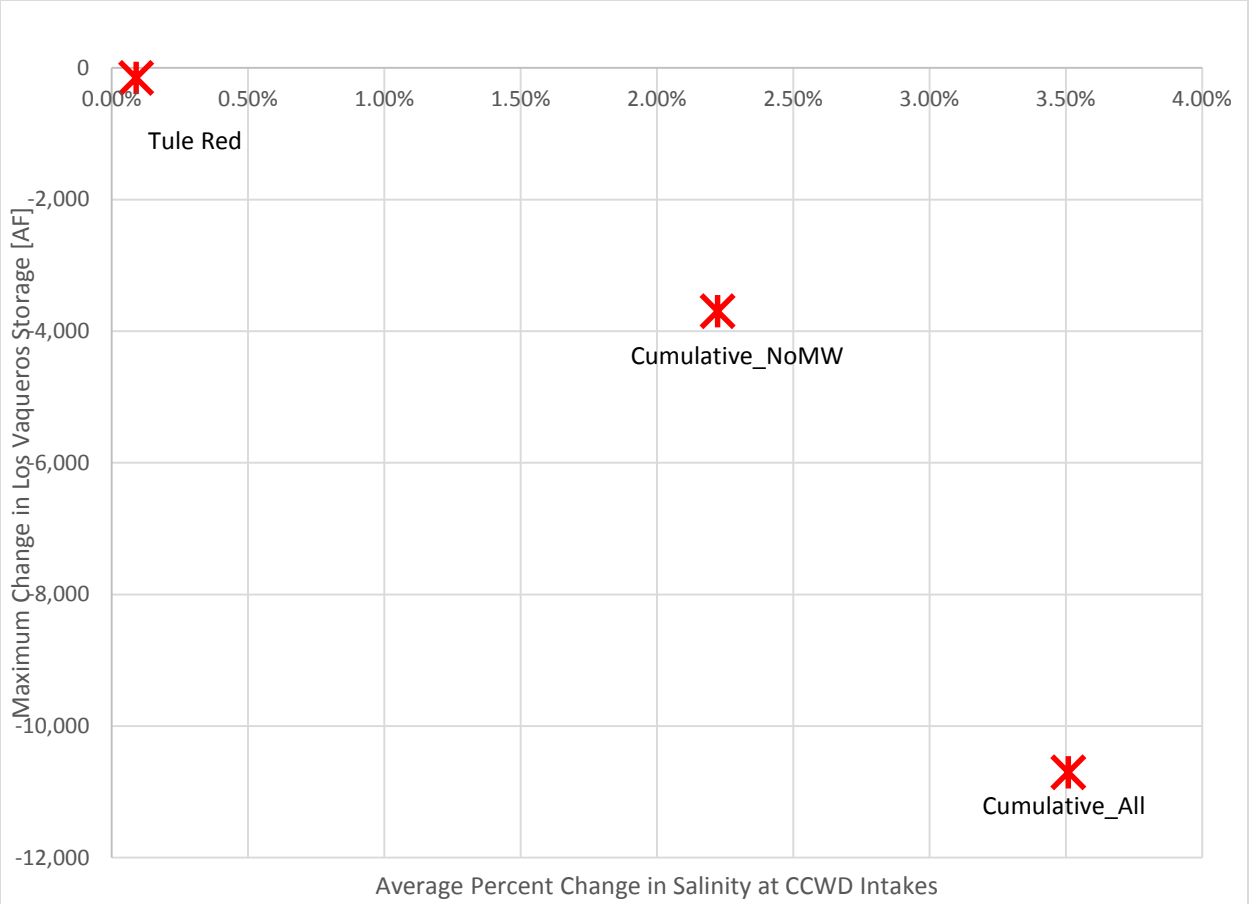

Figure 2. Change in Los Vaqueros Reservoir storage for the three restoration scenarios modeled.

Los Vaqueros Reservoir was built in 1998 and was expanded in 2012 to improve water quality delivered to customers, improve drought and emergency supply reliability, and provide Delta fisheries benefits. Figure 2 shows the average change in salinity at CCWD's intakes for the three habitat restoration scenarios and the corresponding maximum change in Los Vaqueros Reservoir storage over the period modeled. The Tule Red only scenario shows small changes in water quality (< 1%) at CCWD's intakes and very small change in Los Vaqueros Reservoir storage. The cumulative, no McCormack-Williamson model scenario shows that salinity at CCWD's intakes increases by 2% on average and leads to a decrease in Los Vaqueros Reservoir storage of 3,700 acre-feet. The cumulative, all scenario shows that salinity at CCWD's intakes increases by less than 4% on average and leads to a decrease in Los Vaqueros Reservoir storage of over 10,000 acre-feet. Given that CCWD's annual demands are on the order of 100,000 acre-feet, a loss of water stored on the order of thousands to tens of thousands of acre-feet is a significant impact.

On page 3-6 the Addendum states, "*[t]he SMP EIS/EIR determined that restoration activities would have less-than-significant impacts on salinity because modeled results did not indicate substantial changes in salinity that would affect the water quality designated beneficial uses (e.g. drinking water supplies)… The largest increase in upstream salinity would be much less than 10% of the average baseline salinity, with no month increasing by more than 10% of the salinity*

objective; therefore, no expected significant changes to exports or Sacramento-San Joaquin Delta diversions were identified."

A 10% increase in salinity as a threshold of significance is arbitrary and overlooks significant impacts to water users in the Delta that occur at a lower threshold. Figure 2 shows the significant impact a 4% increase in salinity would have on CCWD's water quality and supply; an increase in salinity of 10% would be a devastating impact and undermine the value of the more than one billion dollars investment that CCWD has made over the last several decades to improve water quality and supply reliability

While the Tule Red Project alone does not result in a significant impact to CCWD water supply and water quality, both of the cumulative restoration scenarios would have significant impacts that must be avoided, minimized or otherwise mitigated to a less than significant level. To avoid cumulative water quality and supply impacts, the restoration projects should be sequenced so that there is no net significant water quality degradation at any time.

Cumulative Effects Salinity Modeling Analysis in Support of the Proposed Tule Red Tidal Marsh Restoration, Grizzly Island, California
Draft Technical Memorandum

February 2016

Prepared For:
Westervelt Ecological Services
600 North Market Blvd., Suite 3
Sacramento, CA 95834

Prepared By:
Resource Management Associates
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Davis, CA 95618
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RMA Resource Management Associates

Executive Summary

The Tule Red Tidal Restoration Project was evaluated in an earlier numerical modeling study to evaluate the regional salinity impacts of the project (RMA, 2015a). Simulation of salt transport, using Electrical Conductivity (EC) as surrogate, was performed for the 2002- 2003 analysis period. The results of that study showed only slight effects in computed Delta EC with the Tule Red Project. The results were evaluated for monthly averaged EC change at three western Delta locations and at south Delta Export locations. Maximum computed EC increases at the south Delta export locations were limited to +0.1% to +0.3% for the 2002 dry year. Maximum computed EC increases at Jersey Point and Emmaton in the western Delta were +0.4% and +0.3% respectively. Computed EC increased for the Mallard Island west Delta location was +0.7% for April 2002.

The present analysis considers the "Cumulative Effects" on salinity with development of the Tule Red Project in combination with other potential Suisun Marsh/Suisun Bay and Delta tidal restoration projects. Six other prospective tidal restoration projects were included in the cumulative effects modeling:

1) *Mallard Farms Conservation Bank*
2) *Honker Bay Conservation Bank*
3) *Dutch Slough Tidal Marsh Restoration Project*
4) *Lower Yolo Restoration Project*
5) *Prospect Island Tidal Restoration Project*
6) *McCormack Williamson Tract Project*

The new model analysis was performed for the same 2002-2003 conditions applied for the earlier Tule Red only analysis. With the additional restoration projects, computed EC at the south Delta export locations increased for the year 2002, particularly in the summer and fall. For the Cumulative Effects configuration (Tule Red + six other projects), monthly averaged EC at the State Water Project, Clifton Court Forebay Intake location increased +8.3% over the Base (no Tule Red or other six restoration projects) condition EC.

Analysis of the hydrodynamic results showed a decrease in Delta Cross Channel (DCC) net flow with the Cumulative Effects configuration. The change in north Delta to central Delta transfer flow (DCC + Georgiana Slough) was about 400 cfs in the months of the 2002 DCC operation. This flow change could be an important factor in the increase in the computed south Delta EC with the Cumulative Effects configuration. Reanalysis of the Tule Red computed flow results from the November 2015 study show no effects of the Tule Red Project on the computed DCC net flow.

Table of Contents

EXECUTIVE SUMMARY ..... **I**

INTRODUCTION **1**

Objective 1

REGIONAL SALINITY IMPACTS, CUMULATIVE EFFECTS ANALYSIS **1**

Tidal Restoration Projects for Cumulative Effects Analysis 2
Base Grid Configuration 4
Simulation Results 12
Cumulative Effects Results in Relation to the Tule Red Project 13

REFERENCES **19**

APPENDIX A: CUMULATIVE EFFECTS RESULTS, TABLES OF COMPUTED SALINITY (EC) CHANGE FOR SUISUN BAY AND DELTA LOCATIONS FOR 2002-2003 ..... **20**

Table of Figures

Figure 1 Mallard Farms Habitat Conservation Bank Restoration Project (Figure from RMA, 2014). Restoration includes breaching levees in three locations to increase tidal exchange with Honker Bay. 5
Figure 2 Honker Bay Conservation Bank Fish Habitat Restoration Project (Figure 15, from Dept. of Resource Management, County of Solano, 2014). Restoration includes enhancing tidal flow by lowering south levee, removing sandbags at southwest end and removing water control structure at southeast end. 6
Figure 3 Dutch Slough Tidal Marsh Restoration Project (Figure 3-3 from DWR, 2014). 7
Figure 4 Lower Yolo Restoration Project (Figure 3-1, from SFCWA, 2013). 8
Figure 5 Prospect Island Tidal Restoration Project (from DWR, 2013). The current project design includes breaches to Miner Slough at north and south ends and breaching of interior levee. 9
Figure 6 McCormack Williamson Tract restoration, Alternative 1-A (Figure 2-1 from DWR, 2010). The design includes degrading the southwest levee along Dead Horse Cut to match island elevation and allow tidal flow. 10
Figure 7 Model bathymetry for Suisun Bay and central and north Delta for the cumulative effects model grid. 11
Figure 8 Contour plots of tidally averaged EC for the Base (top) and Cumulative Effects (bottom) configurations for September 15, 2002. 16
Figure 9 Station locations for output of EC plot and table results. 17
Figure 10 Computed monthly averaged flow for 2002 for the Cumulative Effects and Base configurations, (top) for the Delta Cross Channel, (bottom) for Georgiana Slough. 18

List of Tables

Table 2 Monthly averaged Base and Cumulative Effects EC for 2002, for three western Delta locations. 14
Table 3 Computed monthly averaged Cumulative Effects EC change for 2002-2003 at the CCWD Rock Slough intake and the SWP at the entrance to the Clifton Court Forebay gates. 15
Table 5 Computed Change from Base condition monthly averaged EC (µS/cm) for the Beldons Landing and Mallard Island locations. 20
Table 6 Computed Change from Base condition monthly averaged EC (µS/cm) for the San Joaquin River at Jersey Point and the Sacramento River at Emmaton. 21
Table 7 Computed Change from Base condition monthly averaged EC (µS/cm) for the Rock Slough and Old River at Hwy 4 CCWD intake locations. 22

TABLE 8 COMPUTED CHANGE FROM BASE CONDITION MONTHLY AVERAGED EC (µS/CM) FOR THE VICTORIA CANAL CCWD INTAKE LOCATION. 23
TABLE 9 COMPUTED CHANGE FROM BASE CONDITION MONTHLY AVERAGED EC (µS/CM) FOR THE STATE WATER PROJECT (SWP) CLIFTON COURT FOREBAY INTAKE AND THE CVP INTAKE AT THE TRACY PUMPING PLANT LOCATIONS. 24

Introduction

The incremental salinity impacts of the Tule Red Tidal Marsh Restoration project were evaluated in the November 2015 Technical Memorandum, "Salinity Modeling Analysis of the Proposed Tule Red Tidal Marsh Restoration, Grizzly Island, California" (RMA, 2015a). The "with" and "without" project configurations were modeled for the 2002-2003 period. For the 2002 dry year condition, computed increases for EC at the south Delta export locations with the Tule Red project were at the most +0.1% to +0.3%.

The analysis presented in the current Technical Memorandum examines the cumulative salinity impacts/effects of the Tule Red Project with the development of other potential tidal restoration projects in the Suisun Marsh/Suisun Bay and Delta region. In addition to the Tule Red Project, six other tidal restoration projects were added to the model grid for the effects analysis:

1) Mallard Farms Conservation Bank
2) Honker Bay Conservation Bank
3) Dutch Slough Tidal Marsh Restoration Project
4) Lower Yolo Restoration Project
5) Prospect Island Tidal Restoration Project
6) McCormack Williamson Tract Project

Objective

The objectives of this study were to evaluate the cumulative effects on regional salinity of the Tule Red Tidal Restoration Project with other prospective tidal restoration projects in Suisun Marsh/Suisun Bay and the Delta region. The model used for the analysis was the RMA Bay-Delta numerical model for flow and water quality. Details of the numerical model and model configuration, boundary conditions and simulation years are available in the November 2015 TM (RMA, 2015a). This report describes the additional tidal restoration projects modeled and the results of the numerical model analysis.

Regional Salinity Impacts, Cumulative Effects Analysis

Tidal restoration around Suisun Bay and in Suisun Marsh can potentially increase modeled EC by increasing tidal prism and tidal mixing downstream of the site, and through the exchange of waters between the Bay and the restoration site (tidal trapping). Conversely, a tidal restoration may slightly dampen the tidal range upstream of the site and thus serve to slightly diminish tidal mixing further upstream towards the Delta (RMA, 2009).

Tidal restoration in the interior Delta can also similarly affect salinity mixing. In addition to the mixing component, Delta restoration projects may also affect net channel flows in the interior Delta that can slightly alter the Delta salinity distribution.

For the Bay-Delta model, Electrical Conductivity (µmhos/cm or µSiemens/cm), or EC, was modeled as a surrogate for salinity. The reference to "EC" in this document is in keeping with some past conventions, and is used as a stand-in for the more precise term of Specific Conductance (SC) for the electrical conductance corrected to 25° C.

The current analysis follows the procedure described in the November 2015 TM. The hydrodynamic (RMA2) and water quality (RMA11) models were run for the January 2002 to December 2003 period. The Water Year 2002 is classified by DWR as a "dry" year type while 2003 is classified as an "above normal" hydrology for the Sacramento River system and "below normal" for the San Joaquin River system (see http://cdec.water.ca.gov/cgi-progs/iodir/wsihist).

The boundary conditions were applied to a "Cumulative Effects" model configuration which included the Tule Red Project and the six other tidal restoration projects. A "Base" model configuration was also simulated with no Tule Red Project and none of the six other restoration projects.

Tidal Restoration Projects for Cumulative Effects Analysis

In addition to the Tule Red Tidal Restoration Project, six other tidal restoration projects in Suisun Marsh/Suisun Bay and the Delta were modeled in the cumulative effects salinity analysis:

1) Mallard Farms Conservation Bank
2) Honker Bay Conservation Bank
3) Dutch Slough Tidal Marsh Restoration Project
4) Lower Yolo Restoration Project
5) Prospect Island Tidal Restoration Project
6) McCormack Williamson Tract Project

These other tidal restoration projects are described briefly below:

Mallard Farms Habitat Conservation Bank

The proposed Mallard Farms Habitat Conservation Bank is located along the north side of Honker Bay. The site encompasses approximately 650 acres and is currently a muted tidal regime. The restoration project will construct three 300' shallow breaches to open the site to full tidal flow (Figure 1) (RMA, 2014).

Honker Bay Conservation Bank

The proposed Honker Bay Conservation Bank is located along the north side of Honker Bay, abutting the Mallard Farms Habitat Conservation Bank to the east. The 112 acre site has been managed historically as a freshwater marsh for duck hunting. With several breaches in the outer levee, the site is currently functioning as muted tidal habitat. The restoration project proposes opening of breaches and lowering of levees for tidal habitat restoration and habitat conservation for native fish (Figure 2) (Department of Resource Management, County of Solano, 2014).

Dutch Slough Tidal Marsh Restoration Project

The proposed Dutch Slough Tidal Marsh Restoration Project is located on the south side of Dutch Slough, east of Big Break. Proposed restoration of the 1,178 acre site includes creation of a mix of marsh, open water and upland habitat using grading and fill; restoration of tidal marsh, tidal channels and tidal circulation; open water management; and construction and breaching of levees (Figure 3) (DWR, 2014).

Lower Yolo Restoration Project

The Lower Yolo Restoration Project is located in the north Delta above Liberty Island. The restoration site is 3,423 acres, 1,787 acres of which would be modified under the proposed project. Lowered berms, excavated tidal channels, breached levees and grading will be implemented to restore intertidal and subtidal habitat (Figure 4) (SFCWA, 2013).

Prospect Island Tidal Restoration Project

The proposed Prospect Island Tidal Restoration Project is located west of Ryer Island in the north Delta. The site is 1,600 acres bordered by Miner Slough on the east side and the Sacramento Deep Water Shipping Channel to the west (Figure 5) (DWR, 2013). The current design includes two breaches to Miner Slough from the north and south and breaching of the interior levee (RMA, 2015b).

McCormack Williamson Tract Project

The proposed McCormack Williamson Tract Project is located in the north Delta between the Mokelumne River and Snodgrass Slough, east of the Delta Cross Channel. The site encompasses approximately 1,600 acres and is currently used as farm land. The Project proposes lowering of levees on the northeast and southwest ends of the property to allow for flood conveyance (Figure 6) (DWR, 2010).

Figure 7 shows the model bathymetry for Suisun Bay and the Delta with Tule Red and six other tidal restoration projects.

Base Grid Configuration

The base grid configuration for the cumulative effects analysis varied slightly from the base configuration used for the Tule Red only analysis presented in the November 2015 TM. The Base grid configuration for the current study included some two-dimensional representation for Delta channels in the vicinity of the six restoration projects, which were represented with one dimensional elements in the Tule Red only analysis. For example, Miner Slough adjacent Prospect Island was represented with two-dimensional elements for both the "with projects" and current study "base" configurations. Miner Slough in the Tule Red only analysis was represented with one-dimensional channel elements. As such, small computed differences can occur in computed channel flow and resulting EC between the Tule Red only base configuration and the current study base configuration.

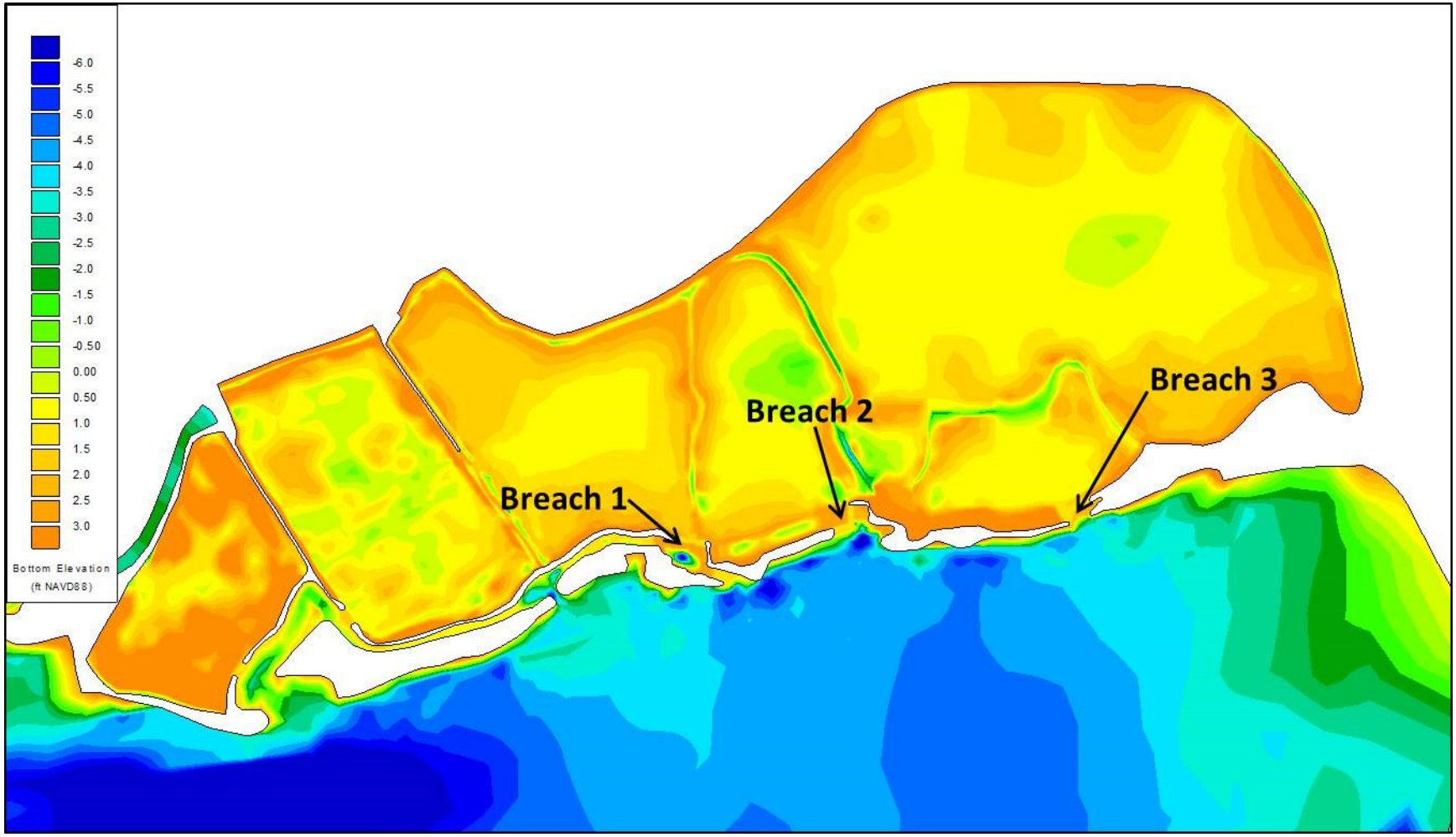

Figure 1 Mallard Farms Habitat Conservation Bank Restoration Project (Figure from RMA, 2014). Restoration includes breaching levees in three locations to increase tidal exchange with Honker Bay.

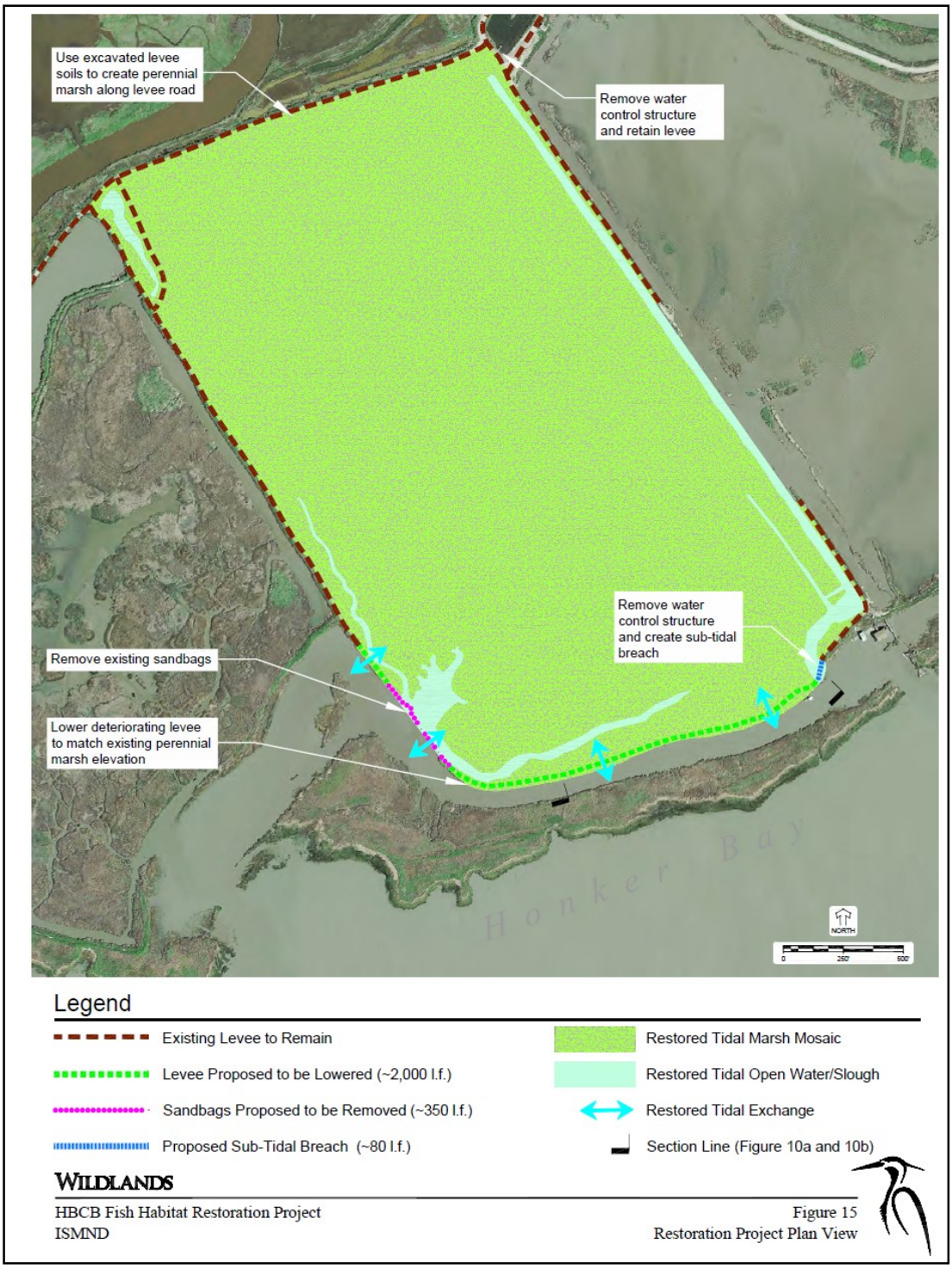

Figure 2 Honker Bay Conservation Bank Fish Habitat Restoration Project (Figure 15, from Dept. of Resource Management, County of Solano, 2014). Restoration includes enhancing tidal flow by lowering south levee, removing sandbags at southwest end and removing water control structure at southeast end.

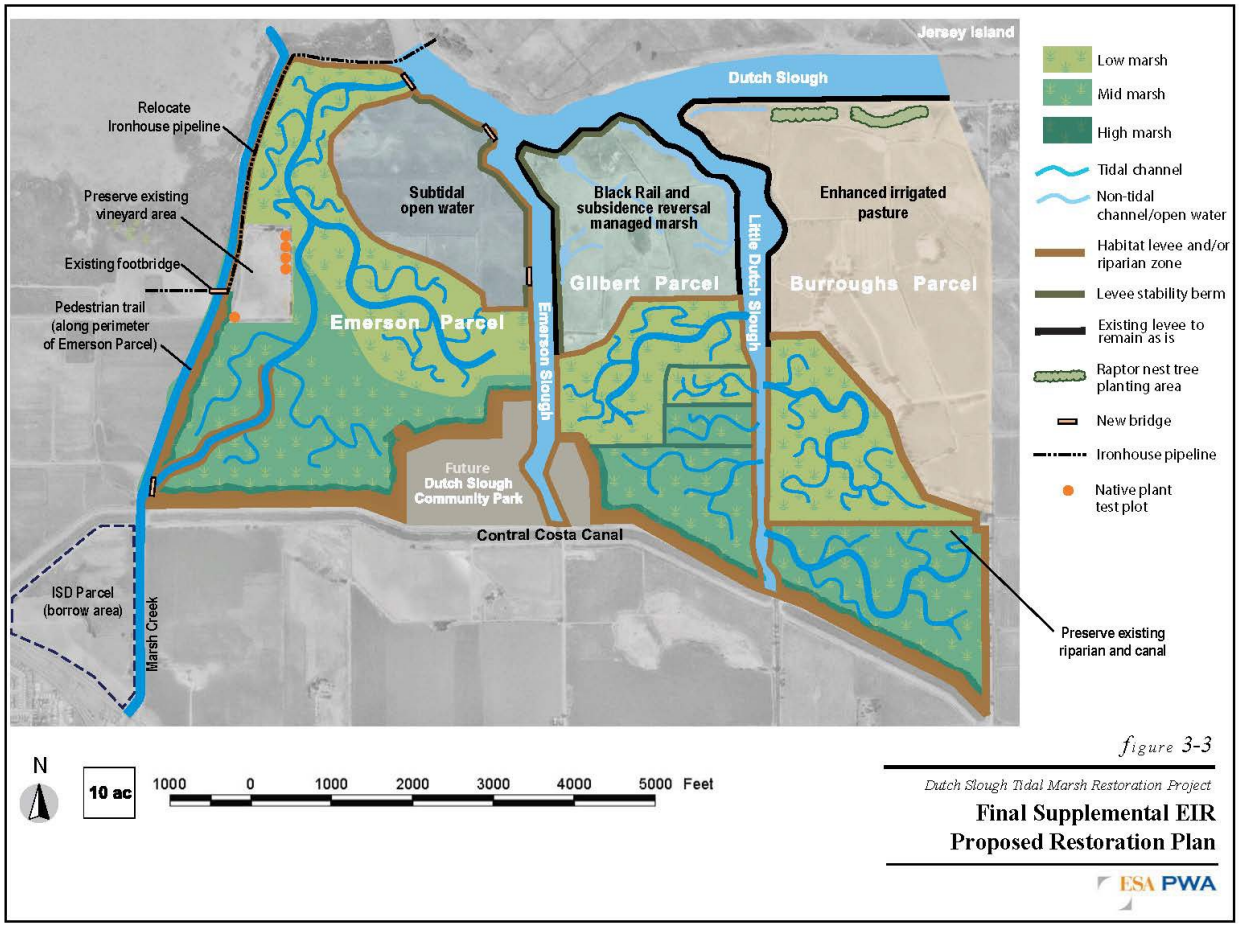

Figure 3 Dutch Slough Tidal Marsh Restoration Project (Figure 3-3 from DWR, 2014).

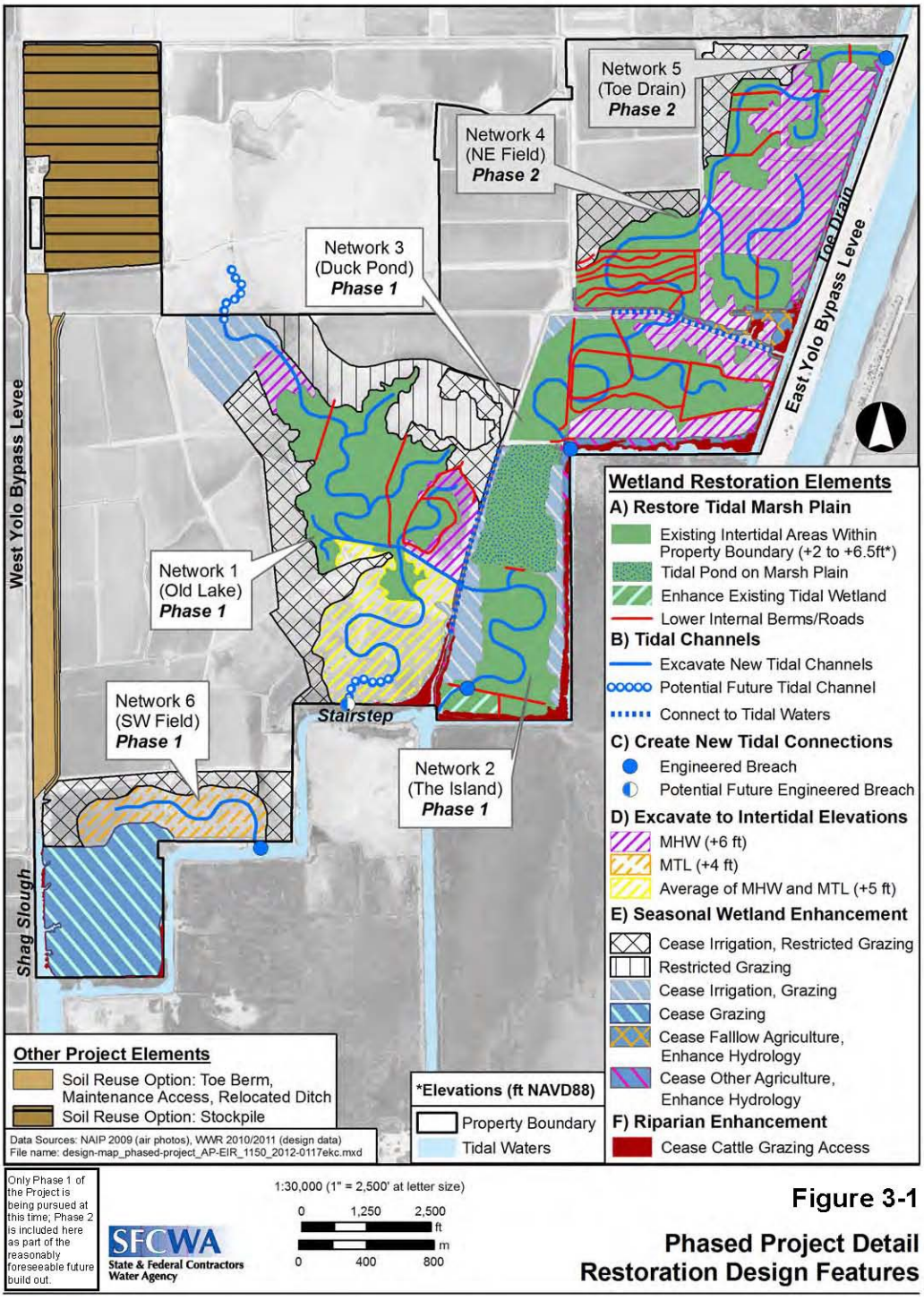

Figure 4 Lower Yolo Restoration Project (Figure 3-1, from SFCWA, 2013).

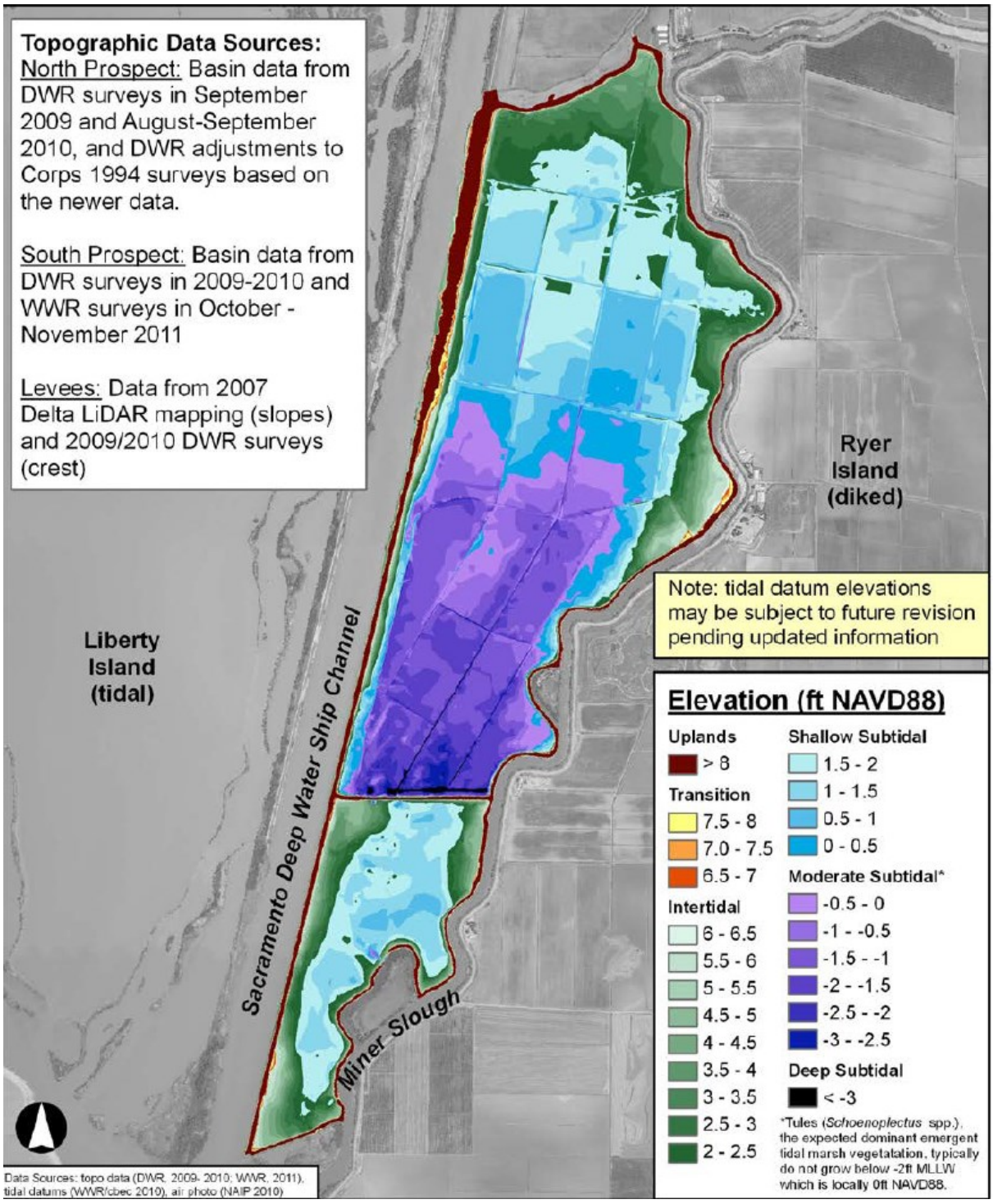

Figure 5 Prospect Island Tidal Restoration Project (from DWR, 2013). The current project design includes breaches to Miner Slough at north and south ends and breaching of interior levee.

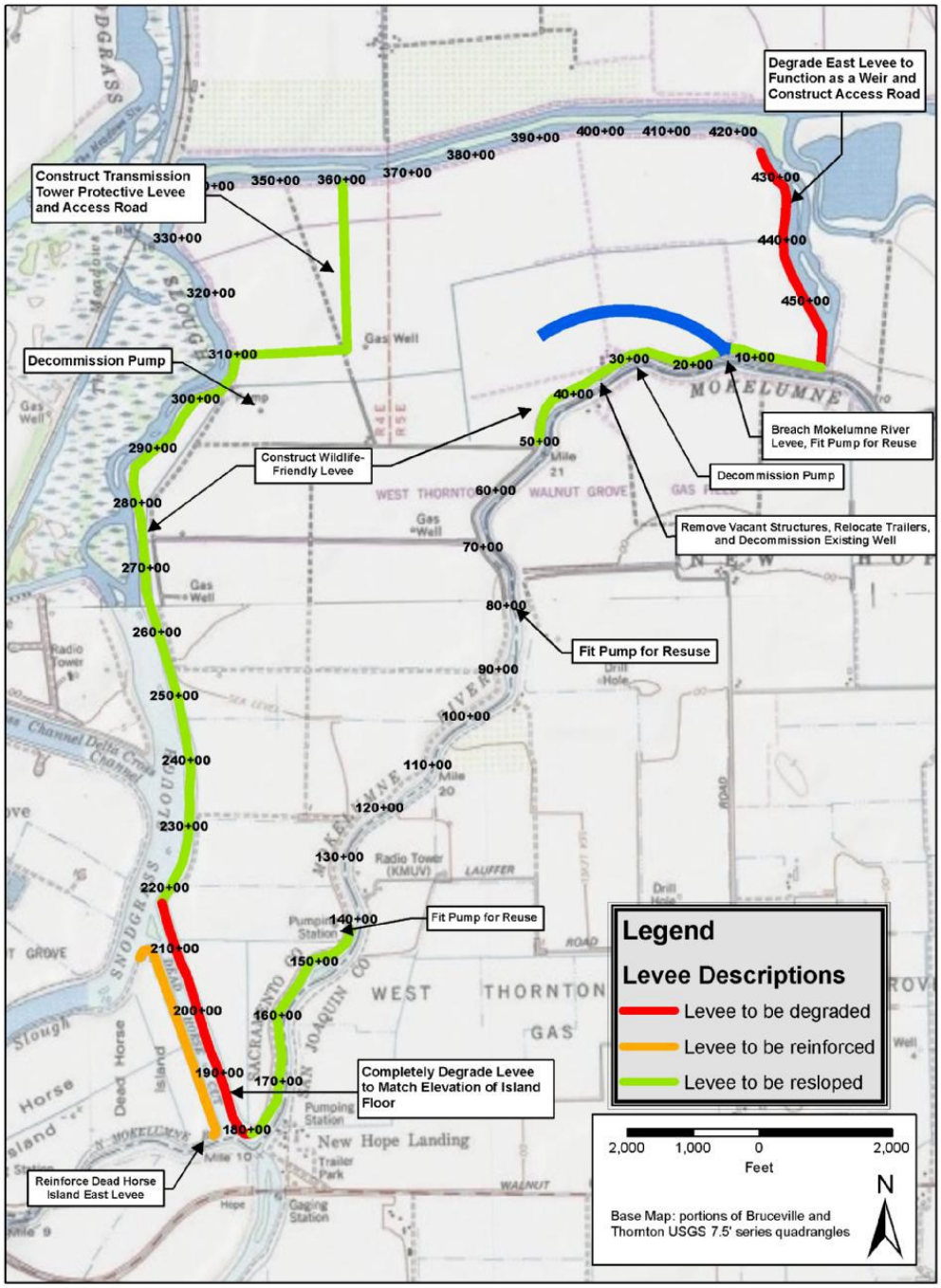

Figure 6 McCormack Williamson Tract restoration, Alternative 1-A (Figure 2-1 from DWR, 2010). The design includes degrading the southwest levee along Dead Horse Cut to match island elevation and allow tidal flow.

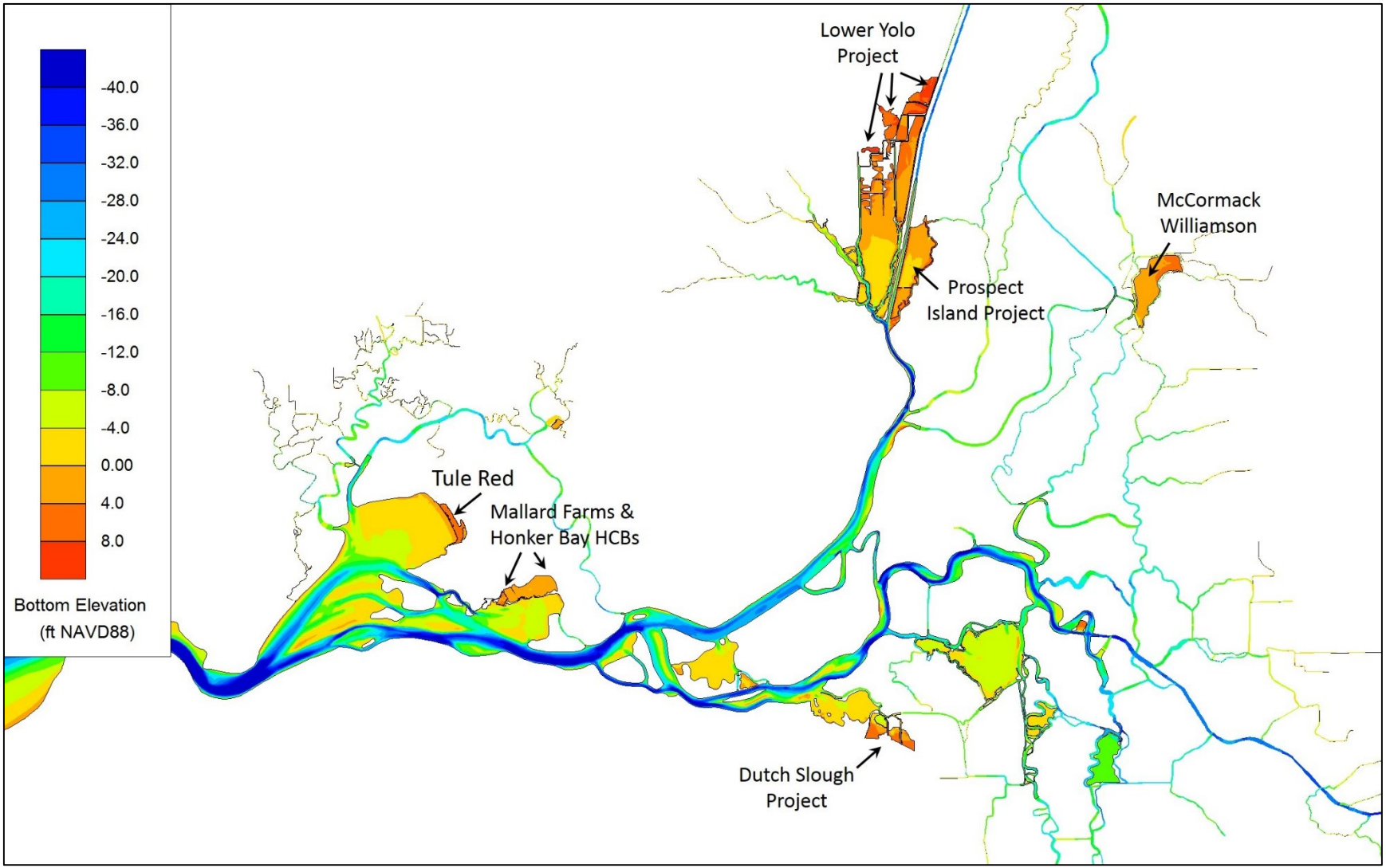

Figure 7 Model bathymetry for Suisun Bay and central and north Delta for the cumulative effects model grid.

Simulation Results

Computed EC for Tule Red and the six other tidal restoration projects (Cumulative Effects configuration) are compared to the computed Base configuration EC (none of the above restoration projects). The focus of the presentation is for the 2002 dry water year where the computed impacts are somewhat more than the wetter 2003 year. Figure 8 presents a spatial comparison of the tidally averaged Base and Project EC over Suisun Bay and the western Delta for a fall period in 2002. Some increases are apparent in the south Delta computed EC while computed EC decreases on the lower Sacramento River.

Figure 9 shows the Delta output results locations for the salinity analysis. The Cumulative Effects EC change from Base is tabulated for the three western Delta locations, the Sacramento River at Mallard Island, the Sacramento River at Emmaton and the San Joaquin River at Jersey Pointe three locations in Table 1. For the Jersey Point location, small increases in computed monthly averaged EC are seen winter and spring months (≤ 0.2%), while larger increases occur for the summer and fall (+6.7% for November). Conversely, small decreases in monthly average EC are seen for winter and spring at the Emmaton location (≤ -0.7%), with larger decreases in computed EC for the summer and fall (-6.5% for September). Computed monthly averaged EC increases slightly at the Mallard Island location (≤ 2.5%).

Tabulated monthly EC and EC change for 2002 and 2003 for the Cumulative Effects configuration vs. Base are provided for all locations shown in Figure 9 in Appendix A. The tabulated monthly results for the Rock Slough and SWP water export locations are presented in Table 2. For 2002, EC increases prior to June are small (≤ +0.2%), but increase for July and the later months. For the SWP, Clifton Court Intake location, computed monthly averaged EC increases to 8.3% for October 2002 over Base computed EC with the cumulative restoration projects.

The model results show a notable increase in central and south Delta computed EC for the summer and fall. Figure 10 presents the computed monthly averaged flow for the Delta Cross Channel (DCC) and Georgiana Slough. The plots shows a decrease of several hundred cfs in net flow through the DCC with development of the tidal restoration projects. Some of the lost DCC flow is captured in Georgiana Slough when the Cross Channel gates are open (Figure 10). However, over June-November 2002 there is about 400 cfs of flow loss to the central Delta from the north Delta in the combined flow for these two channels. The decrease of flow transfer from the north to central Delta could be the primary factor for the computed EC changes observed in the central and south Delta. The changes in computed Delta EC, higher in the south and central Delta and lower at Emmaton, primarily occur when the DCC is in operation.

Cumulative Effects Results in Relation to the Tule Red Project

The results of the current cumulative effects modeling show some increases at the south Delta exports (+8.3% at the SWP for October 2002) with the combined development of the tidal restoration projects. In comparison, results of the earlier Tule Red only analysis (RMA, 2015a) showed very small increases, +0.1% to +0.3% for the year 2002. The computed changes in the Delta Cross Channel flows discussed above with the combined set of tidal restoration projects are a likely factor in the computed increases in central and south Delta EC. Analysis of the Tule Red only base and project computed flows show no effect of the Tule Red Project on flows through the DCC and Georgiana Slough.

Table 1 Monthly averaged Base and Cumulative Effects EC for 2002, for three western Delta locations.

Month	Mallard Island			Emmaton			Jersey Point		
	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	306	0.4	1.4%	177	-0.2	-0.1%	202	0.1	0.0%
Feb 2002	1909	5.1	2.3%	212	-0.3	-0.1%	247	0.0	0.0%
Mar 2002	955	4.1	2.5%	159	-0.3	-0.2%	207	0.9	0.4%
Apr 2002	1427	10.6	2.0%	167	-0.7	-0.4%	189	0.3	0.2%
May 2002	1950	11.4	2.5%	190	-1.4	-0.7%	236	0.4	0.2%
Jun 2002	4379	22.0	1.9%	335	-10.6	-3.2%	294	7.5	2.6%
Jul 2002	8018	22.7	1.3%	613	-25.2	-4.1%	842	29.0	3.4%
Aug 2002	9056	12.5	0.6%	767	-43.1	-5.6%	1206	30.3	2.5%
Sep 2002	11127	5.2	0.6%	1326	-85.8	-6.5%	1507	60.2	4.0%
Oct 2002	12498	-3.1	0.5%	1775	-95.6	-5.4%	1401	79.9	5.7%
Nov 2002	11849	-3.5	0.7%	1676	-72.3	-4.3%	1367	91.8	6.7%
Dec 2002	6491	-2.4	1.1%	876	-16.9	-1.9%	939	52.0	5.5%

Table 2 Computed monthly averaged Cumulative Effects EC change for 2002-2003 at the CCWD Rock Slough intake and the SWP at the entrance to the Clifton Court Forebay gates.

CCWD, Rock Slough

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	433	0.7	0.2
Feb 2002	318	0.4	0.1
Mar 2002	303	0.2	0.1
Apr 2002	272	0.0	0.0
May 2002	374	0.2	0.1
Jun 2002	314	1.4	0.5
Jul 2002	362	12.8	3.5
Aug 2002	626	29.0	4.6
Sep 2002	712	40.4	5.7
Oct 2002	704	62.3	8.9
Nov 2002	680	61.5	9.0
Dec 2002	820	43.7	5.3
Jan 2003	503	13.5	2.7
Feb 2003	330	2.4	0.7
Mar 2003	268	1.2	0.4
Apr 2003	237	0.0	0.0
May 2003	357	0.4	0.1
Jun 2003	255	1.0	0.4
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

SWP, Clifton Court Intake

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	368	-0.7	-0.2
Feb 2002	331	-0.8	-0.2
Mar 2002	333	-0.8	-0.2
Apr 2002	329	0.0	0.0
May 2002	395	0.4	0.1
Jun 2002	334	1.0	0.3
Jul 2002	315	10.2	3.2
Aug 2002	476	24.2	5.1
Sep 2002	557	34.5	6.2
Oct 2002	552	45.6	8.3
Nov 2002	547	40.2	7.3
Dec 2002	579	30.6	5.3
Jan 2003	343	2.5	0.7
Feb 2003	269	-1.2	-0.5
Mar 2003	254	-0.8	-0.3
Apr 2003	319	-0.4	-0.1
May 2003	408	0.7	0.2
Jun 2003	214	0.0	0.0
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

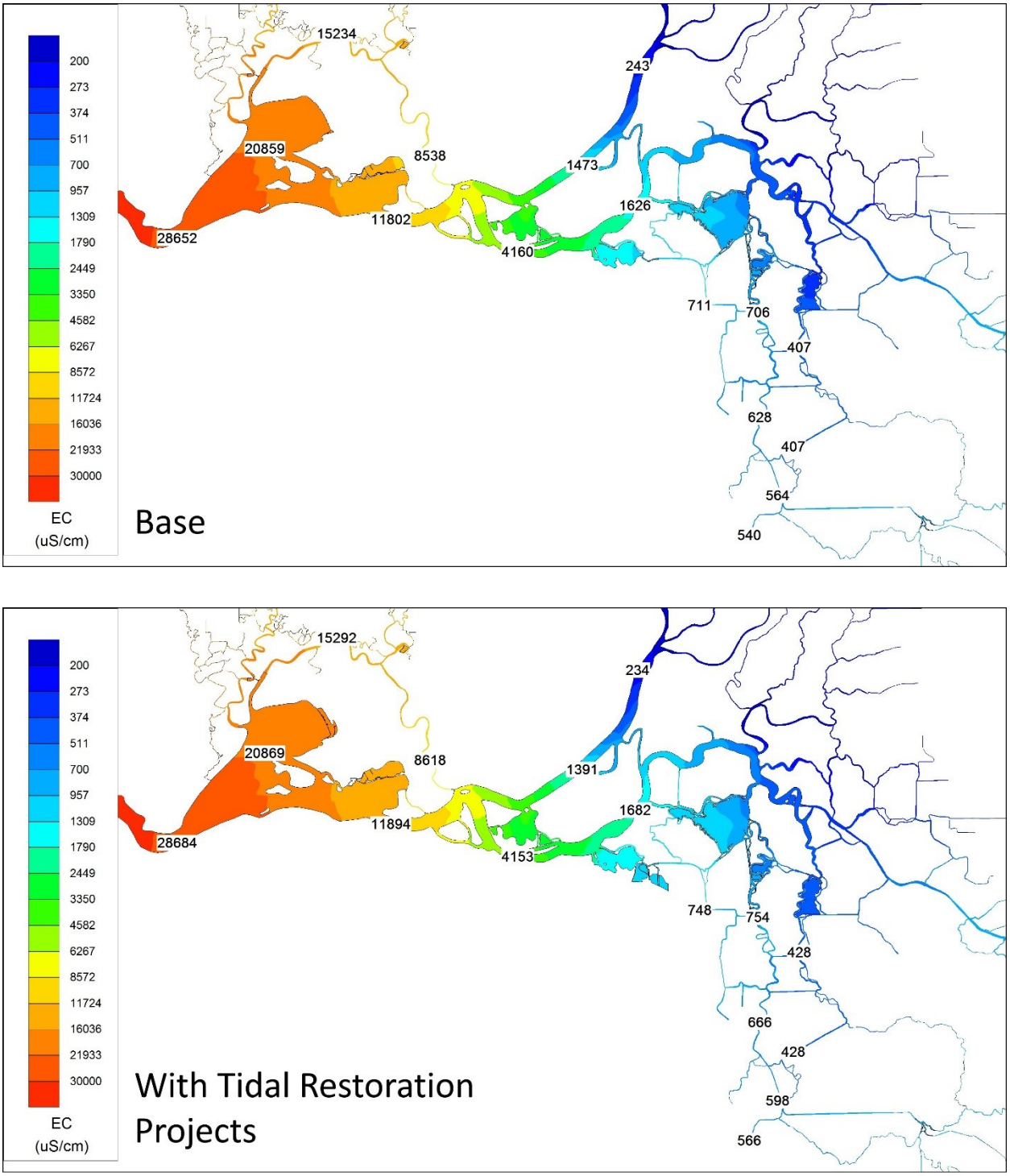

Figure 8 Contour plots of tidally averaged EC for the Base (top) and Cumulative Effects (bottom) configurations for September 15, 2002.

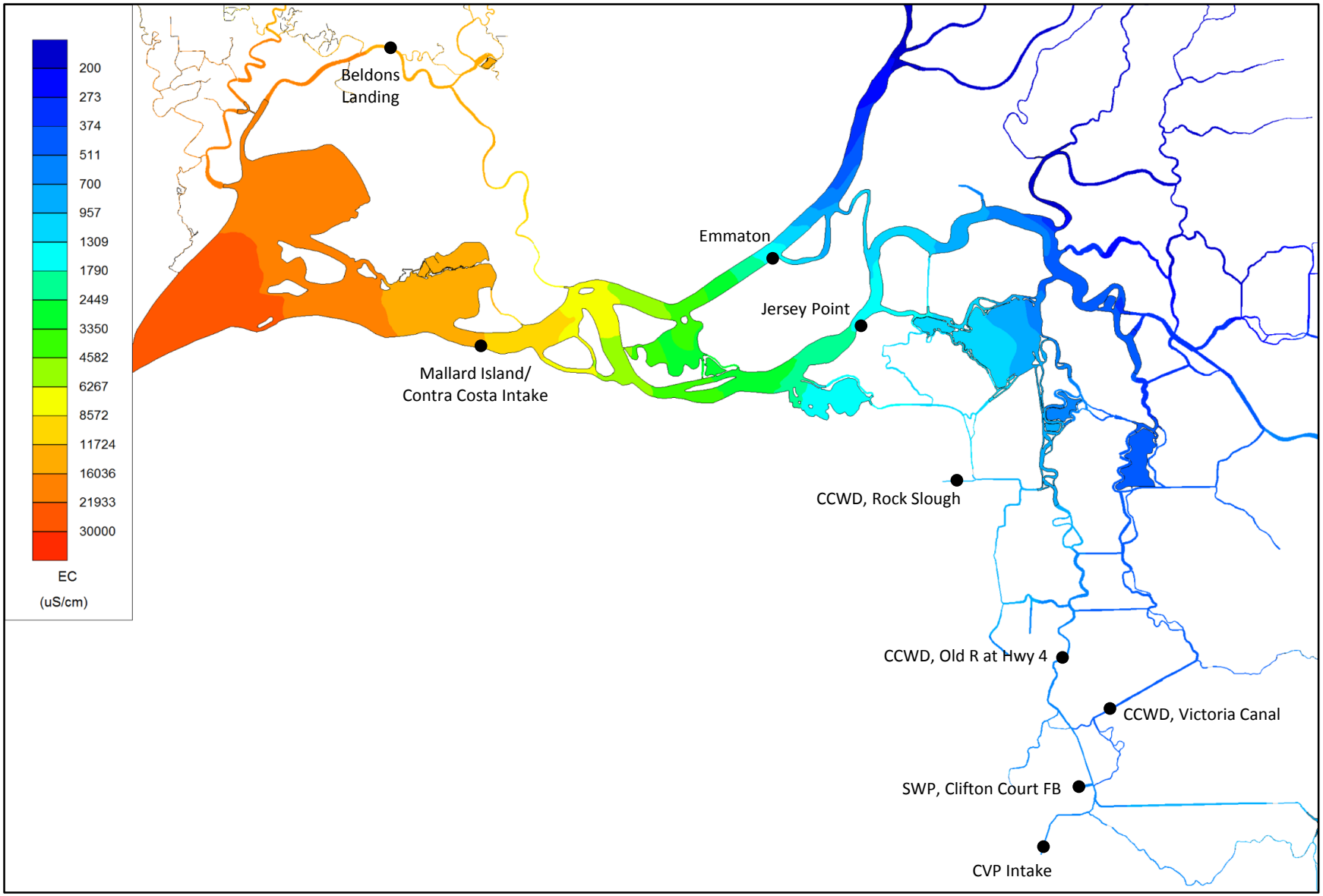

Figure 9 Station locations for output of EC plot and table results.

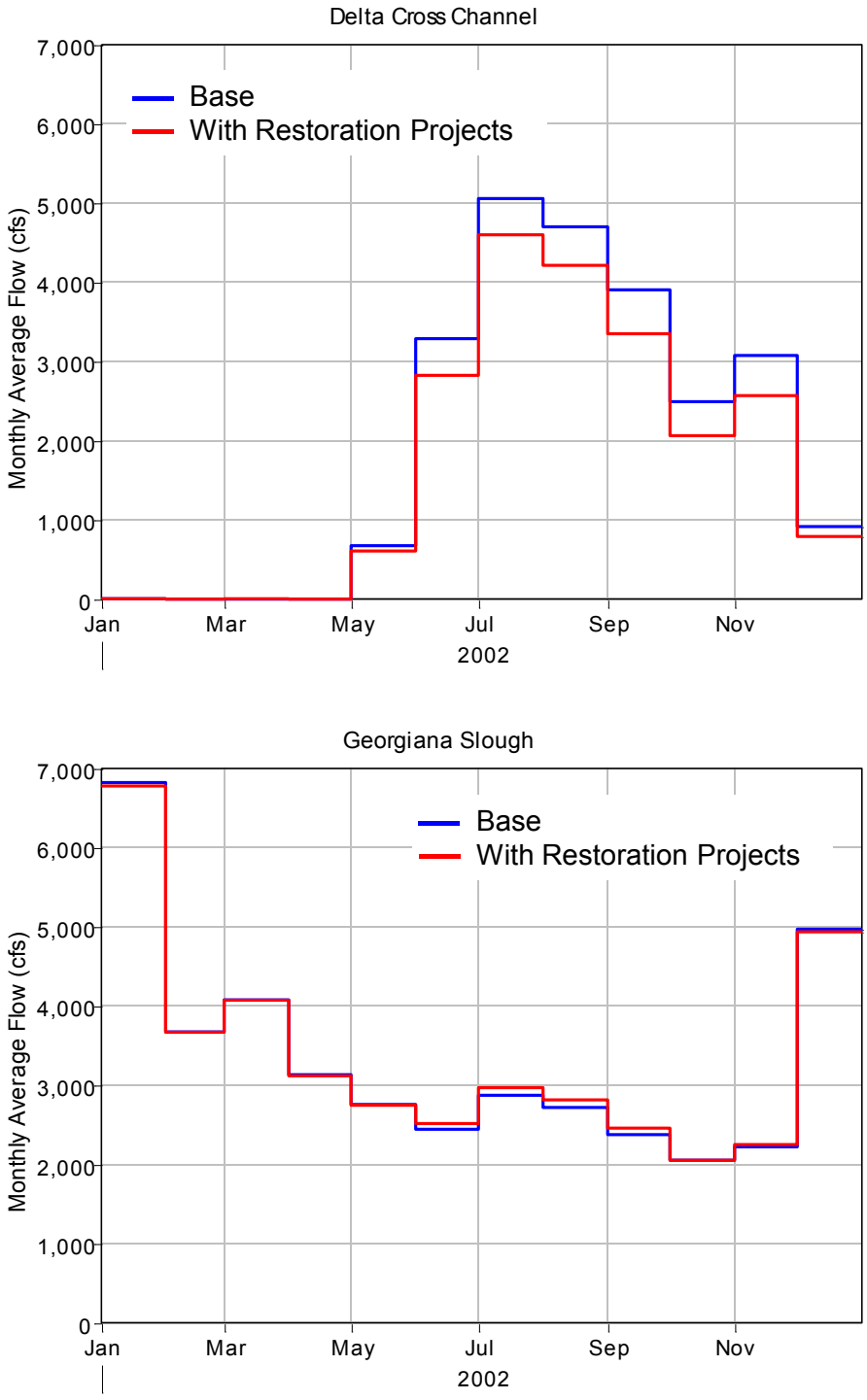

Figure 10 Computed monthly averaged flow for 2002 for the Cumulative Effects and Base configurations, (top) for the Delta Cross Channel, (bottom) for Georgiana Slough.

References

California Department of Water Resources (DWR), (2010). *North Delta Flood Control and Ecosystem Restoration Project, Final Environmental Impact Report,* California Department of Water Resources, October 2010.

DWR (2013). *Prospect Island Tidal Habitat Restoration Project Environmental Impact Report, CEQA Scoping Report*. California Department of Water Resources, Fish Restoration Program Agreement. August 2013.

DWR (2014). *Dutch Slough Tidal Marsh Restoration Project, Final Supplemental Environmental Impact Report,* California Department of Water Resources, FloodSAFE Environmental Stewardship and Statewide Resources Office. September 2014.

DWR (2004). *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh, Twenty-fifth Annual Progress Report to the State Water Resources Control Board*, October 2004.

Department of Resource Management, County of Solano (2014). *Honker Bay Conservation Bank Fish Habitat Restoration Project U-14-02, Draft Initial Study and Mitigated Negative Declaration*. August 2014.

RMA (2009). *Numerical Modeling in Support of Suisun Marsh PEIR/EIS,* September 2009. Appendix A, Suisun Marsh Habitat Management, Preservation and Restoration Plan. Vol II, Final Environmental Impact Statement/Environmental Impact Report. USBR November 2011.

RMA (2014). *Modeling of Local and Regional Impacts of the Proposed Mallard Farms Conservation Bank, Suisun Marsh California, Technical Memorandum*. Prepared for April 2014.

RMA (2015a). *Salinity Modeling Analysis of the Proposed Tule Red Tidal Marsh Restoration, Grizzly Island, California, Technical Memorandum*. Prepared for Westervelt Ecological Services. November 2015.

RMA (2015b). *Prospect Island Tidal Restoration Project, Modeling Evaluation for Miner Slough Velocity and Scour, Draft Technical Memorandum*. Prepared for Wetland and Water Resources. December 2015.

State and Federal Contractors Water Agency (SFCWA) (2013*). Lower Yolo Restoration Project, Draft Environmental Impact Report, Volume 1: Main Report*. April 2013.

Appendix A: Cumulative Effects Results, Tables of Computed Salinity (EC) Change for Suisun Bay and Delta Locations for 2002-2003

Table 3 Computed Change from Base condition monthly averaged EC (µS/cm) for the Beldons Landing and Mallard Island locations.

Beldons Landing

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	199	0.0	0.0
Feb 2002	1983	10.0	0.5
Mar 2002	2950	30.2	1.0
Apr 2002	2811	22.3	0.8
May 2002	3580	27.3	0.8
Jun 2002	5330	47.2	0.9
Jul 2002	10087	79.0	0.8
Aug 2002	13255	91.1	0.7
Sep 2002	14109	67.4	0.5
Oct 2002	12564	0.2	0.0
Nov 2002	7373	15.7	0.2
Dec 2002	4583	34.4	0.7
Jan 2003	228	3.0	1.3
Feb 2003	224	2.5	1.1
Mar 2003	1000	4.5	0.4
Apr 2003	1949	17.8	0.9
May 2003	815	9.6	1.2
Jun 2003	1102	11.0	1.0
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

Mallard Island

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	306	4.4	1.4
Feb 2002	1905	43.2	2.3
Mar 2002	953	24.2	2.5
Apr 2002	1424	28.6	2.0
May 2002	1946	48.2	2.5
Jun 2002	4379	81.6	1.9
Jul 2002	8021	102.0	1.3
Aug 2002	9053	54.9	0.6
Sep 2002	11118	70.9	0.6
Oct 2002	12487	61.1	0.5
Nov 2002	11837	87.7	0.7
Dec 2002	6482	71.9	1.1
Jan 2003	152	1.5	1.0
Feb 2003	187	3.9	2.1
Mar 2003	556	14.2	2.6
Apr 2003	870	29.5	3.4
May 2003	141	0.5	0.3
Jun 2003	1166	31.6	2.7
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

Table 4 Computed Change from Base condition monthly averaged EC (µS/cm) for the San Joaquin River at Jersey Point and the Sacramento River at Emmaton.

Jersey Point

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	202	0.1	0.0
Feb 2002	247	0.0	0.0
Mar 2002	207	0.9	0.4
Apr 2002	189	0.3	0.2
May 2002	236	0.4	0.2
Jun 2002	294	7.5	2.6
Jul 2002	842	29.0	3.4
Aug 2002	1206	30.3	2.5
Sep 2002	1507	60.2	4.0
Oct 2002	1401	79.9	5.7
Nov 2002	1367	91.8	6.7
Dec 2002	939	52.0	5.5
Jan 2003	179	4.5	2.5
Feb 2003	156	0.7	0.4
Mar 2003	159	0.2	0.1
Apr 2003	172	0.0	0.0
May 2003	182	-0.1	-0.1
Jun 2003	152	0.9	0.6
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

Emmaton

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	177	-0.2	-0.1
Feb 2002	212	-0.3	-0.1
Mar 2002	159	-0.3	-0.2
Apr 2002	167	-0.7	-0.4
May 2002	190	-1.4	-0.7
Jun 2002	335	-10.6	-3.2
Jul 2002	613	-25.2	-4.1
Aug 2002	767	-43.1	-5.6
Sep 2002	1326	-85.8	-6.5
Oct 2002	1775	-95.6	-5.4
Nov 2002	1676	-72.3	-4.3
Dec 2002	876	-16.9	-1.9
Jan 2003	142	0.6	0.4
Feb 2003	139	0.0	0.0
Mar 2003	151	-0.2	-0.1
Apr 2003	152	-0.1	-0.1
May 2003	122	0.1	0.1
Jun 2003	134	-0.6	-0.4
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

Table 5 Computed Change from Base condition monthly averaged EC (µS/cm) for the Rock Slough and Old River at Hwy 4 CCWD intake locations.

CCWD, Rock Slough

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	433	0.7	0.2
Feb 2002	318	0.4	0.1
Mar 2002	303	0.2	0.1
Apr 2002	272	0.0	0.0
May 2002	374	0.2	0.1
Jun 2002	314	1.4	0.5
Jul 2002	362	12.8	3.5
Aug 2002	626	29.0	4.6
Sep 2002	712	40.4	5.7
Oct 2002	704	62.3	8.9
Nov 2002	680	61.5	9.0
Dec 2002	820	43.7	5.3
Jan 2003	503	13.5	2.7
Feb 2003	330	2.4	0.7
Mar 2003	268	1.2	0.4
Apr 2003	237	0.0	0.0
May 2003	357	0.4	0.1
Jun 2003	255	1.0	0.4
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

CCWD, Old R at Hwy 4

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	311	-0.5	-0.1
Feb 2002	263	-0.4	-0.2
Mar 2002	267	-0.4	-0.2
Apr 2002	263	-0.1	0.0
May 2002	362	0.2	0.1
Jun 2002	304	1.5	0.5
Jul 2002	334	12.4	3.7
Aug 2002	531	27.7	5.2
Sep 2002	624	39.9	6.4
Oct 2002	598	54.0	9.0
Nov 2002	580	51.8	8.9
Dec 2002	578	40.7	7.0
Jan 2003	271	4.0	1.5
Feb 2003	199	0.0	0.0
Mar 2003	199	0.1	0.0
Apr 2003	233	-0.2	-0.1
May 2003	362	0.7	0.2
Jun 2003	196	0.1	0.1
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

Table 6 Computed Change from Base condition monthly averaged EC (µS/cm) for the Victoria Canal CCWD intake location.

CCWD, Victoria Canal

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	390	0.8	0.2
Feb 2002	304	0.1	0.0
Mar 2002	336	0.0	0.0
Apr 2002	324	0.6	0.2
May 2002	400	1.1	0.3
Jun 2002	344	1.4	0.4
Jul 2002	270	5.2	1.9
Aug 2002	340	15.7	4.6
Sep 2002	400	22.1	5.5
Oct 2002	436	25.6	5.9
Nov 2002	423	20.8	4.9
Dec 2002	462	20.4	4.4
Jan 2003	323	2.0	0.6
Feb 2003	239	0.3	0.1
Mar 2003	255	0.7	0.3
Apr 2003	285	0.8	0.3
May 2003	421	2.0	0.5
Jun 2003	242	0.1	0.1
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

Table 7 Computed Change from Base condition monthly averaged EC (µS/cm) for the State Water Project (SWP) Clifton Court Forebay intake and the CVP intake at the Tracy Pumping Plant locations.

SWP, Clifton Court Intake

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	368	-0.7	-0.2
Feb 2002	331	-0.8	-0.2
Mar 2002	333	-0.8	-0.2
Apr 2002	329	0.0	0.0
May 2002	395	0.4	0.1
Jun 2002	334	1.0	0.3
Jul 2002	315	10.2	3.2
Aug 2002	476	24.2	5.1
Sep 2002	557	34.5	6.2
Oct 2002	552	45.6	8.3
Nov 2002	547	40.2	7.3
Dec 2002	579	30.6	5.3
Jan 2003	343	2.5	0.7
Feb 2003	269	-1.2	-0.5
Mar 2003	254	-0.8	-0.3
Apr 2003	319	-0.4	-0.1
May 2003	408	0.7	0.2
Jun 2003	214	0.0	0.0
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

CVP Intake

Month	Base EC (uS/cm)	EC Chng (uS/cm)	EC Chng (%)
Jan 2002	511	0.8	0.2
Feb 2002	524	1.0	0.2
Mar 2002	539	0.3	0.1
Apr 2002	439	0.4	0.1
May 2002	405	0.3	0.1
Jun 2002	380	1.0	0.3
Jul 2002	326	8.1	2.5
Aug 2002	463	20.1	4.3
Sep 2002	548	28.5	5.2
Oct 2002	549	38.2	7.0
Nov 2002	554	31.9	5.8
Dec 2002	635	22.7	3.6
Jan 2003	536	3.3	0.6
Feb 2003	490	1.3	0.3
Mar 2003	530	1.1	0.2
Apr 2003	444	1.1	0.2
May 2003	433	0.7	0.2
Jun 2003	275	0.0	0.0
Jul 2003			
Aug 2003			
Sep 2003			
Oct 2003			
Nov 2003			
Dec 2003			

CONTRA COSTA
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September 2, 2016

Dan Riordan
California Department of Water Resources
3500 Industrial Blvd
West Sacramento, CA 95691

Subject: Comments Regarding Decker Island Restoration Project

Dear Mr. Riordan,

Contra Costa Water District (CCWD) has reviewed the August 2016 Initial Study/Mitigated Negative Declaration (IS/MND) for Decker Island Restoration Project. While CCWD supports habitat restoration in the Delta, the environmental impacts of such projects must be evaluated and mitigated as appropriate. The IS/MND contains no analysis of the Project's potential to increase seawater intrusion into the Sacramento-San Joaquin Delta, and no disclosure or mitigation of the potentially significant water quality impacts that could be caused by increased seawater intrusion. Furthermore, the IS/MND does not contain an analysis of the cumulative impacts the Project and other restoration projects planned in the area could have on Delta water quality.

Depending on location and configuration, tidal habitat restoration projects in the Delta and Suisun Marsh can increase or decrease Delta salinity. CCWD provides water diverted at its four intakes in the Sacramento-San Joaquin Delta to approximately 500,000 people in Contra Costa County. Small changes in water quality at CCWD intakes, even in the absence of water quality objective violations, can impact operations, water supply, and water quality served to customers. CEQA guidelines require that such impacts be analyzed, and given CCWD's dependence on the Delta, it is vital to understand how the Project could change Delta water quality.

To avoid cumulative water quality and supply impacts, all habitat restoration projects should be sequenced so that there is no net significant water quality degradation at any time. CCWD has made this comment on environmental documents for Delta tidal restoration projects such as the 2011 Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/ Environmental Impact Report, the 2013 Notice of Preparation for the Prospect Island Tidal Habitat Restoration Project, the 2013 Initial Study/Mitigated Negative Declaration for the Mallard Farms Conservation Bank, the 2014 Dutch Slough Tidal Marsh Restoration Project Supplemental Environmental Impact Report, the 2014 Initial Study/Mitigated Negative Declaration for the Honker Bay Conservation Bank, and the 2015 Tule Red Addendum to the Suisun Marsh Habitat Management, Preservation, and Restoration Plan Environmental Impact Statement/ Environmental Impact Report, and we reiterate it here. If significant water quality impacts cannot be avoided, then appropriate mitigation is required.

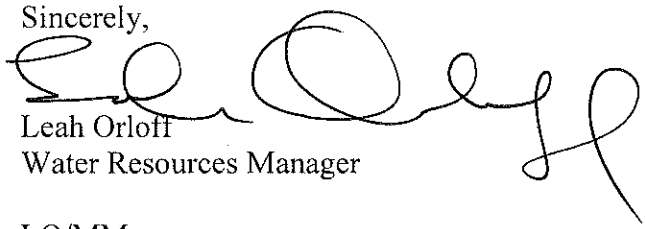
Because the Environmental Impact Report is the "heart of CEQA" and a negative declaration ends environmental review, a "low threshold" is required for preparation of an EIR. (*No Oil, Inc. v. City of Los Angeles* (1974) 13 Cal.3d 68, 84.) An agency's "decision not to require an EIR can be upheld only when there is no credible evidence to the contrary." (*Sierra Club v. County of Sonoma* (1992) 6 Cal.App.4th 1307, 1318.) '"A governmental agency must prepare an EIR on any project that may have a significant impact on the environment.' .... 'A negative declaration is inappropriate' ... and an EIR is required whenever 'it can be fairly argued on the basis of substantial evidence that the project may have significant environmental impact.'" (*Nelson v. County of Kern* (2010) 190 Cal.App.4th 252, 266-267.) Accordingly, the IS/MND should be withdrawn, and an EIR containing a detailed, good faith reasoned analysis of these issues should be prepared and circulated.

In 2014, CCWD reached a settlement agreement with the Mallard Farms Habitat Conservation Bank guaranteeing the public release of the proprietary RMA modeling inputs and results that future restoration projects can use to identify water quality impacts on an individual and cumulative basis so that they can be mitigated to the extent necessary. The settlement agreement includes information related to the Mallard Farms Habitat Conservation Bank and the Dutch Slough Tidal Marsh Restoration Project. In 2015, the proponents of the Tule Red Restoration Project further updated the RMA model to include the following proposed projects: Tule Red, Prospect Island, Lower Yolo, and McCormack Williamson. In addition, as you know, the Department of Water Resources is now working with RMA to refine the modeling and include more proposed projects.

CCWD requests that the new environmental document for the Project utilizes the most current available RMA model, and information regarding other restoration projects, to analyze potential water quality impacts on an individual and cumulative basis. We would be happy to work with you on determining the appropriate modeling tool and input assumptions, and we look forward to reviewing your analysis of the potential water quality and water supply impacts of the Project on an individual and cumulative basis once it has been completed.

The attachment to this letter contains CCWD's previous comments on similar restoration projects and results of previous modeling efforts. Please call me at 925-688-8083 or call Maureen Martin at 925-688-8323 if you have any questions or would like to discuss our comments.

Sincerely,



Leah Orloff
Water Resources Manager

LO/MM:wec

Attachment

End of attachments to CCWD

Central Delta Water Agency

(CDWA)

CDWA

CENTRAL DELTA WATER AGENCY

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October 7, 2016

Via Email to frpa@water.ca.gov
and U.S. First Class Mail to:

Dept. of Water Resources
Attn: Daniel Riordan
P.O. Box 942836
Sacramento, CA 94236

Re: CDWA Comments on the Draft EIR for the Prospect Island Tidal Habitat Restoration Project.

Dear Mr. Riordan:

The creation of tidal habitat, such as the proposed project, raises numerous questions and concerns. While the DEIR attempts to address many of those questions and concerns, the DEIR's discussion and analysis is lacking in numerous, significant respects, including those discussed herein.

1. **Improper Peacemealing of the 8,000 Acre Tidal Habitat Restoration Obligation.**

According to the DEIR at page xix:

> The overarching goal of the Project is to restore tidal action to the interior of Prospect Island. The Project is intended to partially fulfill the 8,000-ac tidal habitat restoration obligations of DWR contained within Reasonable and Prudent Alternative (RPA) 4 of the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion (BiOp) for long-term coordinated operations of the State Water Project (SWP) and the federal Central Valley Project (CVP) (USFWS 2008).

CDWA-1

At the outset, the DEIR appears to be a piecemealed analysis of a small piece of that 8,000-acre tidal habitat restoration obligation. Nearly the entire gamut of potentially significant environmental impacts resulting from this project has the potential to be cumulatively significant when similar impacts from all 8,000 acres of tidal habitat restoration are evaluated as a whole. Unless and until there is a programmatic or other analysis of the "whole" of the 8,000 acre obligation, this DEIR is ineffective and cannot support the approval of this project.

2. **Tidal Prism Impacts.**

The DEIR acknowledges that this project will increase the tidal prism. However, it's analysis of the impacts of such on Delta flow and water quality is based on whether the projects will be able to meet and maintain the Delta water flow and quality standards if the project is implemented. That is not the proper CEQA analysis that must be conducted. Instead, the analysis must evaluate the potential magnitude of the project's impacts on flow and water quality (both individually and cumulatively in light of other past, present and reasonably foreseeable future projects, such as the remainder of the 8,000 acre objective), and then, among other things, analyze where the water will come from in order to offset any impacts to flow and water quality, and identify the entire host of potentially significant impacts that may result from redirecting that water from where it would have been used in the absence of the project. For example, to the extent such offsetting will foreseeably come from reservoir releases, impacts to cold water pool storage, carryover storage, river flows, water quality, etc., will be foreseeable and potentially significant. CDWA-2

Moreover, such analysis should be conducted during foreseeable drought conditions, such as the instant drought period where widespread water curtailments are implemented, because during such times every drop of water becomes critical and, hence, offsetting the individual and cumulative impacts from the project correspondingly becomes critical and the potentially significant impacts resulting from such offsetting become heightened. Thus far, the DEIR appears to have done no analysis for the tidal prism impacts, as well as for other impacts, during historical and foreseeable extended drought hydrologic conditions. CDWA-3

3. **Seepage Impacts.**

For Impacts 3.1-3 and 3.1-6, the DEIR states the following as part of the mitigation measures for any increased seepage to adjacent areas resulting from the project:

> Additionally, DWR would continue groundwater and surface water monitoring during and after implementation of the Proposed Project, which would allow for assessment of conditions following restoration.

The DEIR should describe and explain the specifics of that groundwater and surface water monitoring that will continue during and after implementation of the project, as well as what events would trigger the need for a response by DWR to address any increased seepage, and what that response would entail. As it stands, the DEIR recognizes the need to conduct monitoring yet improperly defers the formulation of mitigation measures (or even performance standards) to address any seepage detected by such monitoring. CDWA-4

4. **Adjacent Levee Impacts.**

While the DEIR purports to analyze impacts on adjacent levees, the DEIR does not adequately explain how the non-breached portions of the Prospect Island levees will be operated and maintained, and to what standards, throughout the duration of the project. Impacts from CDWA-5 (Cont. below)

wind-wave erosion and impacts from the alteration of the flow and velocity of the waters in the vicinity of the project as a result of the project could greatly increase and take on new dimensions should there be one or more unintended breaches of the levee system. The DEIR should explain how those unintended breaches will be avoided if that is the proposed plan. If, however, the proposed plan is allow or not remedy any such breaches, then the DEIR must analyze impacts such as wind-waves, scour, seepage, etc. on adjacent levees (including any increased operation and maintenance costs of those levees) in light of that "breached" condition.

CDWA-5 (Cont.)

Moreover, impacts such as wind-waves, scour, seepage, altered hydrodynamics/flow, etc. on adjacent levees/islands will likely be considerably more pronounced during extreme high flow/flood/wind storm events. Thus far the DEIR does not appear to analyze such impacts during such events and thereby significantly underestimates the potential significance of such impacts.

CDWA-6

5. **Lack of an Identified Water Right for the Project.**

The DEIR asserts that the breaching of the levees will not constitute a "diversion of water" within the meaning of Water Code section 5100. That section, however, defines a "diversion" as the "taking of water by gravity . . . from a surface stream . . . into a canal, pipeline, or other conduit, and includes impoundment of water in a reservoir." Because the proposed levee breaches are "conduits" through which the surface water will flow via gravity into Prospect Island, a "diversion" of water will indeed occur. The DEIR should thoroughly explain the water right or water rights the project will be relying on to conduct those diversions and, in particular, discuss the priority of those water rights and how diversions will be halted in order to protect more senior water rights in the event the SWRCB curtails water rights based on priority as it did in 2014 and 2015.

CDWA-7

6. **Fishery Impacts.**

In the analysis of Impact 3.3-9, "Post-construction increased predation on native fish," consideration was only given to the impacts of fish predation by other piscivorous fish. Many species of wildlife in the Delta prey upon fish including, but not limited to Pelicans, Egrets, Cormorants, Herons, Grebes, Minks and Otters. (See attached photo of Pelicans and Egrets foraging for fish in a pond adjacent to the San Joaquin River in Middle Roberts Island.)

CDWA-8

Furthermore the growth benefits of restored floodplain habitat on out migrating juvenile salmon appear to be greatly exaggerated and the narrative presented in the DEIR is not supported by the science cited in the document. For example, the DEIR's implication that growth benefits to out migrating smolts increases survival by "[e]ffectively eliminating the potential of predation by piscivorous fish" at page 3-124 is misplaced. The contention that due to the extreme productivity and habitat refuge provided on the island out migrating smolts might grow so big they would be too large to fit in the mouths of predators appears to be wholly unsupported by the cited studies.

CDWA-9 (Cont. below)

///

Moreover, important fishery studies appear to have been overlooked or not adequately addressed in the preparation of the project and subsequent analysis, including the following two studies.

The study by Ted R. Sommer, William C. Harrell and Matthew L. Lobriga titled "Habitat use and Stranding Risk of Juvenile Chinook Salmon on a Seasonal Floodplain" published online November 4, 2005, North American Journal of Fisheries Management 25: 193-1504, 2005 reflects uncertainty as to habitat benefits from flooded areas, including seasonal flooding of floodplains. (A copy of the study is attached hereto.)

The study concludes that "Floodplains appear to be a viable rearing habitat for Chinook Salmon, making Floodplain restoration an important tool for enhancing salmon production" and that "seasonal habitat should be considered as part of restoration plans for this species."

The survival data from the study is as follows:

Release Group	1998 (53,000)	1999 (105,000)	2000 (55,000)
Yolo Bypass	75	136	27
Sacramento River	35	138	47
Survival Ratio	2.14	0.99	0.57

CDWA-9
(Cont. below)

Although the report finds that "The limited results suggest that fry-adult survival rates were at least comparable in the Yolo Bypass and Sacramento River" the data reflects that the positive results are related to higher flow and the negative results are related to lower flow through the bypass.

The subject management area although still located within the boundary of the lower bypass is in great part no longer "Floodplain" or seasonally flooded but rather is to be a permanently inundated area bordered by wetlands.

The April 2011 report by Dave Vogel titled "Insights into the Problems, Progress, and Potential Solutions for Sacramento River Basin Anadromous Fish Restoration"prepared for the Northern California Water Association and Sacramento Valley Water Users contains the results of studies which include the Liberty Island Ecological Reserve area. (The entire study can be viewed on the Northern California Water Association website by clicking on "Fisheries"; excerpts are attached hereto).

At pages 112 and 113 the report provides:

> Subsequent, additional juvenile salmon telemetry studies were conducted by Natural Resource Scientists Inc. on behalf of the USFWS and CALFED in the north Delta (Vogel 2001, Vogel 2004). Triangulating radio-tagged fish locations

in real time (Figure 61) clearly demonstrated how juvenile salmon move long distances with the tides and were advected into regions with very large tidal prisms, such as upstream into Cache Slough and into the flooded Prospect and Liberty Islands (Figure 62). During the studies, it was determined that some radio-tagged salmon were eaten by predatory fish in northern Cache Slough, near the levee breaches into flooded islands (discussed below).

At page 120 the report provides:

During recent years, there has been an emphasis to reclaim or create shallow, tidal wetlands to assist in re-recreating the form and function of ecosystem processes in the Delta with the intent of benefitting native fish species (Simenstad *et al.* 1999). Amoung a variety of measures to create such wetlands, Delta island levees either have been breached purposefully or have remained unrepaired so the islands became flooded. A recent example is the flooding of Prospect Island which was implemented under the auspices of creating shallow water habitat to benefit native fish species such as anadromous fish (Christophel *et al.* 1999). Initial fish sampling of the habitat created in Prospect Island suggested the expected benefits may not have been realized due to an apparent dominance of non-native fish (Christophel *et al.* 1999). Importantly, a marked reduction of sediment load to the Delta in the past century (Shvidchenko *et al.* 2004) has implications in the long-term viability of natural conversion of deep water habitats on flooded Delta islands into shallow, tidal wetlands. The very low rates of sediment accretion on flooded Delta islands indicate it would take many years to convert the present-day habitats to intertidal elevations which has potentially serious implications for fish restoration (Nobriga and Chotkowski (2000) due to likely favorable conditions for non-salmonid fish species that can prey on juvenile salmon. Studies of the shallow water habitats at flooded Delta islands showed that striped bass and largemouth bass represented 88 percent of the individuals amoung 20 fish species sampled (Nobriga *et al.* 2003).

CDWA-9
(Cont. below)

There have likely been significant adverse, unintended consequences of breaching levees in the Delta. There is a high probability that site-specific conditions at the breaches have resulted in hazards for juvenile anadromous fish through the creation of favorable predator habitats. The breaches have changed the tidal prisms in the Delta and can change the degree in which juvenile fish are advected back and forth with the tides (Figure 61; previously discussed). Additionally, many of the breaches were narrow which have created deep scour holes favoring predatory fish. Sport anglers are often seen fishing at these sites during flood or ebb tides. Breaching the levees at Liberty Island is an example (Figure 72 and 73). Recent acoustic-tagging of striped bass in this vicinity confirmed a high presence of striped bass (Figure 74, D. Vogel, unpub. data.)

The evidence appears to be clear that the increased tidal prism and advection of juvenile salmon into the area of Cache Slough, Prospect Island and Liberty Island resulting from

maintaining Lower Liberty Island as proposed will likely cause ongoing significant adverse impacts to juvenile salmon.

CDWA-9 (Cont.)

7. **Monitoring of the Project's Benefits.**

Many of the purported benefits of the project are highly questionable. The DEIR, however, is void of any measurable, quantifiable biological objectives or goals. There was seemingly no attempt to establish or predicate or evaluate the success/benefits or failure or detriment to listed species. Without a clearly delineated method to evaluate the success or failure of the project, and without a specific plan to address any failures, the DEIR is inadequate. Even mitigation measures themselves need to be analyzed under CEQA, and to do that, they must be first be identified which, in this respect, they are not.

CDWA-10

8. **Conclusion.**

As it stands the DEIR is not in compliance with CEQA. The above and another deficiencies must first be duly corrected and addressed prior to approval of this project.

Respectfully submitted,

Dante J. Nomellini, Jr.
Attorney for the CDWA

Enclosures

Start of attachments to CDWA

Insights into the Problems, Progress, and Potential Solutions for Sacramento River Basin Native Anadromous Fish Restoration



Spring-Run Chinook Salmon in Mill Creek, California (Photo by Dave Vogel)

April 2011

Prepared for:

Northern California Water Association
and
Sacramento Valley Water Users

Prepared by:

Dave Vogel, Senior Scientist
Natural Resource Scientists, Inc.
P.O. Box 1210
Red Bluff, CA 96080
dvogel@resourcescientists.com

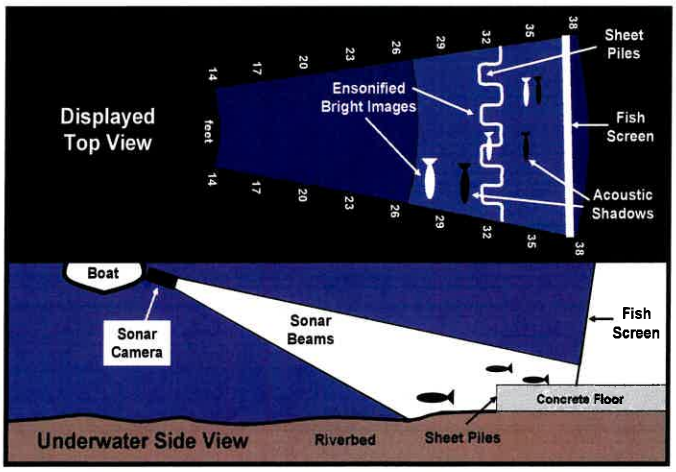

Figure 60. Schematics of DIDSON™ imaging at the base of a flat-plate fish screen. Bottom diagram shows orientation of sonar beams from the acoustic camera off the side of a boat and submerged objects at the fish screens. Top diagram shows the resultant corresponding sonar imaging of objects ensonified with acoustic shadows from the objects. (from Vogel 2008b)

From 1996 through 2010, Natural Resource Scientists, Inc. conducted 22 separate research projects on juvenile salmon (including four studies of predatory fish) in the Delta using acoustic or radio telemetry as a means to gain an improved understanding of fish movements and mortality (Vogel 2010a). The reason juvenile salmon telemetry studies were initiated in the Delta was to acquire detailed data on fish behavior, fish route selection through complex channels, and estimate fish survival in discrete reaches. Past efforts using traditional coded-wire tagging could not answer those critically important questions. Research findings from the telemetry investigations indicate that smolt survival assumptions and models must incorporate these new conclusions to avoid misinterpretation of data and improve quantitative estimates of fish survival and movements (Vogel 2010a).

The first successful use of telemetry on juvenile salmon in the Central Valley was conducted by Natural Resource Scientists, Inc. on behalf of EBMUD in 1996 and 1997. At that time, the specific behavior of juvenile salmon in the Delta was largely unknown. The initial studies quickly determined that the fish did not move as a school, but instead, dispersed, exhibiting a wide range in migratory behaviors in the complex Delta environment. Salmon moved many miles back and forth each day with the ebb and flood tides and the side channels (where flow was minimal) were largely unused. Site-specific hydrodynamic conditions present at flow splits when the fish arrived had a major affect in initial route selection. Importantly, some of the salmon were believed to have been preyed upon based on very unusual behavior patterns (Vogel 2010a).

Subsequent, additional juvenile salmon telemetry studies were conducted by Natural Resource Scientists Inc. on behalf of the USFWS and CALFED in the north Delta (Vogel 2001, Vogel 2004). Triangulating radio-tagged fish locations in real time (Figure 61) clearly demonstrated

how juvenile salmon move long distances with the tides and were advected into regions with very large tidal prisms, such as upstream into Cache Slough and into the flooded Prospect and Liberty Islands (Figure 62). During the studies, it was determined that some radio-tagged salmon were eaten by predatory fish in northern Cache Slough, near the levee breaches into flooded islands (discussed below). Also, monitoring telemetered fish revealed that higher predation occurred in Georgiana Slough as compared to the lower Sacramento River (Figure 63). As discussed previously, past coded-wire tagging studies found that salmon released into northern Georgiana Slough were found to have a higher mortality rate than fish released downstream of the slough in the Sacramento River (Brandes and McLain 2001).



Figure 61. Left picture, mobile telemetry conducted in the north Delta. Photo by Dave Vogel.
Figure 62. Right picture, telemetered locations of approximately 100 radio-tagged salmon smolts released in the lower Sacramento River near Ryde (data from Vogel 2001 and Vogel 2004).

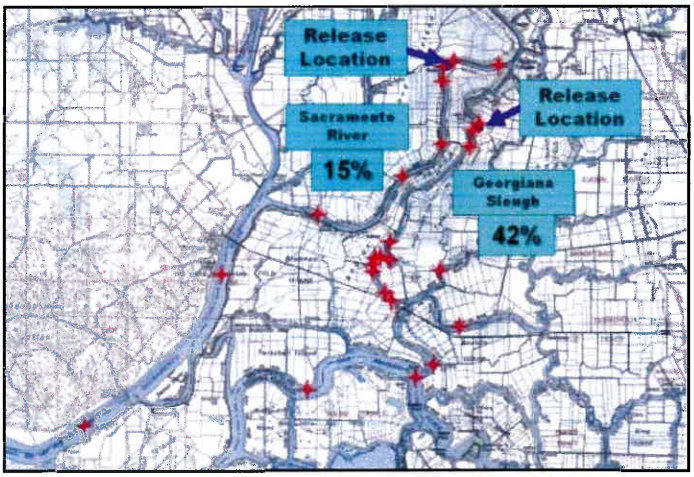

Figure 63. Estimated mortality rate for groups of radio-tagged salmon released at two locations in the north Delta and locations where radio-tagged salmon smolts were detected to have been preyed upon (Vogel 2001, Vogel 2004).

More recently, a 2007 study conducted by releasing acoustic-tagged juvenile salmon in the San Joaquin River found 116 motionless juvenile salmon transmitters in the lower San Joaquin River near the Stockton Waste Water Treatment Plant and a nearby bridge (Figure 64) (Vogel 2007b). This was an all-time record for the largest number of dead radio- or acoustic-telemetered juvenile

vegetation at some sites in the Delta and water clarity. Increased water clarity for sight predators such as black bass and striped bass would presumably favor predatory fish over prey (*e.g.*, juvenile salmon). Fewer native fish species are found in *Egeria* stands compared to introduced fish species (Grimaldo and Hymanson 1999). Additionally, it has been hypothesized that high densities of *Egeria* in portions of the Delta may restrict juvenile salmon access to preferred habitats, forcing salmon to inhabit deep water or channel areas where predation risks may be higher (Grimaldo *et al.* 2000).

During recent years, there has been an emphasis to reclaim or create shallow, tidal wetlands to assist in re-recreating the form and function of ecosystem processes in the Delta with the intent of benefitting native fish species (Simenstad *et al.* 1999). Among a variety of measures to create such wetlands, Delta island levees either have been breached purposefully or have remained unrepaired so the islands became flooded. A recent example is the flooding of Prospect Island which was implemented under the auspices of creating shallow water habitat to benefit native fish species such as anadromous fish (Christophel *et al.* 1999). Initial fish sampling of the habitat created in Prospect Island suggested the expected benefits may not have been realized due to an apparent dominance of non-native fish (Christophel *et al.* 1999). Importantly, a marked reduction of sediment load to the Delta in the past century (Shvidchenko *et al.* 2004) has implications in the long-term viability of natural conversion of deep water habitats on flooded Delta islands into shallow, tidal wetlands. The very low rates of sediment accretion on flooded Delta islands indicate it would take many years to convert the present-day habitats to intertidal elevations which has potentially serious implications for fish restoration (Nobriga and Chotkowski (2000) due to likely favorable conditions for non-salmonid fish species that can prey on juvenile salmon. Studies of the shallow water habitats at flooded Delta islands showed that striped bass and largemouth bass represented 88 percent of the individuals among 20 fish species sampled (Nobriga *et al.* 2003).

There have likely been significant adverse, unintended consequences of breaching levees in the Delta. There is a high probability that site-specific conditions at the breaches have resulted in hazards for juvenile anadromous fish through the creation of favorable predator habitats. The breaches have changed the tidal prisms in the Delta and can change the degree in which juvenile fish are advected back and forth with the tides (Figure 61; previously discussed). Additionally, many of the breaches were narrow which have created deep scour holes favoring predatory fish. Sport anglers are often seen fishing at these sites during flood or ebb tides. Breaching the levees at Liberty Island is an example (Figure 72 and 73). Recent acoustic-tagging of striped bass in this vicinity confirmed a high presence of striped bass (Figure 74, D. Vogel, unpub. data).



Figure 72. Liberty Island in the north Delta before and after flooding.

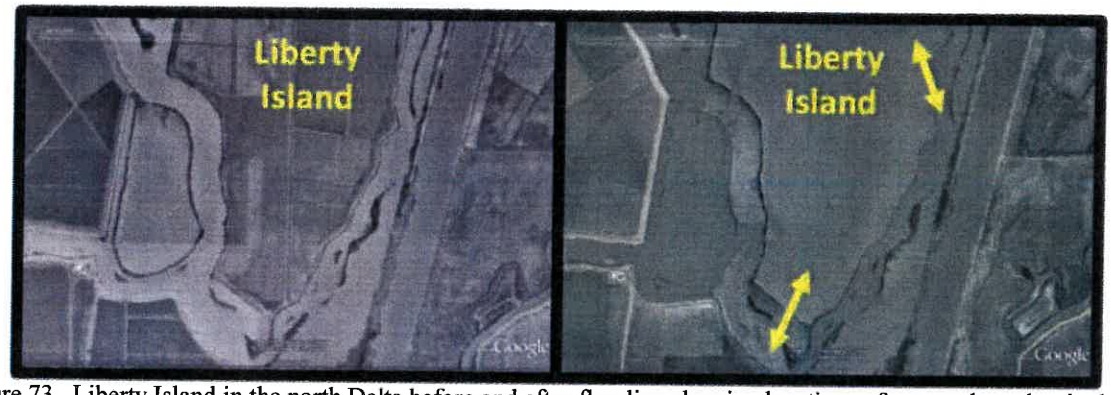

Figure 73. Liberty Island in the north Delta before and after flooding showing locations of narrow breaches in the levee.



Figure 74. Locations (squares) where predatory striped bass were acoustic-tagged with transmitters during the winter of 2008 – 2009 in the north Delta near Liberty Island (D. Vogel, unpublished data).

North American Journal of Fisheries Management 25:1493–1504, 2005
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DOI: 10.1577/M04-208.1

[Article]

Habitat Use and Stranding Risk of Juvenile Chinook Salmon on a Seasonal Floodplain

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Abstract.—Although juvenile Chinook salmon *Oncorhynchus tshawytscha* are known to use a variety of habitats, their use of seasonal floodplains, a highly variable and potentially risky habitat, has not been studied extensively. Particularly unclear is whether a seasonal floodplain is a net "source" or a net "sink" for salmonid production. To help address this issue, we studied salmon habitat use in the Yolo Bypass, a 24,000-ha floodplain of the Sacramento River, California. Juvenile salmon were present in the Yolo Bypass during winter–spring; fish were collected in all regions and substrates of the floodplain in diverse habitats. Experimental releases of tagged hatchery salmon suggest that the fish reared on the floodplain for extended periods (mean = 33 d in 1998, 56 d in 1999, and 30 d in 2000). Floodplain rearing and associated growth are also supported by the significantly larger size of wild salmon at the floodplain outlet than at the inlet during each of the study years. Several lines of evidence suggest that although the majority of young salmon successfully emigrated from the floodplain, areas with engineered water control structures had comparatively high rates of stranding. Adult ocean recoveries of tagged hatchery fish indicate that seasonal floodplains support survival at least comparable with that of adjacent perennial river channels. These results indicate that floodplains appear to be a viable rearing habitat for Chinook salmon, making floodplain restoration an important tool for enhancing salmon production.

A large downstream movement of fry to provide dispersal to rearing areas is typical of ocean-type Chinook salmon *Oncorhynchus tschawytcha* (Healey 1991). Rearing areas include channel and off-channel habitat in natal and nonnatal streams and their estuaries (Bjornn 1971; Kjelsen et al. 1982; Levy and Northcote 1982; Swales et al. 1986; Swales and Levings 1989; Healey 1991; Shreffler et al. 1992). Recently, Sommer et al. (2001b) observed that juvenile Chinook salmon also live on seasonal floodplains. Large rivers and streams typically have dynamic floodplains varying in size from several to thousands of hectares, unless their channels are heavily confined by topography (e.g., streams at high elevation or confined by canyons or levees). Floodplains are known to be of major importance to aquatic ecosystems in most regions; large rivers typically favor the development of a fauna adapted to colonize this habitat (Welcomme 1979; Junk et al. 1989; Sparks 1995). As a result, it is reasonable to expect dispersing salmonid fry show some ability to use seasonal habitat. In support of this hypothesis, Sommer et al. (2001b) reported that food resources and water temperatures on the seasonal floodplain of a large river were superior to those in an adjacent perennial channel, resulting in enhanced growth rates of young salmon. Despite some evidence that enhanced growth on the floodplain improved fry–smolt survival in the estuary, Sommer et al. (2001b) did not address any effects on adult production.

Intuitively, rearing in seasonal floodplains or intermittent streams seems risky because these habitats are among the most dynamic on earth (Power et al. 1995). It is still unknown whether seasonally dewatered habitats are a net "source" or a "sink" for salmonid production relative to production in permanent stream channels (Brown 2002). In particular, the high degree of seasonal flow fluctuation characteristic of floodplain habitat could cause major stranding events and increase mortality rates of young salmon (Bradford 1997; Brown 2002). For resident taxa in intermittent streams, the benefits of very large flow fluctuations appear to outweigh costs associated with a variable environment (Spranza and Stanley 2000). This issue continues to be a key concern for regulatory agencies that evaluate off-channel restoration projects or proposed flow fluctuations for possible effects on fishes (Brown 2002; Bruce Oppenheim, NOAA Fisheries, personal communication).

Here, we describe spatial and temporal trends in juvenile Chinook salmon habitat use and stranding in a large California river floodplain. Our study was conducted in the Yolo Bypass, the primary floodplain of the Sacramento River, the major pro-

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Received December 9, 2004; accepted July 11, 2005
Published online November 4, 2005

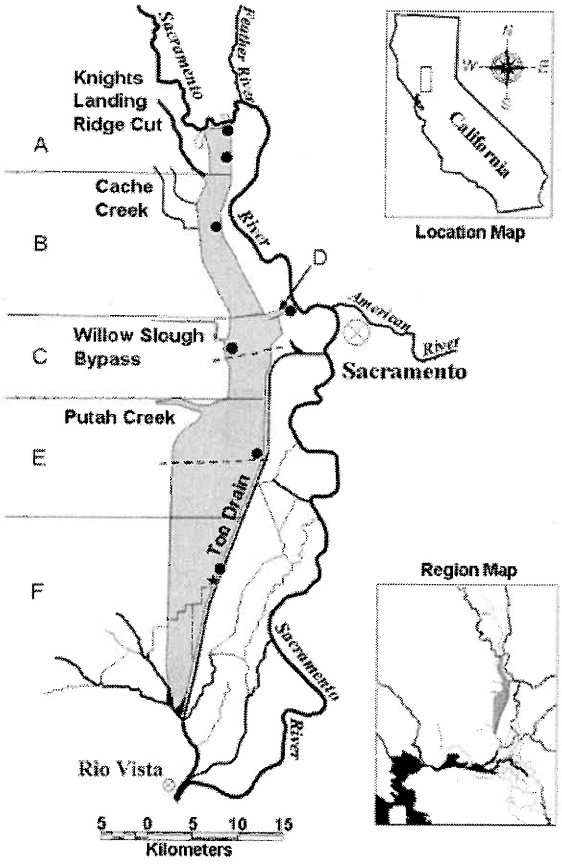

FIGURE 1.—Location of Yolo Bypass in relation to the San Francisco Bay–Delta and its tributaries. Fremont Weir is the upper (northern) edge of the Yolo Bypass. The major regions of the floodplain are delineated from north to south and correspond to the following codes: (**A**) Fremont Weir; (**B**) Cache Creek sinks; (**C**) Yolo Bypass Wildlife Area; (**D**) Sacramento Bypass; (**E**) Putah Creek Sinks; and (**F**) Liberty Island. The sampling locations are identified as follows: beach seine sites (solid circles); screw trap (star); and purse seine transects (dotted lines).

ducer of salmon in the San Francisco estuary (Figure 1). Because the Yolo Bypass can convey 75% or more of the total flow from the Sacramento River basin (Sommer et al. 2001a), this floodplain can be expected to be a migratory pathway for a substantial number of juvenile Chinook salmon. A major objective of our study was to collect basic information about the timing, duration, and habitat use of salmon on floodplains. We hoped that these data would provide insight into whether a floodplain is a net source (i.e., with rearing benefits) or a net sink (i.e., with high mortality because of stranding or predation) for salmon populations. The major hypotheses evaluated were as follows: (1) salmon occur in all major habitat types and geographic regions; (2) floodplains provide rearing habitat for salmon and are not simply a migration corridor; and (3) stranding of juvenile salmon does not have a major population-level effect on survival of the fish that use floodplain habitat. We addressed these hypotheses by sampling wild fish throughout the floodplain, experimentally releasing tagged fish, and using hydrologic modeling and measurements of physical conditions to describe how habitat varied over the study period.

Study Area

The San Francisco Estuary and its two component regions, Sacramento–San Joaquin Delta and downstream bays (Figure 1), make up one of the largest estuaries on the Pacific coast of North America. Major changes to the system have included diking and isolation of about 95% of the wetlands, introduction of exotic species, channelization, sediment inputs from hydraulic mining, and discharge of agricultural and urban chemicals (Nichols et al. 1986; Kimmerer 2002). The Estuary receives most freshwater via the Delta, which drains approximately 100,000 km^2. Most precipitation occurs upstream of the Delta during winter and spring, resulting in a greater than 10-fold seasonal range of daily freshwater flow into the estuary. However, the hydrograph is substantially altered by dams on each of the major rivers. Peak flow pulses typically occur during winter, but dam operations can reduce the magnitude of the pulses, particularly in dry years, when much of the inflow is captured behind reservoirs (Mount 1995; Kimmerer 2002). The historically prominent spring flow pulse from snowmelt is at present muted except during heavy, late-season storms. For the past several decades, much of the spring snowmelt has been stored in reservoirs and released during summer and autumn, periods of historically lower flow. As much as 65% of the net Delta flow during summer and autumn is diverted from the channels by two large water diversions (the State Water Project and the Central Valley Project); additional water is diverted by 2,200 pumps and siphons for irrigation (Kimmerer 2002).

The 24,000-ha Yolo Bypass is the primary floodplain of the Delta (Sommer et al. 2001a). The majority of the floodplain is leveed to protect surrounding cities from floodwaters, but levees confine flow through the bypass only under very high flow events. The Yolo Bypass currently floods an average of every other year, typically under high-flow periods in winter and spring. The Yolo Bypass has a complex hydrology, with inundation possible

from several different sources. The floodplain typically has a peak inundation period during January–March but can flood as early as October and as late as June. The primary input to the Yolo Bypass is through Fremont Weir in the north, which conveys floodwaters from the Sacramento and Feather rivers. During major storm events (e.g., >5,000 m^3/s), additional water enters from the east via the Sacramento Weir, adding flow from the American and Sacramento rivers. Flow also enters the Yolo Bypass from several small streams on its western margin, including Knights Landing Ridge Cut, Cache Creek, and Putah Creek. During much of the winter, water-suspended sediment levels in the Yolo Bypass and Sacramento River are high, generally resulting in secchi depths of less than 0.25 m. However, hydraulic residence times are typically longer in the Yolo Bypass than in the Sacramento River (Sommer et al. 2004). Floodwaters recede from the northern and western portions of the bypass along relatively even elevation gradients of 0.09% west–east and 0.01% north–south into a perennial channel on the eastern edge of the Bypass; they then rejoin the Sacramento River near Rio Vista. The majority of the Yolo Bypass is at present managed for wildlife in a mosaic that includes riparian, wetland, upland, and perennial pond habitats; however, a dominant land use during the past two decades, agriculture has decreased in recent years because of habitat restoration activities.

Our data collection focused on the fall-run juvenile Chinook salmon, currently the numerically dominant race in the Sacramento Valley (Yoshiyama et al. 2000). There are four races of Chinook salmon in the Sacramento Valley: winter, spring, late-fall, and fall-run. Like many other native fish, Chinook salmon in the San Francisco estuary and its tributaries have been adversely affected by such factors as habitat loss, water diversions, and species introductions (Bennett and Moyle 1996); as a result, the Sacramento River winter and spring run Chinook salmon are protected under the Federal Endangered Species Act. The typical life history pattern is for young fall-run salmon fry (approximately 35–70 mm fork length) to migrate from the tributaries during winter and spring to the estuary (Brandes and McLain 2001).

Methods

Physical habitat.—Because seasonal hydrologic variability is a key characteristic of floodplain habitat, we reasoned that detailed data on changes in physical habitat would be necessary to evaluate the responses of young salmon. Daily flow data were obtained from gauging stations in the floodplain, and temperature data were collected using continuous temperature recorders (Sommer et al. 2001b). However, the vast area of Yolo Bypass made it impractical to directly measure other parameters, such as depth and surface area. As an alternative, we used a hydrologic model to estimate these parameters (Sommer et al. 2004). To summarize, the model treated Yolo Bypass as a "reservoir" described by (1) basin geometry and (2) flow and stage time series. The Yolo Bypass floodplain geometry was developed from 200 cross-sections with data collected at 300-m intervals by standard rod and level survey techniques. Mean daily stage and flow data were obtained from five gauging stations in the Yolo Bypass. For each date in the time series, we used linear interpolation between the gauging stations to estimate the stage at each cross-section. The estimated stage value was then used to calculate conveyance characteristics of each cross-section: area, width, and wetted perimeter. The daily results for each cross-section were used to estimate total surface area and mean depth. The large scale of the study reach did not allow validation of the depth estimates. As a partial validation of the model, Sommer et al. (2004) estimated total inundated area for the Yolo Bypass by using aerial photographs on days when the floodplain was inundated (February 8 and March 2, 1998) and when the floodplain was draining (April 28, 1998). To provide additional information about areas where fish stranding and consequent losses could occur, we estimated the portion of the area that was isolated ponds versus inundated area that was actively draining to the Delta (i.e., perennial channels and adjacent inundated area) on April 28, 1998.

Fish habitat use.—We used beach seine sampling to examine which regions and substrates of the floodplain were used by young salmon (hypothesis 1). During January through April of each year, a 15-m seine (3.2-mm mesh) was used to sample six regions of the Yolo Bypass (Figure 1). Fixed stations were used in each region during flooded periods. After floodplain drainage, samples were collected randomly within each region. For all periods, the primary substrate type of the habitat (sand, mud, gravel, pavement, or vegetation), fish species and size, and an estimate of the surface area swept by the seine were recorded. Habitat use during flood events was summarized in terms of the percentage of samples that contained salmon for each region and substrate type.

To provide additional information about habitat use, we conducted purse seine sampling along two transects (Figure 1). This sampling, performed in 1998 when the Yolo Bypass flow was relatively high (>850 m^3/s), used purse seines (30.5 m × 4.6 m, 4.75-mm mesh) set from a jet boat. Purse seining was conducted at 1–2 transects up to five times weekly, depending on hydrology. Hauls were made at random points in each of three habitat types (riparian, agricultural fields, and wetlands), the boundaries of which were established from aerial photographs taken before the Bypass was inundated. In the case of riparian habitat, hauls were made in clearings adjacent to trees to avoid snagging. We also recorded transect side (east or west half) for each haul because the western side of the Yolo Bypass was shallower and flow was dominated by inputs from westside streams rather than from Fremont or Sacramento weirs (Sommer et al. 2004). Most of these hauls were performed in areas exposed to at least a modest current. Additional limited paired sampling was conducted to examine possible differences between areas with and without velocity refuges. Low-velocity habitats sampled included downstream edges of levees, islands, and clusters of trees. Water velocities in randomly selected areas were approximately 0–0.05 m/s compared with greater than 0.33 m/s in adjacent exposed areas. Water depths were similar for each sampling pair. Differences in salmon densities for each habitat type were examined by using a Kruskal–Wallace test. A randomization *t*-test with 1,000 iterations (Haddon 2001) was used to compare salmon density on the east and west sides of the floodplain.

Migration trends.—To examine temporal trends in salmon migration through the floodplain (hypotheses 2 and 3), we operated a rotary screw trap (EG Solutions, Corvallis, Oregon) near the base of the Yolo Bypass during each study year. This technique was intended to provide an indication of the timing and duration of migration, rather than an absolute measure of the number of salmon emigrating the floodplain. During much of the sampling period the inundated width of the floodplain was 1–5 km, an area we considered too large for the traditional mark–recapture evaluations required to measure trap efficiency and total emigration (Roper and Scarnecchia 1996). A 1.5-m-diameter trap was used for the first 3 weeks of sampling in February 1998, after which a 2.4-m trap was used for all other sampling. We operated traps as often as 7 days each week, the daily effort varying from 1 to 24 h, depending on debris load and safety considerations. Fish number and size were recorded in all years. In 1998, young salmon were classified as fry (prominent parr marks) or transitional fish/smolts (faded parr marks, silver appearance).

Floodplain residence time and growth.—We used experimental releases of salmon with coded wire tags (CWTs) as our primary method to evaluate fish residence time on the floodplain (hypothesis 2). Fry (mean size = 57 mm fork length) from the Feather River Fish Hatchery (Figure 1) were tagged by using coded-wire half tags (Northwest Marine Technologies) and released in the Yolo Bypass below the Fremont Weir on March 2, 1998 (53,000 fry); February 11, 1999 (105,000 fry); and February 22, 2000 (55,000 fry). We assessed residence time in the Yolo Bypass from recoveries of tagged fish in the screw trap at the base of the floodplain.

We also examined, using the previously described beach seine data, whether there was evidence of long-term rearing of wild salmon in the floodplain. We compared the slopes of weekly fork length measurements for the two northern beach seine regions ("North") to the southernmost region ("South"), using a generalized linear model (GLM) with a Poisson distribution and log link variance function. We reasoned that major significant differences between the sizes of fish in the two areas provided evidence of extended rearing and growth of fish in the floodplain.

Salmon survival and stranding.—We used several independent data sources to examine whether salmon successfully emigrated from the floodplain (hypothesis 3). First, we compared survival of each of the Yolo Bypass CWT hatchery-reared salmon release groups with the survival of parallel CWT groups containing the same number of fish released into the Sacramento River (Sommer et al. 2001b). Recapture rates at the smolt stage of the 1998 and 1999 release groups had previously been analyzed by Sommer et al. (2001b); in the present study, we evaluated adult recoveries in the commercial and recreational ocean fisheries through 2003. Second, we examined stranding by using beach seine data (described previously) collected within a few weeks after the Sacramento River stopped flowing into the Yolo Bypass. Densities of salmon were compared with a randomization *t*-test (Haddon 2001) for (1) isolated earthen ponds (2) perennial channels, and any sites immediately adjacent to these water sources. The results for all years were pooled because of relatively low sample sizes for individual years. Data for each year

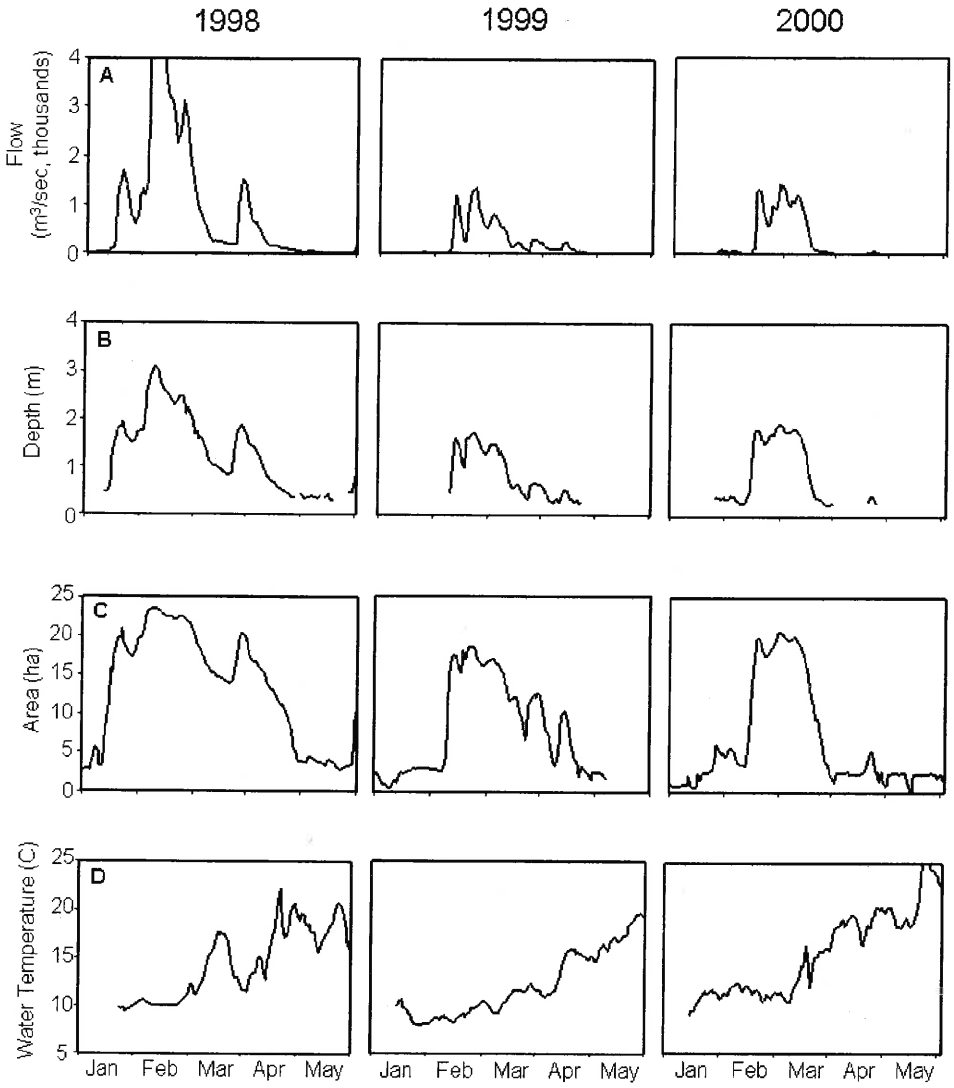

FIGURE 2.—Trends in physical variables for January–June 1998–2000: (**A**) mean daily flow in the Yolo Bypass; (**B**) simulated mean daily depth; (**C**) surface area; and (**D**) daily mean water temperature. The surface area data for 1998 and 2000 are from Sommer et al. (2004).

were first standardized for possible annual differences in abundance by conversion to *z*-scores; we then ran the randomization analysis using 1,000 iterations. We hypothesized that abundance of salmon would be equal in isolated ponds and contiguous water sources; that is, they would show no distinct "preferences." Our reasoning was that similar abundance levels would indicate successful emigration, because most of the water drains from the floodplain. To further understand factors that could affect stranding, we also used a randomization *t*-test to compare densities of fish in two types of isolated ponds: isolated earthen ponds and concrete weir scour ponds at Fremont and Sacramento weirs (Figure 1). Sampling effort was much greater in the isolated earthen ponds, so the randomization *t*-test was performed after randomly subsampling the earthen pond data from throughout the floodplain to provide equal sample sizes. We predicted that flood control structures would cause higher stranding than "natural" ponds. In addition, we examined trends in the catch of salmon in the screw trap data. We predicted that salmon catch would increase substantially during drainage because fish successfully emigrated the floodplain.

Results

Physical Habitat

The hydrographs varied substantially during the years of study (Figure 2A). In 1998 the hydrology

was wet (4.4-year recurrence flood event) and the Yolo Bypass was inundated during mid-January through mid-April and again in early June. The flow was lower in the other 2 years, when inundation occurred between mid-February and mid-March, peak flood events being at the 1.7-year recurrence interval in 1999 and at the 2.4-year recurrence interval in 2000. Surface area in the Yolo Bypass closely followed the flow peaks, the amounts of inundated area being successively smaller in each of the study years (Figure 2C). For the April 28, 1998, photographs, the total surface area of 5,050 ha was slightly lower than the model estimate of 6,700 ha. Based on the aerial photographs, we estimated that only 600 ha of the 5,050 ha comprised isolated ponds, the remainder being water that drained to the Delta. For all but peak flood events, mean water depth remained less than 1 m (Figure 2B). During peak flood events, mean depths did not exceed 2 m except in February 1998. Water temperature showed gradual increases throughout each study year (Figure 2D).

Fish Habitat Use

We captured salmon in all regions of the floodplain and on all substrate types. During 1998–2000 flood events, salmon were captured in a high percentage of samples in each region (Figure 1) of the floodplain: (1) Fremont Weir (100%, n = 13 samples); (2) Cache Creek Sinks (50%, n = 16 samples); (3) Yolo Bypass Wildlife Area (77%, n = 22 samples); (4) Sacramento Bypass (100%, n = 7 samples); (5) Putah Creek Sinks (94%, n = 11 samples); and (6) Liberty Island (100%, n = 7 samples). Similarly, during 1998–2000 flood events we collected salmon on a high percentage of substrate types: (1) mud (70%, n = 47 samples); (2) sand (100%, n = 3 samples); (3) pavement (100%, n = 8 samples); (4) vegetation (97%, n = 32 samples); and 5) gravel (89%, n = 9 samples).

Salmon densities as estimated by purse seine sampling were not significantly different between riparian (mean abundance = 46.9/ha, SE = 10.4, n = 23), agricultural (mean abundance = 20.9/ha, SE = 6.1, n = 35), or natural vegetated habitat types (mean abundance = 27.5/ha, SE = 5.6, n = 31) based on a Kruskal–Wallis test (H = 4.38, df = 2, P = 0.112). There was also no statistically significant difference between the east (mean abundance = 29.5/ha, SE = 6.0, n = 53) and west (mean abundance = 29.9/ha, SE = 6.7, n = 36) sides of the Bypass as shown by a randomization t-test (P = 0.95). Salmon were collected in six hauls in low-velocity habitat (mean abundance = 189/ha, SE = 24/ha), but none were collected in adjacent areas exposed to a current.

Floodplain Migration Trends

Salmon migration as indicated by trends in screw trap catch was highly variable over the course of the study, but there were prominent peaks in Chinook salmon catch coincident with floodplain drainage during late March–April (Figure 3B). Additional smaller peaks in salmon catch also paralleled flow, mostly during February and March. The life history stage of salmon during 1998 was exclusively parr through the end of March, after which the majority showed signs of smoltification.

Floodplain Residence Time

Based on recoveries of tagged fish in the screw trap, the mean residence time of CWT salmon was 33 d (range, 16–46 d; n = 10) in 1998, 56 d (range, 4–76 d; n = 49) in 1999, and 30 d (range, 28–37 d; n = 25) in 2000. The size of fish was significantly larger (P<0.001; GLM) at the outlet of the floodplain than at the top (Figure 3C) during each of the study years.

Salmon Survival and Stranding

The numbers of CWT fish recovered for the Yolo Bypass were higher than in the Sacramento River in 1998, similar in 1999, and lower in 2000 (Table 1). Densities of wild Chinook salmon were highly variable during floodplain drainage events, with no statistically significant difference between densities in isolated earthen ponds and contiguous water sources (Table 2). However, densities of salmon were significantly higher (P < 0.0001; randomization t-test) in concrete weir scour ponds than in isolated earthen ponds (Table 3).

Discussion

Research on migratory fishes reveals that these species frequently have alternative life histories that may be influenced by habitat use at early life stages (Clark 1968; Secor 1999). Under Clark's (1968) "contingent hypothesis," migratory taxa have divergent migration pathways that could help the species deal with environmental variability and heterogeneity. This theory is consistent with our understanding of Chinook salmon, which are adapted to the extreme hydrologic variability in western North America and show a range of life histories (Healey 1991; Bottom et al. 2005). In this context, the use of multiple habitats—including natal and nonnatal streams (Bjornn 1971; Scriv-

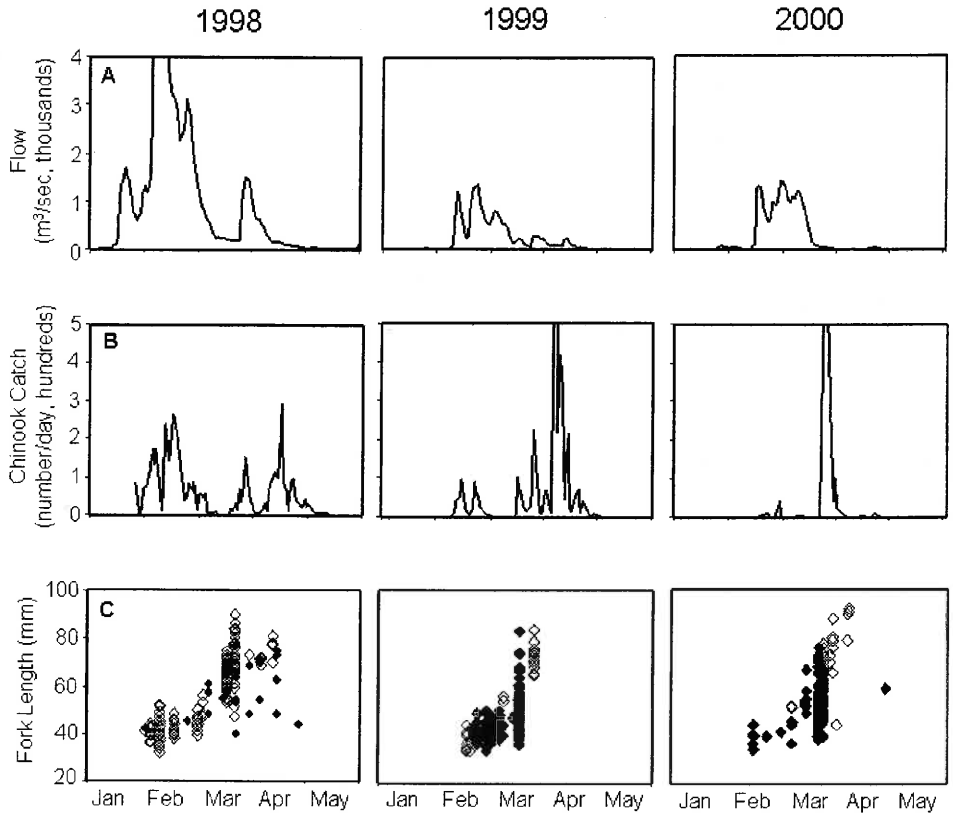

FIGURE 3.—Chinook salmon results during winter and spring 1998–2000: (**A**) mean daily flow; (**B**) salmon catch rates in screw trap sampling; and (**C**) salmon size for beach seine samples near the Yolo Bypass intake (solid symbols) and outlet (clear symbols).

ener et al. 1994), side channels and off-channel ponds (Swales et al. 1986; Swales and Levings 1989), low-elevation rivers (Kjelsen et al. 1982; Brown 2002), and estuaries (Healey 1991; Shreffler et al. 1992)—can be considered as part of an overall "bet-hedging" strategy that spreads risk across a variable environment. Despite the fact that seasonal floodplain represents perhaps the single most variable habitat available to salmon, our study suggests that floodplains are a viable rearing location for young fish.

TABLE 1.—Number of coded wire tags recovered in the ocean and commercial fisheries for Chinook salmon released in the Yolo Bypass and Sacramento River. The total number of tagged fish released in each location for each year is shown in parentheses. The survival ratio is calculated as the number of Yolo Bypass recoveries divided by the number of Sacramento River recoveries.

Release group	1998 (53,000)	1999 (105,000)	2000 (55,000)
Yolo Bypass	75	136	27
Sacramento River	35	138	47
Survival ratio	2.14	0.99	0.57

At the beginning of our study, our conceptual model for floodplain habitat use was that young salmon move into the floodplain during high-flow events and spread throughout the broad expanse of seasonally inundated habitat. Among the wide variety of suitable substrates and habitat types for rearing, young salmon appear to seek out low-velocity areas. Moreover, floodplain habitat apparently is not simply a migration corridor; many young salmon actively rear on the highly productive floodplain habitat for extended periods of time, resulting in high growth rates. Our findings suggest that salmon emigrate from the seasonally inundated habitat both during flood events and during drainage. Juvenile Chinook salmon do not appear to be especially prone to stranding mortality; indeed, survival may actually be enhanced by floodplain rearing in some years. Our conceptual model was supported by our results and has a variety of management implications.

Salmon were present in a broad range of habitat and substrate types and were collected in all regions and sides of the Yolo Bypass floodplain. The

TABLE 2.—Densities of Chinook salmon (number/ha ± SE, with sample size in parentheses) collected in beach seine sampling during drainage events in 1998–2000. The sample locations are divided into isolated earthen ponds and contiguous water sources. Density differences were not statistically significant between the two pond types based on a randomization t-test of the pooled data for all years ($P = 0.79$; $n = 43$ for isolated ponds; $n = 59$ for contiguous water sources).

Location type	1998	1999	2000
Isolated ponds	206 ± 112 (30)	890 ± 491 (8)	126 ± 65 (5)
Contiguous water sources	167 ± 79 (33)	310 ± 104 (13)	463 ± 123 (13)

fact that they were present on the western half of the Bypass, where flows are dominated by Knights Landing Ridge Cut and Cache and Putah creeks, suggests that salmon spread throughout the floodplain after entering the basin by way of Fremont and Sacramento weirs. A few of these fish may have originated from a modest spawning population in Putah Creek (Marchetti and Moyle 2001). The fact that salmon were present in a wide range of habitat and substrate types and in different regions of the Yolo Bypass indicates that many areas of habitat were suitable, although this does not mean that there were no habitat preferences. Like many young fishes, much of the distribution of juvenile Chinook salmon can be explained by their association with shallow depths and low velocities (Everest and Chapman 1972; Roper et al. 1994; Bradford and Higgins 2001). The physical modeling indicated that mean depths were generally 1 m or less during all but peak flood periods, so much of the thousands of hectares of inundated habitat was probably within the shallow range typically preferred by young Chinook salmon (Everest and Chapman 1972). Our limited purse seine sampling suggested that young salmon were most abundant in low-velocity areas, which is consistent with previous studies in river and stream habitat (Everest and Chapman 1972; Roper et al. 1994; Bradford and Higgins 2001). We did not directly simulate water velocity in the present study; however, the relatively shallow water depth during flood events reflects the broad area of low-velocity rearing habitat created during flood events. We expect that this increase in rearing habitat in the Yolo Bypass provides foraging opportunities (Sommer et al. 2001b), reduced energy expenditure, and perhaps reduced probability of encounter with a predator (Ward and Stanford 1995).

Our results also suggest that fish rear in the system for extended periods rather than simply using it as a migration corridor. The mean residence time of 30–56 d for the 44-km reach between the floodplain release location and the screw trap is substantially longer than one would expect, given that (1) fingerlings are capable of migrating at rates of at least 6–24 km/d in low-elevation reaches of other large rivers (Healey 1991) and (2) one of our 1999 CWT fish was recovered just 4 days after being released, having traveled an estimated rate of 11 km/d. The fish were significantly larger at the base of the Yolo Bypass, suggesting that their period of residence in the floodplain was long enough to support substantial growth. Similarly, Sommer et al. (2001b) found that salmon showed higher growth rates in the Yolo Bypass than in the adjacent Sacramento River, primarily because of higher levels of invertebrate prey in the floodplain. A long period of rearing is also supported by the screw trap data, which showed that the densities of salmon were greatest during drainage of the floodplain. We believe that these peaks are a result of rearing salmon being forced off of the floodplain by receding flows. Temperature and salmon life history stage do not provide good alternative explanations for the emigration trends. In 1998, for example, water temperatures were relatively high by late March and salmon began smoltification shortly thereafter; yet the screw trap data indicate

TABLE 3.—Densities of Chinook salmon (number/ha ± SE, with sample size in parentheses) collected in beach seine sampling for earthen ponds and adjacent concrete weir ponds. Density differences were statistically significant between the two pond types based on a randomization t-test of the pooled data for all years ($P < 0.0001$; $n = 26$ for each pond type). Note that we used a randomly sampled subset of the earthen pond data to provide equal sample sizes for the comparison.

Location type	1998	1999	2000
Earthen ponds	186 ± 67 (63)	531 ± 200 (21)	369 ± 97 (18)
Concrete weir ponds	2,717 ± 1,115 (14)	14,208 ± 3,898 (12)	4,181 ± 1,275 (3)

that emigration did not peak until the end of April, when the floodplain drained. Perhaps the emigration trends are partially confounded by seasonal variation in salmon abundance. In the absence of trap efficiency data, we cannot estimate the proportion of the population that emigrated in winter versus spring events.

Several lines of evidence suggest that the majority of fish successfully emigrated from the floodplain. One important observation was that the area of isolated ponds was small relative to the overall area of the floodplain during both peak flood and drainage periods. As an example, in 1998, the wettest year we studied, the peak area of inundation was 24,000 ha, but the total inundated area dropped to 5,000 ha by late April. Of the 5,000 ha remaining at this point, our estimates from aerial photographs showed that isolated ponds took up only 600 ha. Put another way, isolated ponds represented just 12% of the wetted area in April and only 2.5% of the peak inundated area in winter. The same trend is evident in the area simulations for 1999 and 2000, when the peak area was 20,000 ha, but dropped to about 2,000 ha within a month. These results demonstrate that the Yolo Bypass drains fairly efficiently, leaving little isolated area where stranding can occur. This finding was somewhat unexpected, because many parts of the Yolo Bypass have natural topographic features or agricultural levees that could potentially impede drainage and fish emigration. Even if the area of isolated ponds is low, stranding could still be a substantial source of mortality if densities of fish in the remaining ponds were very high. However, we found no evidence that densities of fish stranded in isolated ponds were significantly higher than those in contiguous water sources that were draining to the Delta. The key point here is that most of the water drains from the floodplain and apparently the majority of the fish are leaving with the receding floodwaters. To help illustrate this issue, if we assume that mean densities of fish observed in Table 2 were representative of the entire wetted area of floodplain in April 1998, then the total number of fish in the 600 ha of isolated ponds would have been 123,600 salmon, lower than an estimate of 835,000 fish in the 5,000 ha of contiguous water sources. This conservative estimate also does not include the large numbers of fish that emigrated from the floodplain before April.

In addition to the beach seine and surface area data, we believe that trends in screw trap data support the hypothesis that stranding is not consistently a major problem on the floodplain. The screw trap data are somewhat ambiguous, because the large area of the floodplain makes it unreasonable to measure the efficiency of the trap. Therefore, we cannot accurately estimate the absolute number of salmon emigrating from the floodplain. However, we can at least examine the patterns of trap catch to evaluate likely mechanisms. Some of the possible patterns that we would expect to see for different factors are summarized in Figure 4. First, under the "trap efficiency" model, we would have expected dual peaks in the earliest and latest portions of flood events, when the screw trap would be sampling the highest portion of total flow (Figure 4A). If young salmon follow the "go with the flow" model, catch and flow peaks should be well-correlated (Figure 4B). Alternatively, if floodplains represent an important rearing habitat, we would expect catch trends to follow the "loitering" model, in which catch does not increase until drainage, when fish are forced from their rearing habitat by receding floodwaters (Figure 4C). Finally, if stranding were a major factor controlling catch trends, we would expect an early increase in catch as fish moved through the floodplain during inundation, but then catch should drop earlier than flow as young salmon became isolated from draining floodwaters (Figure 4D; "bathtub" model). Of these patterns, our data for the Yolo Bypass provide the strongest support for both the "go with the flow" and "loitering" models. In each year we saw obvious screw trap catch peaks associated with flow events, and additional prominent peaks associated with drainage. To summarize, apparently some of the fish move

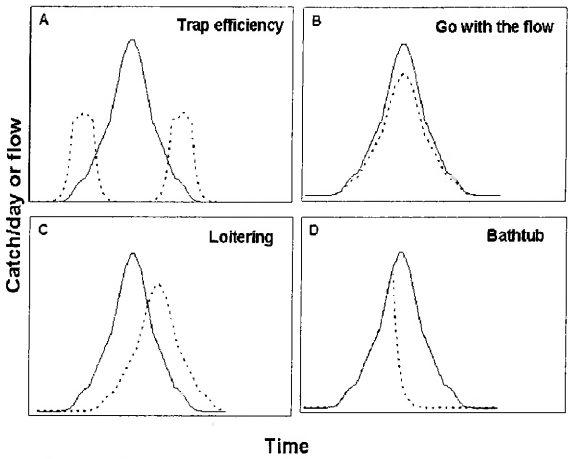

FIGURE 4.—Four conceptual models of expected screw trap catch (dotted line) relative to flow (solid line). See the Discussion for further details about each model.

through the floodplain in direct association with flow, whereas others remain as long as possible to rear on the floodplain. The screw trap trends show no evidence that stranding had a major influence on patterns of emigration.

Relatively low stranding rates on the Yolo Bypass floodplain are supported by observations from other seasonal floodplain habitat in the San Francisco estuary (Peter Moyle, University of California–Davis, personal communication) and other studies. Higgins and Bradford (1996) and Bradford (1997) report that juvenile salmonids are relatively mobile and that most avoid being stranded during moderate rates of stage change. Higgins and Bradford (1996) state that maximum recommended stage reduction levels for gravel bars of regulated rivers are typically 2.5–5 cm/h, much more than the 1 cm/h or less rates of change in mean water depth we observed during drainage in the present study. In his review of the ecology of fishes in floodplain rivers, Welcomme (1979) noted that the majority of fish emigrate from floodplain habitat during drainage.

Even if stranding is not a major source of mortality, this does not necessarily mean that floodplains are not sinks for salmon production. Of the possible sources of mortality, birds and piscivorous fishes may have benefited from stranded salmon (Brown 2002). As noted by Sommer et al. (2001a), major avian predation is unlikely because densities of wading birds are low relative to the thousands of hectares of rearing habitat available during flood events. We did not measure densities of fish predators, but believe that the creation of large areas of rearing habitat should create more refuges for young fish and decrease the probability of encounter with a predator.

Ultimately, it is survival data that allow us to differentiate source from sink habitat. The size and complexity of the San Francisco estuary made it very difficult to directly measure survival rates with statistical rigor (Newman and Rice 2002); however, our CWT release studies at least provide an indication of whether survival rates in the Yolo Bypass were substantially different from those in the Sacramento River, the adjacent migration corridor. The limited results suggest that fry–adult survival rates were at least comparable in the Yolo Bypass and the Sacramento River. Moreover, the 1998 results suggest that in some years, survival may actually be substantially higher for salmon that migrate through the floodplain. Although none of these CWT releases were replicated, the fact that Sommer et al. (2001b) reported similar results for fry-to-smolt survival for the same releases in 1998 and 1999 increases our confidence that the survival data are not spurious.

Our data indicate that floodplains are a viable rearing habitat for juvenile Chinook salmon. Hence, the most important management implication of our study is that seasonal habitat should be considered as part of restoration plans for this species. Despite frequent concerns that off-channel habitat could increase stranding mortality (Brown 2002; Bruce Oppenheim, NOAA Fisheries, personal communication), our results for a hydrologically variable seasonal floodplain suggest that one should be able to design restoration projects that do not create a population sink because of excessive mortality. This is not to say, however, that stranding mortality is never an issue on floodplain habitat. For example, in the Yolo Bypass we saw significantly higher stranding rates in the concrete weir scour ponds of Fremont and Sacramento weirs than in earthen ponds. This finding suggests that artificial water control structures can create unusual hydraulics that promote stranding. However, the total area of these concrete weir ponds was only 3 ha, much smaller than our estimate of 600 ha for total isolated pond area for April 1998 and insignificant compared with the peak inundated area of 24,000 ha area. Fixing the poor hydraulics at these water-control structures may, nonetheless, be an attractive option, particularly if the cost of the solution is relatively low or if it helps to address other fisheries issues such as adult fish passage. In the Yolo Bypass, the concrete weirs not only create stranding problems for juveniles but also frequently block upstream passage of adult salmon, sturgeon, and steelhead trout (Sommer et al. 2001a), thus creating an incentive to resolve both issues simultaneously.

Finally, we wish to acknowledge that even natural floodplain or well-designed restored floodplain habitat could at least occasionally be a population sink because of stranding or predation losses. Our study was conducted over 3 years for a single, large floodplain; we cannot rule out the possibility that floodplains may not have net benefits in other years or locations. As an example, fish densities in the Yolo Bypass were relatively low compared with those reported in some other studies (Levy and Northcote 1982; Swales et al. 1986; Swales and Levings 1989); perhaps young salmon behavior could be different at higher densities. However, the potential for such losses can still be consistent with effective management of salmon populations. Diverse life history strategies

provide bet-hedging for salmon populations in the highly variable environment of coastal tributaries (Secor 1999; Bottom et al. 2005). We therefore expect that young salmon will not thrive in all habitats in every year. In the case of highly variable seasonal environments such as floodplains, stranding losses might cause excessive mortality in some years, but the risks may be offset by increased rearing habitat and food resources in other years (Sommer et al. 2001b; Brown 2002).

Acknowledgments

This study would not have been successful without the contributions of staff from the Interagency Ecological Program, which includes the California Department of Water Resources, California Department of Fish and Game, and U.S. Fish and Wildlife Service. The field assistance of W. Batham, R. Kurth, C. Messer, K. Malchow, F. Feyrer, and L. Grimaldo is gratefully acknowledged. This manuscript was substantially improved by the comments of P. Moyle, B. Herbold, F. Feyrer, T.G. Brown, and two anonymous reviewers. Funding was provided by the Interagency Ecological Program and CALFED.

References

Bennett, W. A., and P. B. Moyle. 1996. Where have all the fishes gone?: interactive factors producing fish declines in the Sacramento–San Joaquin Estuary. Pages 519–542 *in* J. T. Hollibaugh, editor. San Francisco Bay: the ecosystem. Pacific Division of the American Association for the Advancement of Science, San Francisco.

Bjornn, T. C. 1971. Trout and salmon movements in two Idaho streams as related to temperature, food, streamflow, cover, and population density. Transactions of the American Fisheries Society 100:423–438.

Bottom, D. L., C. A. Simenstad, J. Burke, A. M. Baptiste, D. A. Kay, K. K. Jones, E. Casillas, and M. H. Schiewe. 2005. Salmon at river's end: the role of the estuary in the decline of Columbia River salmon. NOAA Technical Memorandum NMFS-NWFSC-68.

Bradford, M. J. 1997. An experimental study of stranding of juvenile salmonids on gravel bars and in side channels during rapid flow decreases. Regulated Rivers 13(5):95–401.

Bradford, M. J., and P. S. Higgins. 2001. Habitat-, season-, and size-specific variation in diel activity patterns of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*). Canadian Journal of Fisheries and Aquatic Sciences 58:365–374.

Brandes, P. L., and J. S. McLain. 2001. Juvenile Chinook salmon abundance, distribution, and survival in the Sacramento–San Joaquin Estuary. California Department of Fish and Game Fish Bulletin 179(2): 39–138.

Brown, T. G. 2002. Floodplains, flooding, and salmon rearing habitats in British Columbia: a review. Canadian Science Advisory Secretariat, Research Document 2002/007. Available: http://www.dfo-mpo.gc.ca/Library/274333.pdf. (May 2005)

Clark, J. 1968. Seasonal movements of striped bass contingents of Long Island Sound and the New York Bight. Transactions of the American Fisheries Society 97:320–343.

Everest, F. H., and D. W. Chapman. 1972. Habitat selection and spatial interaction by juvenile Chinook salmon and steelhead trout in two Idaho streams. Journal of the Fisheries Research Board of Canada 29(1):91–100.

Haddon, M. 2001. Modelling and quantitative methods in fisheries. Chapman and Hall–CRC, Boca Raton, Florida.

Healey, M. C. 1991. Life history of Chinook salmon. Pages 311–394 *in* C. Groot and L. Margolis, editors. Pacific salmon life histories. UBC Press, Vancouver.

Higgins, P. S., and M. J. Bradford. 1996. Evaluation of a large-scale fish salvage to reduce the impacts of controlled flow reduction in a regulated river. North American Journal of Fisheries Management 16: 666–673.

Junk, W. J., P. B. Bayley, and R. E. Sparks. 1989. The flood pulse concept in river–floodplain systems. Canadian Special Publication of Fisheries and Aquatic Sciences 106:110–127.

Kimmerer, W. J. 2002. Physical, biological, and management responses to variable freshwater flow into the San Francisco estuary. Estuaries 25:1275–1290.

Kjelsen, M. A., P. F. Raquel, and F. W. Fisher. 1982. Life history of all-run juvenile Chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento–San Joaquin Estuary, California. Pages 393–411 *in* V. S. Kennedy, editor. Estuarine comparisons. Academic Press, New York.

Levy, D. A., and T. G. Northcote. 1982. Juvenile salmon residence in a marsh area of the Fraser River estuary. Canadian Journal of Fisheries and Aquatic Sciences 39:270–276.

Marchetti, M. P., and P. B. Moyle. 2001. Effects of flow regime on fish assemblages in a regulated California stream. Ecological Applications 11:530–539.

Mount, J. F. 1995. California's rivers and streams: the conflict between fluvial process and land use. University of California Press, Berkeley.

Newman, K. B., and J. Rice. 2002. Modeling the survival of Chinook salmon smolts out-migrating through the lower Sacramento River system. Journal of the American Statistical Association 97:983–993.

Nichols, F. H., J. E. Cloern, S. N. Luoma, and D. H. Peterson. 1986. The modification of an estuary. Science 231:567–573.

Power, M. E., A. Sun, G. Parker, W. E. Dietrich, and J. T. Wootton. 1995. Hydraulic food-chain models: an approach to the study of food-web dynamics in larger rivers. Bioscience 45:159–167.

Roper, B., D. L. Scarnecchia, and T. J. La Marr. 1994.

Summer distribution of and habitat use by Chinook salmon and steelhead within a major basin of the South Umpqua River, Oregon. Transactions of the American Fisheries Society 123(3):298–308.

Roper, B., and D. L. Scarnecchia. 1996. A comparison of trap efficiencies for wild and hatchery age-0 Chinook salmon. North American Journal of Fisheries Management 16:214–217.

Scrivener, J. C., T. G. Brown, and B. C. Anderson. 1994. Juvenile Chinook salmon (*Oncorhynchus tshawytscha*) utilization of Hawks Creek, a small and non-natal tributary of the upper Fraser River. Canadian Journal of Fisheries and Aquatic Sciences 41:1139–1146.

Secor, D. H. 1999. Specifying divergent migrations in the concept of stock: the contingent hypothesis. Fisheries Research 43:13–34.

Shreffler, D. K., C. A. Simenstad, and R. M. Thom. 1992. Juvenile salmon foraging in a restored estuarine wetland. Estuaries 15:204–213.

Sommer, T. R., W. C. Harrell, A. Mueller-Solger, B. Tom, and W. J. Kimmerer. 2004. Effects flow variation on the channel and floodplain biota and habitats of the Sacramento River, California, USA. Aquatic Conservation: Marine and Freshwater Ecosystems 14:247–261.

Sommer, T. R., W. C. Harrell, M. Nobriga, R. Brown, P. B. Moyle, W. J. Kimmerer, and L. Schemel. 2001a. California's Yolo Bypass: evidence that flood control can be compatible with fish, wetlands, wildlife, and agriculture. Fisheries 26(8):6–16.

Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001b. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58:325–333.

Sparks, R. E. 1995. Need for ecosystem management of large rivers and their floodplains. Bioscience 45: 168–182.

Spranza, J. J., and E. H. Stanley. 2000. Condition, growth, and reproductive styles of fishes exposed to different environmental regimes in a prairie drainage. Environmental Biology of Fishes 59(1): 99–109.

Swales, S., and C. D. Levings. 1989. Role of off-channel ponds in the life cycle of coho salmon (*Oncorhynchus kisutch*) and other juvenile salmonids in the Coldwater River, British Columbia. Canadian Journal of Fisheries and Aquatic Sciences 46:232–242.

Swales, S., R. B. Lauzier, and C. D. Levings. 1986. Winter habitat preferences of juvenile salmonids in two interior rivers in British Columbia. Canadian Journal of Zoology 64:1506–1514.

Ward, J. V., and J. A. Stanford. 1995. Ecological connectivity in alluvial river ecosystems and its disruption by flow regulation. Regulated Rivers: Research and Management 11:105–119.

Welcomme, R. L. 1979. Fisheries ecology of floodplain rivers. Longman Group Limited, London.

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle. 2000. Chinook salmon in the California Central Valley: an assessment. Fisheries 25(2):6–20.


End of attachments to CDWA

California Farm Bureau Federation

(CFBF)

CFBF

CALIFORNIA FARM BUREAU FEDERATION
OFFICE OF THE GENERAL COUNSEL
2300 RIVER PLAZA DRIVE, SACRAMENTO, CA 95833-3293 · PHONE (916) 561-5665 · FAX (916) 561-5691

Sent via E-Mail
frpa@water.ca.gov

October 7, 2016

Department of Water Resources
Attention: Daniel Riordan
P.O. Box 942836
Sacramento, CA 94236

RE: Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riodan:

The California Farm Bureau Federation ("Farm Bureau") is a non-governmental, non-profit, voluntary membership California corporation whose purpose is to protect and promote agricultural interests throughout the state of California and to find solutions to the problems of the farm, the farm home and the rural community. Farm Bureau is California's largest farm organization, comprised of 53 county Farm Bureaus currently representing more than 53,000 agricultural, associate and collegiate members in 56 counties. Farm Bureau strives to protect and improve the ability of farmers and ranchers engaged in production agriculture to provide a reliable supply of food and fiber through responsible stewardship of California's resources.

Potential Opportunities

The proposed 1,600-acre Prospect Island project is one project within a larger suite of similar proposed projects required under the USFWS's Delta smelt biological opinion for the CVP and SWP to restore a total 8,000 acres of tidal marsh. In addition, the project would qualify to meet a portion of the salmon rearing habitat requirements in NMFS's biological opinion for salmon and steelhead.

CFBF-1
(Cont. below)

In recent years, a disturbing trend has emerged. Under this trend, new regulations and restrictions have required more and more instream flows, even as fish populations have declined. New regulatory proposals would now potentially require even more water. This is impacting agricultural water supplies at great cost to our agricultural communities and producers around the state, without any apparent significant or commensurate benefit to fish.

California farmers over the last few decades have made dramatic advance in the area of water efficiency as their supplies have shrunk, yet there is currently no equivalent efficiency standard for the environment. Given current statewide water situation, such efficiency in environmental use is not only inexcusable, it is also a luxury we simply no lower afford. At the

NANCY N. MCDONOUGH, GENERAL COUNSEL
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same, while agriculture must continue to aggressively pursue new practices and technologies to maximize efficiency, it must also not be deprived of the minimum quantity it requires to function, survive, and thrive as the important industry of state, national, and global significance that it is.

Against this backdrop of water scarcity and the need for maximum efficiency across *all* uses of our state's scarce water resources, the nexus of flow and habitat is emerging as an important component of environmental water efficiency. Flows without habitat have limited utility, just as habitat without flow misses the optimum level of efficiency our challenging statewide water situation demands. Instead, optimal environmental water efficiency appears to come with an optimized combination of flow and habitat and other non-flow measures (invasive species controls in particular).

The hope here, for both fish and farmers, is that such a combination can yield manageable levels of environmental water demand by actually assisting the fish while, at the same time, reducing the magnitude of any additional agricultural water losses.

Prospect as a Potential Model

In many ways, the proposed Prospect Island proposal appears well-suited to provide a laboratory in which to test something like the approach described above.

Prospect Island is at the bottom of the Yolo Bypass and would form part of a large block of planned or existing habitat lands. At Liberty Island, year-round smelt populations have been documented in recent years, at a time when historic populations of smelt elsewhere in the Delta have been in precipitous decline. This suggests that another similar location in this portion of the Delta could offer important benefits by providing additional, functioning habitats for smelt. In addition, recent studies, experiments, and pilot projects of the last few years suggest that floodplain rearing habitats may be critical to juvenile salmon, while it seems Prospect Island could double as beneficial floodplain habitat for the salmon.

CFBF-1
(Cont. below)

Prospect Island, at the bottom of the Yolo Bypass and within the larger Cache Slough Area of the North Delta, is also part of the so-called "North Delta Arc," extending southward and westward, around into the Western Delta and Suisun Marsh. Biologists, including the respected Peter Moyle at UC Davis, have specifically identified this "North Delta Arc" area as the area of the Sacramento-San Joaquin Bay-Delta with perhaps the greatest positive, remnant biological biological attributes and potential to generate real benefits for fish.

Some potential additional advantages of the Prospect Island proposal include the fact that it involves existing publicly-owned lands (rather than private lands) and little-to-no direct or indirect farmland conversion. In addition, it appears that the project could provide some potential flood management benefits, either alone or in combination with other system modifications over time, by creating additional flood space.

For all of these reasons, it appears that the Prospect Island project *may* have significant potential to provide the mentioned biological and water supply benefits mentioned. As explained

below, however, these considerations do not exist in a vacuum and must take account of the regional context that is the setting for the project.

CFBF-1 (Cont.)

Monitoring and Mitigation

Notwithstanding many potential advantages, the Prospect Island project is not without controversy, with impacts in several areas of potential concern. Here too though, the Prospect Island project could again provide a unique opportunity. Specifically, to the extent potential impacts and concerns with the Prospect Island reflect similar concerns and potential impacts elsewhere in the Delta, the project may represent an opportunity to develop a model to meaningfully address such concerns and impacts as they arise both now and in the future.

CFBF-2

Some of the general concerns and impacts we are aware of with these types of projects—many of which are, indeed, mentioned in the Draft EIR—include 1) direct or indirect losses of farmland, 2) potential underseepage and erosion effects on adjacent islands, 3) potential effects on adjacent diversions (including water quality/salinity effects and potential restrictions associated with the presence of protected species), and 4) potential cumulative effects with other similar projects over time.

CFBF-3

Many of these impacts are unique to, or are at least more pronounced in the Delta, and may or may not be individually significant in the case of a particular project. However, the potential combined effects of multiple projects over time, all in the same geographic area, may be cumulatively more significant than the effect any one project alone.

This is where robust analysis of project effects, robust monitoring, and robust mitigation protocols become very important. Environmental analyses, monitoring programs, and mitigation approaches must robustly and forthrightly address local concerns, and take all reasonable and practicable steps to address those concerns in good faith. Done successfully, such a model could make such projects more effective and easier to implement over time. Done wrongly—or not done—the result will be a much harder path to project implementation both now and in the future.

CFBF-4

As an example, with respect to potential impacts on agricultural lands and economies, pursuing a robust regional Agricultural Lands Stewardship Plan[1] approach in cooperation with a broad cross-section of the affected stakeholder community can provide an agricultural mitigation blueprint and build greater support (or at least less opposition) and a more stable long-term implementation program for an entire region. In addition to agricultural impacts, underseepage and erosion and salinity intrusion with changing tidal patterns are additional major concerns in the Delta that the Department would do well to address forthrightly, robustly, and consistently from the outset.

CFBF-5

Additionally, with respect to Prospect Island, we know that concerns about potential impacts to levees and diversions on Ryer Island are an area of specific concern, in addition to

CFBF-6 (Cont. below)

[1] See Department of Water Resources Agriculture and Land Stewardship Framework and Strategies, including Framework 1B, "Develop Agricultural Land Stewardship Plans for Projects" (https://agriculturallandstewardship.water.ca.gov/web/guest/framework-1b1).

potential impacts to other neighboring lands, levees, and water users. Accordingly, as the Department moves forward, these should be specific targets within a larger general strategy, as it relates to the Prospect Island.

CFBF-6 (Cont.)

Predation

In addition to the critical intersection of flow and functional habitat, another potential, major, non-flow factor to consider carefully in connection with projects like the Prospect Island project consideration is the separate stressor of predation.

In this area as well, mitigation, careful monitoring and appropriate intervention, if necessary, can be very important. In contrast, continuing to take this option and this stressor off of the table (as the State of California has so far done via the Fish and Game Commission) could potentially cancel out any beneficial effects that can be achieve with on such projects, with an optimized intersection of flow and habitat alone.

CFBF-7

Conclusion

In closing, assuming adequate outreach to affect local communities and robust effective monitoring, mitigation and corrective action over time, the potential of more projects like Prospect Island to yield mutual species and human water supply benefits should give us all some cause for optimism. To ensure that these potential benefits are maximized and consistently delivered, the recommendations above include some of important elements of a potential model for future success.

Very truly yours,



JUSTIN E. FREDRICKSON
Environmental Policy Analyst

California State Lands Commission

(CSLC)

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October 5, 2016

File Ref: SCH #2013052056

Dan Riordan
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

CSLC

Subject: Draft Environmental Impact Report (EIR) for Prospect Island Tidal Habitat Restoration Project (Project) in the Sacramento-San Joaquin Delta, Solano County

Dear Mr. Riordan:

The California State Lands Commission (CSLC) staff has reviewed the Draft EIR prepared by the Department of Water Resources (DWR) for the subject Project. The DWR, as a public agency carrying out the Project, is the lead agency under the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq.). The CSLC is a trustee agency because of its trust responsibility for projects that could directly or indirectly affect sovereign lands, their accompanying Public Trust resources or uses, and the public easement in navigable waters. Additionally, because the Project involves work on sovereign lands, the CSLC will act as a responsible agency.

CSLC Jurisdiction and Public Trust Lands

The CSLC has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways. The CSLC also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions (Pub. Resources Code, §§ 6009, subd. (c), 6301, 6306). All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the protections of the common law Public Trust. CLSC-1 (Cont. below)

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable lakes and waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all people of the State for statewide Public Trust purposes, which include but are not limited to waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation, and open space. On tidal waterways, the State's sovereign fee ownership extends landward to the mean high tide line, except for areas of fill or artificial accretion

or where the boundary has been fixed by agreement or a court. On navigable non-tidal waterways, including lakes, the State holds fee ownership of the bed of the waterway landward to the ordinary low water mark and a Public Trust easement landward to the ordinary high water mark, except where the boundary has been fixed by agreement or a court. Such boundaries may not be readily apparent from present day site inspections.

The CSLC has not yet made a full boundary investigation of the Project Area. However, after reviewing the information contained in the Draft EIR, CSLC staff has made a preliminary determination that the portion of the Project in Miner Slough will be located on State-owned sovereign land under the jurisdiction of the CSLC. Because a lease or other agreement with the CSLC will be required for DWR to implement the Project on sovereign land, please contact Wendy Hall (see contact information below) for further information about the extent of the CSLC's sovereign ownership and further coordination on leasing and other contractual and jurisdictional requirements.

CLSC-1 (Cont.)

Please also be advised that the waterways involved in the Project area are subject to a public navigational easement. This easement provides that the public has the right to navigate and exercise the incidences of navigation in a lawful manner on State waters that are capable of being physically navigated by oar or motor-propelled small craft. Such uses may include, but are not limited to, boating, rafting, sailing, rowing, fishing, fowling, bathing, skiing, and other water-related public uses. The activities completed under the Project must not restrict or impede the easement right of the public.

CLSC-2

These comments are made without prejudice to any future assertion of State ownership or public rights, should circumstances change, or should additional information become available. This letter is not intended, nor should it be construed as a waiver or limitation of any right, title, or interest of the State of California in any lands under its jurisdiction.

Project Description

The overarching goal of the Project is to restore tidal action to the interior of Prospect Island as illustrated in Figure 2.2-1 of the Draft EIR. The following objectives are intended to meet tidal and biological restoration requirements pursuant to Biological Opinions from the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service:

CLSC-3 (Cont. below)

- Enhance primary and secondary productivity and food availability for native fishes within Prospect Island and surrounding Delta waterways;
- Increase the quantity and quality of salmonid rearing habitat within and in the areas surrounding Prospect Island;
- Increase the amount and quality of habitats to support other listed species, to the extent they can be supported by site conditions and natural processes;
- Provide other ecosystem benefits associated with increased Delta freshwater tidal marsh habitat, including water quality enhancement, recreation, and carbon sequestration; and
- To the greatest extent practical, promote habitat resiliency to changes in future Delta conditions, such as land use conversions, climate change, sea-level rise, and invasive species.

Under the proposed Project, the Miner Slough levee would be breached in two Locations: adjacent to the north property and adjacent to the south property as explained in Subsection 2.2.3 and illustrated in Figures 2.2-2 and 2.2-3 of the Draft EIR. A portion of the internal cross levee separating the north and south properties would also be removed. Once these breaches are completed, the north and south properties would be subject to daily tidal inundation. The Project would include the following actions:

- Invasive species control with herbicide application;
- Old infrastructure and debris removal;
- Excavation of tidal slough channels and placement of excavated soils into the Prospect Island site interior;
- Removal of a portion of the internal cross levee separating the north and south properties;
- Excavation of two levee breaches to Miner Slough; and
- Dredging of the spur channel between Miner Slough and the south property.

Two build alternatives and a No Project Alternative were selected to be analyzed in the Draft EIR. Alternative Two would include two breaches in the Miner Slough levee, and under Alternative Three, three breaches would be created on the Miner Slough levee as illustrated in Figures 4.5-1 and 4.6-1. CLSC-3 (Cont.)

Environmental Review

For CSLC's jurisdictional area of the Project as explained above, Project activities include excavation of the breached levee locations and dredging of the spur channel between Miner Slough and the south property. CSLC staff requests that the following information and potential impacts be analyzed in the Draft EIR.

Biological Resources

1. The Project Description explains that use of barges are proposed for dredging activities. One of the major stressors in California waterways is introduced species. For example, construction boats and barges brought in from stays at distant projects may transport new species to the Project area via hull biofouling, wherein marine and aquatic organisms attach to and accumulate on the hull and other submerged parts of a vessel. Possible mitigation could include contracting vessels and barges from nearby, or requiring a certain degree of hull-cleaning from contractors. The CDFW's Invasive Species Program could assist with this analysis as well as with the development of appropriate mitigation (information at http://www.dfg.ca.gov/invasives/). Please update the Biological Resources section to disclose the above information with regard to proposed use of barges.

   In addition, in light of the recent decline of native pelagic organisms and in order to protect at-risk fish species, the Draft EIR should examine if any elements of the Project would favor non-native fisheries within the Sacramento-San Joaquin River Delta. CLSC-4

Hydrology/Water Quality

2. Levee Maintenance: The Hydrology section indicates that interior and exterior sections of the Miner Slough levee in the Project area could be subjected to long-term increased erosion potential due to changes in hydrology from the Project. This section also explains that areas of the levee system are currently in need of repair and are identified for future maintenance work. Part of the rationale for DWR's determination of less than significant with mitigation is that DWR will conduct long-term monitoring of the affected levee areas and provide any maintenance repairs as needed. More information should be provided in the Hydrology section to disclose other planned levee maintenance projects in the Project area, identify what existing sections of the levee are most vulnerable to future repair and maintenance by DWR from Project-related impacts, and explain why these areas of the levee are not proposed for improvement during site preparation for the Project. This information would further support the determination for less than significant with mitigation. CLSC-5

   Page 2-50 of the Project Description explains that armoring of the levee end points at the breached locations may be necessary for long-term erosion control and refers to Figure 2.2-9 for conceptual design of proposed armoring. However, the figure does not appear to illustrate the armoring design explained on page 2-50. Leaving the breached levee end points unarmored and exposing levee soils to the erosional velocities of the newly created discharges from Miner Slough would seem to have direct potential to erode levee foundations and compromise integrity of the levee system. Further, the Hydrology section does not appear to directly evaluate this impact concern. Please update the Hydrology section to provide further justification for why armoring of the breached levee end points is not directly proposed, and if armoring may not be proposed, explain why erosion potential for the levee is not an impact concern. CLSC-6

3. Sedimentation: The Hydrology section explains that flow velocity in Miner Slough will increase downstream of the breached levee locations with potential for increased bed scour, but does not seem to directly evaluate potential for increased sedimentation to downstream receiving waters. Please update this section to discuss the level of significance of this potential impact, and as related to potential methylmercury contamination as explained below. CLSC-7

4. Contaminant Testing: The Water Quality section explains that sediment sampling and testing will occur prior to proposed dredging activities. Given the potential for known legacy pollutants, such as methylmercury and other toxins, and reliance on dredging spoils for proposed fill activities, sediment contaminant testing should be conducted now and evaluated in the Draft EIR, as sediment quality may further influence Project planning and proposed fill activities. CSLC staff recommends the Water Quality section be updated to include this analysis. CLSC-8

   Please be advised that on April 22, 2010, the Central Valley Regional Water Quality Control Board (CVRWQCB) identified the CSLC as both a State agency that manages open water areas in the Sacramento-San Joaquin Delta Estuary and a nonpoint source discharger of methylmercury (Resolution No. R5-2010-0043), CLSC-9 (Cont. below)

because subsurface lands under the CSLC's jurisdiction are impacted by mercury from legacy mining activities dating back to California's Gold Rush. Pursuant to a CVRWQCB Total Maximum Daily Load (TMDL), the CVRWQCB is requiring the CSLC to fund studies to identify potential mercury/methylmercury control methods in the Delta and to participate in an Exposure Reduction Program. The goal of the studies is to evaluate existing control methods and evaluate options to reduce methylmercury in open waters under jurisdiction of the CSLC. Any action taken that may result in mercury/methylmercury suspension within the Sacramento-San Joaquin Delta Estuary may affect the CSLC's efforts to comply with the CVRWQCB TMDL. Please update the methylmercury discussion on page 3-46 and Impact 3.2-8 on page 3-81 with the above information, and to disclose DWR's obligations to minimize or avoid releases of methylmercury from dredging and sedimentation impacts associated with the Project.

CLSC-9 (Cont.)

5. Mitigation Monitoring Program: The Draft EIR includes a summary of mitigation measures in Table ES-1 (beginning at p. xxii), but does not appear to include a complete Mitigation Monitoring Program (MMP) identifying reporting, monitoring, and implementation responsibilities for all proposed mitigation measures. Pursuant to the State CEQA Guidelines (§ 21081.6), a public agency shall adopt a monitoring program of mitigation measures and ensure their enforceability. Therefore, CSLC staff recommends that the Final EIR include a clearly identified MMP.

Thank you for the opportunity to comment on the Draft EIR for the Project. As a responsible agency, CSLC staff requests that you consider our comments prior to certification of the Final EIR. Please send copies of future Project-related documents, including electronic copies of the Final EIR, MMP, Notice of Determination, DWR Approving Resolution, CEQA Findings and, if applicable, Statement of Overriding Considerations when they become available, and refer questions concerning environmental review to Jason Ramos, Senior Environmental Scientist, at (916) 574-1814 or via e-mail at Jason.Ramos@slc.ca.gov. For questions concerning CSLC leasing jurisdiction, please contact Wendy Hall, Public Land Management Specialist, at (916) 574-0994 or via e-mail at Wendy.Hall@slc.ca.gov.

CLSC-10

Sincerely,

Cy R. Oggins, Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
W. Hall, CSLC
L. Calvo, CSLC
J. Ramos, CSLC

Central Valley Regional Water Quality Control Board

(CVRWQCB)

30 September 2016

Dan Riordan
Department of Water Resources
3500 Industrial Boulevard
West Sacramento, CA 95691

CERTIFIED MAIL
91 7199 9991 7035 8362 8783

COMMENTS TO REQUEST FOR REVIEW FOR THE DRAFT ENVIRONMENTAL IMPACT REPORT, PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT, SCH# 2013052056, SOLANO COUNTY

Pursuant to the State Clearinghouse's 25 August 2016 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Request for Review for the Draft Environment Impact Report* for the Prospect Island Tidal Habitat Restoration Project, located in Solano County.

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues.

I. Regulatory Setting

Basin Plan

The Central Valley Water Board is required to formulate and adopt Basin Plans for all areas within the Central Valley region under Section 13240 of the Porter-Cologne Water Quality Control Act. Each Basin Plan must contain water quality objectives to ensure the reasonable protection of beneficial uses, as well as a program of implementation for achieving water quality objectives with the Basin Plans. Federal regulations require each state to adopt water quality standards to protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. In California, the beneficial uses, water quality objectives, and the Antidegradation Policy are the State's water quality standards. Water quality standards are also contained in the National Toxics Rule, 40 CFR Section 131.36, and the California Toxics Rule, 40 CFR Section 131.38. CVRWQCB-1 (Cont. below)

The Basin Plan is subject to modification as necessary, considering applicable laws, policies, technologies, water quality conditions and priorities. The original Basin Plans were adopted in 1975, and have been updated and revised periodically as required, using Basin Plan amendments. Once the Central Valley Water Board has adopted a Basin Plan amendment in noticed public hearings, it must be approved by the State Water Resources Control Board (State Water Board), Office of Administrative Law (OAL) and in some cases,

the United States Environmental Protection Agency (USEPA). Basin Plan amendments only become effective after they have been approved by the OAL and in some cases, the USEPA. Every three (3) years, a review of the Basin Plan is completed that assesses the appropriateness of existing standards and evaluates and prioritizes Basin Planning issues.

For more information on the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins*, please visit our website:
http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/.

Antidegradation Considerations

All wastewater discharges must comply with the Antidegradation Policy (State Water Board Resolution 68-16) and the Antidegradation Implementation Policy contained in the Basin Plan. The Antidegradation Policy is available on page IV-15.01 at:
http://www.waterboards.ca.gov/centralvalleywater_issues/basin_plans/sacsjr.pdf

In part it states:

Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.

CVRWQCB-1
(Cont. below)

This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives.

The antidegradation analysis is a mandatory element in the National Pollutant Discharge Elimination System and land discharge Waste Discharge Requirements (WDRs) permitting processes. The environmental review document should evaluate potential impacts to both surface and groundwater quality.

II. Permitting Requirements

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit), Construction General Permit Order No. 2009-009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan

(SWPPP).

For more information on the Construction General Permit, visit the State Water Resources Control Board website at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml.

Phase I and II Municipal Separate Storm Sewer System (MS4) Permits[1]
The Phase I and II MS4 permits require the Permittees reduce pollutants and runoff flows from new development and redevelopment using Best Management Practices (BMPs) to the maximum extent practicable (MEP). MS4 Permittees have their own development standards, also known as Low Impact Development (LID)/post-construction standards that include a hydromodification component. The MS4 permits also require specific design concepts for LID/post-construction BMPs in the early stages of a project during the entitlement and CEQA process and the development plan review process.

For more information on which Phase I MS4 Permit this project applies to, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/municipal_permits/.

For more information on the Phase II MS4 permit and who it applies to, visit the State Water Resources Control Board at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/phase_ii_municipal.shtml

CVRWQCB-1
(Cont. below)

Industrial Storm Water General Permit
Storm water discharges associated with industrial sites must comply with the regulations contained in the Industrial Storm Water General Permit Order No. 2014-0057-DWQ.

For more information on the Industrial Storm Water General Permit, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/industrial_general_permits/index.shtml.

Clean Water Act Section 404 Permit
If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed from the United States Army Corps of Engineers (USACOE). If a Section 404 permit is required by the USACOE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water

[1] Municipal Permits = The Phase I Municipal Separate Storm Water System (MS4) Permit covers medium sized Municipalities (serving between 100,000 and 250,000 people) and large sized municipalities (serving over 250,000 people). The Phase II MS4 provides coverage for small municipalities, including non-traditional Small MS4s, which include military bases, public campuses, prisons and hospitals.

drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements.

If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACOE at (916) 557-5250.

Clean Water Act Section 401 Permit – Water Quality Certification

If an USACOE permit (e.g., Non-Reporting Nationwide Permit, Nationwide Permit, Letter of Permission, Individual Permit, Regional General Permit, Programmatic General Permit), or any other federal permit (e.g., Section 10 of the Rivers and Harbors Act or Section 9 from the United States Coast Guard), is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications.

Waste Discharge Requirements – Discharges to Waters of the State

If USACOE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project may require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation.

CVRWQCB-1
(Cont. below)

For more information on the Water Quality Certification and WDR processes, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/help/business_help/permit2.shtml.

Dewatering Permit

If the proposed project includes construction or groundwater dewatering to be discharged to land, the proponent may apply for coverage under State Water Board General Water Quality Order (Low Risk General Order) 2003-0003 or the Central Valley Water Board's Waiver of Report of Waste Discharge and Waste Discharge Requirements (Low Risk Waiver) R5-2013-0145. Small temporary construction dewatering projects are projects that discharge groundwater to land from excavation activities or dewatering of underground utility vaults. Dischargers seeking coverage under the General Order or Waiver must file a Notice of Intent with the Central Valley Water Board prior to beginning discharge.

For more information regarding the Low Risk General Order and the application process, visit the Central Valley Water Board website at:

http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2003/wqo/wqo2003-0003.pdf

For more information regarding the Low Risk Waiver and the application process, visit the Central Valley Water Board website at:

http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/waivers/r5-2013-0145_res.pdf

Regulatory Compliance for Commercially Irrigated Agriculture

If the property will be used for commercial irrigated agricultural, the discharger will be required to obtain regulatory coverage under the Irrigated Lands Regulatory Program. There are two options to comply:

1. **Obtain Coverage Under a Coalition Group.** Join the local Coalition Group that supports land owners with the implementation of the Irrigated Lands Regulatory Program. The Coalition Group conducts water quality monitoring and reporting to the Central Valley Water Board on behalf of its growers. The Coalition Groups charge an annual membership fee, which varies by Coalition Group. To find the Coalition Group in your area, visit the Central Valley Water Board's website at: http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/app_approval/index.shtml; or contact water board staff at (916) 464-4611 or via email at IrrLands@waterboards.ca.gov.

2. **Obtain Coverage Under the General Waste Discharge Requirements for Individual Growers, General Order R5-2013-0100**. Dischargers not participating in a third-party group (Coalition) are regulated individually. Depending on the specific site conditions, growers may be required to monitor runoff from their property, install monitoring wells, and submit a notice of intent, farm plan, and other action plans regarding their actions to comply with their General Order. Yearly costs would include State administrative fees (for example, annual fees for farm sizes from 10-100 acres are currently $1,084 + $6.70/Acre); the cost to prepare annual monitoring reports; and water quality monitoring costs. To enroll as an Individual Discharger under the Irrigated Lands Regulatory Program, call the Central Valley Water Board phone line at (916) 464-4611 or e-mail board staff at IrrLands@waterboards.ca.gov.

CVRWQCB-1
(Cont. below)

Low or Limited Threat General NPDES Permit

If the proposed project includes construction dewatering and it is necessary to discharge the groundwater to waters of the United States, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. Dewatering discharges are typically considered a low or limited threat to water quality and may be covered under the General Order for *Dewatering and Other Low Threat Discharges to Surface Waters* (Low Threat General Order) or the General Order for *Limited Threat Discharges of Treated/Untreated Groundwater from Cleanup Sites, Wastewater from Superchlorination Projects, and Other Limited Threat Wastewaters to Surface Water* (Limited Threat General Order). A complete application must be submitted to the Central Valley Water Board to obtain coverage under these General NPDES permits.

For more information regarding the Low Threat General Order and the application process, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2013-0074.pdf

For more information regarding the Limited Threat General Order and the application process, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2013-0073.pdf

NPDES Permit

If the proposed project discharges waste that could affect the quality of the waters of the State, other than into a community sewer system, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. A complete Report of Waste Discharge must be submitted with the Central Valley Water Board to obtain a NPDES Permit.

CVRWQCB-1
(Cont.)

For more information regarding the NPDES Permit and the application process, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/help/business_help/permit3.shtml

If you have questions regarding these comments, please contact me at (916) 464-4644 or Stephanie.Tadlock@waterboards.ca.gov.

Stephanie Tadlock

Stephanie Tadlock
Environmental Scientist

cc: State Clearinghouse unit, Governor's Office of Planning and Research, Sacramento

Delta Stewardship Council

(DSC)

DSC

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DELTA STEWARDSHIP COUNCIL
A California State Agency

October 6, 2016

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P.O. Box 942836
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frpa@water.ca.gov

RE: Prospect Island Tidal Habitat Restoration Project Draft Environmental Impact Report, SCH # 2013052056

Dear Mr. Riordan:

Thank you for the opportunity to provide comments on the Prospect Island Tidal Habitat Restoration Project (hereafter referred to as "Prospect Island Restoration Project") Draft Environmental Impact Report (DEIR). As part of that project, the Department of Water Resources (DWR) will implement an approximately 1,600-acre tidal restoration project on Prospect Island in Solano County under the Fish Restoration Program (FRP). This project is listed under the California Natural Resource Agency's EcoRestore Initiative as a priority project.

The Delta Stewardship Council (Council) through the Delta Reform Act was granted specific regulatory and appellate authority over certain actions that take place in whole or in part in the Delta and Suisun Marsh; the Council exercises this authority through the development and implementation of the Delta Plan. According to the Delta Reform Act, it is the state or local agency approving, funding, or carrying out the project that must determine if that project is a "covered action" subject to Delta Plan regulations, and if so, file a certification of consistency with the Delta Plan.

DSC-1 (Cont. below)

Delta Plan Policies

The Delta Plan includes 14 regulatory policies that are applicable to all covered actions. Below we have highlighted a few key regulatory policies from the Delta Plan that may be specifically relevant to the Prospect Island Restoration Project and a Delta Plan certification of consistency, if DWR determines the project to be a covered action.

Best Available Science and Adaptive Management

Delta Plan Policy **G P1** (23 California Code of Regulations [CCR] Section 5002) calls for covered actions to document use of best available science. This documentation should be consistent with the criteria listed in Appendix 1A of the Delta Plan regulations (available at http://deltacouncil.ca.gov/docs/appendix-1a), which include relevance, inclusiveness, and objectivity. If DWR files a Delta Plan certification of consistency, we suggest DWR explain the role of the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) technical review and the "Science Panel" convened in March 2014 in guiding planning and design of the project using best available science.

Additionally, Policy **G P1** calls for ecosystem restoration projects to include adequate provisions for continued implementation of adaptive management, appropriate to the scope of the action; this requirement can be satisfied through the development of an adaptive management plan that is consistent with the framework described in Appendix 1B of the Delta Plan (http://deltacouncil.ca.gov/docs/appendix-1b), along with documentation of adequate resources to implement the proposed adaptive management process. Since ongoing funds originating from the State Water Project contractors will be used to support and monitor the project, we anticipate DWR will have the ability to describe access to the funding, equipment and staffing necessary to implement adaptive management for the project.

DSC-1 (Cont. below)

Some key parts of the adaptive management process involve identifying key uncertainties that can be addressed by a project and disseminating key findings to interested parties so that the design of future projects can be based on the lessons learned from past efforts. Two notable features of the Prospect Island Restoration Project involve excavating tidal channels as part of site preparation and constructing levee breaches with velocity dissipation features (as described on page 2-46 of the DEIR). According to the DEIR, the excavation of tidal channels is intended to facilitate hydraulic connectivity and transport pathways within the project site as well as serve as a "template" for channel network evolution. Concurrent projects like the State and Federal Contractor Water Agency's Tule Red Restoration Project are also using the approach of excavating the primary tidal channels before breaching the exterior levee in an area with high sedimentation, while another DWR FRP project, the Decker Island Restoration Project, will not involve any channel excavation since hydrologic modelling indicated it was not necessary for that site. Major channel excavation and earthwork increases the complexity and cost of tidal wetland restoration projects, but it is hypothesized that for certain sites these efforts can help accelerate the reestablishment of natural tidal wetland processes following the introduction of full tidal influence. We suggest the adaptive management plan incorporate strategies for evaluating the effectiveness of excavating tidal networks prior to exterior levee breaching (e.g., evaluate whether the main channel silts in, determine if channels help maintain adequate velocities to help preclude colonization by invasive aquatic vegetation, and assess whether the excavated main channel helps facilitate formation of smaller dendritic, channel networks), as the lessons learned will be valuable for guiding the design of future tidal wetland restoration projects.

The breach velocity dissipater approach is a unique strategy being implemented by the project to reduce the formation of disorienting eddy currents near levee breaches that can confuse native fish and increase their vulnerability to predation loss. Council staff understand the major challenges of directly evaluating the effects of this levee breach design on predation rates (e.g., predator stomach contents studies) given the current restrictions on fish sampling to reduce incidental take of delta smelt. One potential approach to study this design is to have a single-time special study that analyzes real-life hydrodynamics around the levee breach and see how that compares to the pre-project modelling results; such a study could verify the effectiveness of the design in reducing the types of water eddies that disorient small, juvenile native fish and/or provide insights in how future pre-project hydrodynamic modeling could be improved.

Another feature of the Prospect Island Restoration Project that lends itself to special study is the establishment and expansion of vegetation. Since there are some features on the site that are scheduled to be pre-planted, and others that are going to be passively re-vegetated, a study on the establishment of vegetation could provide valuable information on natural versus transplanted colonization rates, which may be useful for planning other projects. Information gained from studying re-vegetation on Prospect Island could also be compared with studies of vegetation at nearby Liberty Island to provide context and reference.

DSC-1 (Cont. below)

Delta Science Program staff provide consultation regarding preparation of documentation of use of best available science and adaptive management. Staff from the FRP shared preliminary drafts of the Prospect Island Restoration Project adaptive management plan with us and we very much appreciated the opportunity to engage during the early phase of adaptive management plan development. Karen Kayfetz (karen.kayfetz@deltacouncil.ca.gov) of the Delta Science Program will continue to be the primary point-of-contact regarding discussions related to documentation of best available science and development of the adaptive management plan for the Prospect Island Restoration Project.

Mitigation Measures

Delta Plan Policy **G P1** (23 CCR Section 5002) also requires that actions not exempt from the California Environmental Quality Act (CEQA) and subject to Delta Plan regulations must include applicable feasible mitigation measures consistent with those identified in the Delta Plan Program Environmental Impact Report (PEIR) or substitute mitigation measures that are equally or more effective. The Delta Plan Mitigation and Monitoring Reporting Program (MMRP) is to be used to ensure compliance with the Delta Plan mitigation measures and this document is available at http://deltacouncil.ca.gov/sites/default/files/documents/files/Agenda%20Item%206a_attach%202.pdf. One specific example of a relevant Delta Plan PEIR mitigation measure is provided below.

Habitat Restoration

Delta Plan Policy **ER P2** (23 CCR Section 5006) states that habitat restoration must occur at appropriate elevations and be consistent with Appendix 3 of the Delta Plan regulations, which is an excerpt from the 2011 Draft Ecosystem Restoration Program Conservation Strategy. Appendix 3 describes the many ecosystem benefits related to restoring tidal wetlands, but it also cautions about the impacts of invasive species and methylation of mercury. The DEIR explains that CDFW and DWR are currently developing studies to evaluate the flux of methylmercury in freshwater tidal wetlands. To the extent possible, DWR should incorporate methylmercury studies into the monitoring and adaptive management plan for Prospect Island Restoration Project.

Invasive Species

Delta Plan Policy **ER P5** (23 CCR Section 5009) states, "The potential for new introductions of or improved habitat conditions for nonnative invasive species, striped bass, or bass must be fully considered and avoided or mitigated in a way that appropriately protects the ecosystem." Nonnative species, such as terrestrial and aquatic weeds, are a major obstacle to successful restoration because they affect the survival, health, and distribution of native wildlife and plant species. Although there is little chance of eradicating most established nonnative species, management can be designed to reduce their abundance. As stated above, the Ecosystem Restoration Program Conservation Strategy also states that a major concern for restored tidal wetland would be potential for colonization of this habitat by non-native species.

DSC-1 (Cont. below)

According to the DEIR, the project site is host to several ecologically disruptive, invasive weeds species, including water primrose, Eurasian watermilfoil, curlyleaf pondweed, giant reed, yellow star thistle, and tamarisk. The restoration strategy includes removing existing invasive weeds in coordination with dewatering of the site. We agree with this approach by DWR to focus on removal of invasive weeds prior during site preparation; lessons learned from other tidal restoration sites indicate that controlling invasive weeds when the site is dry is important as weed control in an aquatic habitat becomes much more challenging. The DEIR outlines different methods for weed control (e.g., herbicide application or mechanical removal) for specific weed species and the timing for these implementing these strategies.

We recommend that DWR develop an invasive species management plan for the project, in accordance with Delta Plan MMRP **Biological Resources Mitigation Measure 4-1**, which addresses both terrestrial and aquatic weeds. This particular mitigation measure calls for an invasive species management plan to be developed and implemented which include the following elements:

- Nonnative species eradication methods (if eradication is feasible)
- Nonnative species management methods
- Early detection methods
- Notification requirements

- Best management practices for preconstruction, construction, and post construction periods
- Monitoring, remedial actions and reporting requirements
- Provisions for updating the target species list over the lifetime of the project as new invasive species become potential threats to the integrity of the local ecosystems

Land Use

Delta Plan Policy **DP P2** (23 CCR Section 5011) calls for habitat restoration projects to avoid or reduce conflicts with existing uses. Additionally, it calls for consideration of comments from local agencies and the Delta Protection Commission.

Habitat restoration efforts can contribute to potential conflicts with neighboring landowners and stakeholders. As you are probably aware, DWR - in collaboration with several other agencies - developed a toolbox of Agricultural and Land Stewardship (ALS) strategies which provide guidance for managers of projects located within agricultural areas. These strategies include good neighbor practices, options for landowner participation, and strategies to support an agricultural economy (all these strategies are available online at https://agriculturallandstewardship.water.ca.gov/). To the extent feasible, we recommend DWR utilize these ALS strategies as it works with local landowners and stakeholders throughout the CEQA analysis process.

DSC-1 (Cont. below)

The DEIR also includes an analysis of the potential for seepage from the project to the neighboring Ryer Island, which the DEIR ultimately concludes will be a less-than-significant effect. Such analyses can be used to demonstrate consistency with DP P2 and how unintended consequences from the project on existing uses for neighboring properties was considered and mitigated if necessary.

Other General Comments on DEIR

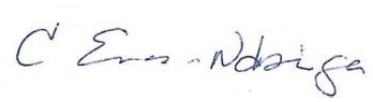
The Delta Plan contains 74 recommendations, which we encourage project proponents to consider as they design and implement their projects and programs. Progress towards their implementation will help with achieving the coequal goals in a manner that protects and enhances the unique values of the Delta. The DEIR identifies a few Delta Plan recommendations as policies (e.g., page 3-320 of DEIR), including Recommendation ER R2 (Prioritize and Implement Projects that Restore Delta Habitat) and DP R10 (Encourage Wildlife-friendly Farming). We want to clarify that unlike the Delta Plan's 14 policies, the 74 recommendations of the Delta Plan are non-regulatory in nature. Although DWR would not be required to document compliance with these recommendations as part of a Delta Plan certification of consistency, we appreciate DWR's recognition of the importance of relevant Delta Plan recommendations as a component of demonstrating consistency with applicable regional plans, as called for by section 15125(d) of the CEQA Guidelines.

We recommend DWR also include in the Final EIR analysis related to Delta Plan recommendations DP R11 (Provide New and Protect Existing Recreation Opportunities), DP R14 (Enhance Nature-based Recreation), and DP R16 (Encourage Recreation on Public Lands) which encourage increasing outdoor recreation to the extent feasible. Potential recreational opportunities to consider for the site include boating access, bird watching and environmental education. DSC-1

Final Remarks

Overall we support DWR in this effort to restore tidal wetlands to benefit native species including delta smelt and salmonids. We look forward to working with DWR staff on this project and, if necessary, providing early consultation to DWR staff on filing a Delta Plan certification of consistency. I encourage you to contact Daniel Huang at Daniel.Huang@deltacouncil.ca.gov for any questions you have regarding issues raised in this comment letter.

Sincerely,



Cassandra Enos-Nobriga
Deputy Executive Officer
Delta Stewardship Council

Local Agencies of the North Delta

(LAND)

LAND

Local Agencies of the North Delta

1010 F Street, Suite 100, Sacramento, CA 95814
(916) 455-7300, osha@semlawyers.com

November 7, 2016

SENT VIA EMAIL (Dan.Riordan@water.ca.gov)

Dan Riordan
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

RE: Comments from Local Agencies of the North Delta on Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

These comments on the proposed Prospect Island Tidal Habitat Restoration ("project") are submitted on behalf of the Local Agencies of the North Delta ("LAND"). LAND is a coalition comprised of reclamation and water districts in the northern geographic area of the Delta.[1] As local agencies in the areas most impacted by the restoration projects such as that now proposed on Prospect Island, we are providing these comments to assist in the design and environmental analysis of this project so that it achieves the project goals, and provides effective mitigation of project impacts to nearby flood protection facilities and agricultural operations.

Generally, we are disappointed that Department of Water Resources ("DWR") has not responded to our comments on the Notice of Preparation submitted on November 4, 2014. Upon review of the Draft Environmental Impact Report ("DEIR") for the project, there is a systematic failure to respond to our technical comments or even to our general environmental impacts comments in in any substantive way. Our comments in this letter do not attempt to catalog every possible issue, but rather, expand on specific technical environmental impacts based on our prior comments and discussions with staff. These comments are in addition to comments from other LAND-associated Reclamation Districts ("RDs"). In response to these deficiencies, we have developed an immediate process by which we feel that these impacts can be mitigated and address the local

LAND-1
(Cont. below)

[1] LAND member agencies cover an approximately 110,000 acre area of the Delta; current LAND participants include Reclamation Districts 3, 150, 307, 317, 349, 407, 501, 551, 554, 556, 744, 755, 813, 999, 1002, 2111, 2067 and the Brannan-Andrus Levee Maintenance District. Some of these agencies provide both water delivery and drainage services, while others only provide drainage services. These districts also assist in the maintenance of the levees that provide flood protection to homes and farms.

concerns about the impacts of the proposed project. We are again reiterating that offer to work together toward a project that is both beneficial for the Delta ecosystem and also acceptable to local landowners and districts. In particular, we would like to follow up informally on our conversation in West Sacramento last week, which discussed ways in which the concerns outlined below could be addressed in a mutually beneficial manner. LAND-1 (Cont.)

I. COMMENTS

Habitat projects in the Delta have had a variety of outcomes, many of which are not intentional or even fully understood. LAND has actively worked with DWR and other parties to attempt to better understand the potential impacts of these habitat projects on reclamation and water districts, as well as agricultural operations and residents. The results of millions of dollars of restoration efforts in the Delta have been poorly documented, poorly monitored, and ecologically uncertain. For instance, despite over 40,000 acres of publically held or managed intertidal and open water habitat in the Delta primary zone, and 116,000 acres in Suisun, native fish species declines do not appear to be stabilizing. Moreover, the vast majority of publically held land in the Delta receives little or no invasive weed management, ecological monitoring, or any ecological-oriented site management.

Though past restoration successes have been limited, we believe it is possible for the proposed project to be a showcase for effective community and RD engagement in the context of habitat creation or restoration projects in the Delta. To that end, LAND proposes that the project planning consider, and implement key project features and address the underlying scientific, technical and economic questions before proceeding on the project. Our comments are organized into the following categories and discussed in detail below: Communications, Technical Premises, Mitigation, Monitoring and Funding, Operations and Maintenance, Water Rights and New Diversion, Good Neighbor Issues, and Adaptive Management. LAND-2 (Cont. below)

Issue 1 – Communications

DWR had initially undertaken direct communications with the local RDs and LAND, and has also provided a field visit to discuss the proposed project features. These efforts were very important for the common understanding of the physical elements of the project, as well as understanding of the potential impacts of the project and possible mitigation under CEQA. LAND appreciated those efforts and urges their expansion for this and future projects. We are concerned that DWR has failed to respond systematically to these comments and failed to take advantage that such communications can lead to early inclusion of project features to enhance compatibility with adjacent land

uses and effective mitigation from the outset, thereby avoiding conflict. We still believe that the long-term success of the project will require the clear communication with neighboring landowners and RDs. LAND-2 (Cont.)

Issue 2 – Technical Premises

LAND has found that in some cases that the scientific basis for the habitat restoration in the Delta is thin at best and is far likelier to improve conditions for the very invasive species that currently "stress" the Delta ecosystem. It is important that the technical basis for restoration elements be clearly articulated, and where habitat creation is being used, that that premise is identified as well. Under the existing conditions (baseline) there is high riparian and wetland bird use at the site; thus, the explicit tradeoffs between current uses by species and projected benefits for other species in the future need to be identified. LAND-3

Elevations

LAND has reviewed several LiDAR elevation figures for the island and it appears that there may be some discrepancies associated with the current elevations and the proposed design elevations. It would be critical for the success of the project that an independent review by a licensed surveyor of the survey, bathymetry, and LiDAR data occur to ensure that the vertical datum and the control points for these data are correct and consistent. The vertical error associated with some LiDAR data in general and the use of too widely spaced control points can lead to significant cut and fill errors that will prevent the project from meeting its design requirements. LAND-4

Salinity, Nutrients and Toxins

The project design has a high possibility of altering local tidal dynamics, sediment deposition in and around Cache Slough, reducing available nitrogen, and increasing salinity. Suisun Marsh projects and their operations have a clear potential to change tidal dynamics and salinity intrusion throughout the northern Delta; when those effects are combined with this project and other DWR' barrier projects throughout the Delta, there are similar confounding effects, which must be identified and planned for effectively. LAND-5

The same complexities are associated with the premise that nutrients would be exported from this site. The tradeoffs between nutrient cycling that occurs there now and the proposed conditions should be analyzed. For example, any unoxidized organic matter currently being trapped onsite would be exported, with greenhouse gas implications, which must identified. This would also include the need for analysis of localized LAND-6 (Cont. below)

eutrophication and toxic cyanobacterial blooms, and conversely the depletion of local nitrogen and reduction of productivity in the Cache Slough complex. LAND-6 (Cont.)

Accordingly, the project's facilitation of invasive aquatic weeds and invasive clams, and the potential for new mussel invasions must be fully analyzed. For example, if the project intent is to export nutrients, how will the project ensure that it simply does not promote these invasives and export methylmercury (dissolved and sediment-associated) into the food chain? LAND-7

Sediment

Sediment dynamics must be fully disclosed. The site sediment mechanics (assessing the local distribution of sediment) need to be fully described from a seasonal, as well as an early and late project perspective. The local-regional sediment balance should also be identified, and the implications of the long-term decline of sediment in the Sacramento River system on the project performance should be fully described. Equally importantly, the implications on sediment mechanics as a result of this project on other nearby locations should also be described.

Sediment plays a complex role in aquatic ecosystems. Too much sediment in high elevation streams can cause significant water quality problems and lead to fish declines. In the Delta however, sediment provides visual cover for some fish, such as Delta smelt, which protects them from predators. Sediment is also the building block for streambanks through over bank deposits. Sediment is critical for the maintenance of floodplains and the associated riparian habitat by creating the new locations for plants to grow and for creating and maintaining topographic complexity. LAND-8

Reductions in stream sediment loads can also lead to scouring, whereby previously accumulated sediment is stripped and mobilized from existing floodplains. Project-associated invasive aquatic (and some terrestrial) weeds can also lead to the additional removal of sediment, exacerbating this problem.

Seepage and Erosion

The extent and impact of project-associated seepage and wave run-up at any levee breaks is unclear. The seepage modeling should be supported with a tracer study, and a 3–dimensional analysis for erosion on neighboring levees. Optimization of intake locations to minimize hydraulic effects is also essential. Inclusion of operable gates could also minimize impacts of the project on neighboring levees. Additionally, construction of cutoff walls, installation of interception wells, or other means, may be LAND-9 (Cont. below)

necessary to control seepage to adjacent islands. Moreover, mitigation in the form of levee maintenance funds for the neighboring islands will likely be necessary due to hydraulic and other effects of the project. Wind fetch effects could feasibly be monitored with bank pins. LAND-9 (Cont.)

Weed Management

Terrestrial weeds such as perennial pepperweed and *Arundo donax*, which interfere with crops and levee maintenance, and aquatic weeds, such as Hydrilla, Hyacinth and Egeria, which clog pumps and wildlife impacts, have to be carefully managed and their management fully funded for the life of the project. The DEIR includes no weed management beyond initial construction. LAND-10

Issue 3 – Mitigation, Monitoring and Funding

Mitigation, monitoring and reporting plans ("MMRP") are required by CEQA and this project will have ongoing impacts that will require follow-up and long-term funding. This project will be under considerable scrutiny to ensure it meets these requirements, as this is just one project among about 28,000 acres of habitat creation requirements already required by the currently applicable Biological Opinions. Currently, the erroneous less-than-significant conclusions for virtually every impact of concern to local interests has led to a complete lack of mitigation.

All impacts that require mitigation must be clearly identified in the MMRP and be adequately funded. The funding should include adequate compensation for the expected types and extents of impacts with a contingency. Typical small claims of road and fence damage, damage to irrigation and drainage facilities, localized groundwater impacts from dewatering or restoration, weed management issues, and loss of access to property can be handled in an expeditious and fair manner by maintaining a mitigation fund for the project. For instance, funding for levee stability if erosion occurs on neighboring levees should be clearly identified. Weeds and the island's own remaining levees will require routine maintenance, as will ongoing environmental monitoring under adaptive management. LAND-11

Issue 4 – Operations and Maintenance

Operations and maintenance are where these projects typically fail to meet their goals and objectives. The Delta has numerous examples of "restoration projects" that have environmental impacts that were not intended. A long-term management plan and associated funding are critical to maintain these goals and objectives and to meet the LAND-12 (Cont. below)

requirements under CEQA. A passive management approach will not suffice. The current condition of the island is a direct result of the passive approach and a lack of funding.

LAND-12 (Cont.)

Issue 5 – Water Rights and New Diversion

We believe that the project should still identify the source and legal rights to water. (*Cf.* DEIR, pp. 3-36 to 3-37.) Specifically, the project must identify the legal water rights basis (including compliance with the no injury rule), and the point of diversion by which water will be diverted away from the Miner Slough and drained into the Sacramento Deep Water Ship Channel/Cache Slough Complex. The environmental impacts of diverting additional water from the slough must also be addressed. According to DWR data, open water and riparian vegetation consume about 67.5 acre-feet per year, which is much greater than most agricultural uses. (See Exhibit A.)[2] Additionally, the project's potential to further reduce outflow must also be considered.

LAND-13

Issue 6 – Good Neighbor Issues

An ongoing focus of LAND has been to minimize the local impacts from restoration projects. In general, the project should include "good neighbor policies." This includes adequate planning, monitoring and maintenance funding to ensure that impacts such as seepage, increased levee erosion, invasive weeds, and other issues are managed effectively so as not to interfere with adjacent and nearby land uses. It is important that the project description and/or mitigation measures include good neighbor principles. DWR has developed a Good Neighbor Checklist as part of its Agricultural Land Stewardship Strategies effort for projects that should be consulted in the development of this project. (See Exhibit B.)

LAND-14

As discussed in this letter, neighboring landowner impacts from this project requiring special attention are:

- Loss of agricultural productivity/crop damage from seepage;
- Damage to levees from wind fetch, increased wave action and changes in flow patterns;
- Increased flood risks from levee damage and changes in flow patterns;

LAND-15 (Cont. below)

[2] Department of Water Resources, Bulletin 168 (October 1978) titled, "Sacramento Valley Water Use Survey 1977," Table A-5 (showing 1976-77 Estimated Crop Evapotranspiration Values for the Delta Service Area).

- Impairment of water quality and reduced surface water availability;
- Increased terrestrial and aquatic weeds leading to crop damage and damage to water diversions;
- Endangered Species take jeopardy by listed species introduction/enhancement of habitat;
- Sound, dust and traffic from construction and ongoing maintenance; and
- Damage to roads and levees along the travel route to the site from heavy equipment needed for construction and ongoing maintenance.

LAND-15 (Cont.)

The DEIR should be revised to analyze and provide adequate mitigation for these impacts. Unfortunately, the DEIR does not mention good neighbor policies at all. We would like to work with DWR to address these issues, as discussed at our meeting last week.

One issue that still requires attention is the potential for increased take liability concerns for operation of existing water diversions in the vicinity of the project. If the project is successful in improving conditions for listed fish (an explicit goal), listed species may become more abundant than they are currently. Though local intakes are not currently a cause of concern with respect to take of listed species,[3] that could change as a result of the project. Thus, the project should include some means to extend take coverage to these intakes, or otherwise provide assurances, if needed.

Though this issue can be complex, on the project-level, there are means by which this issue could be addressed, for instance, through extension of take coverage to neighboring landowners in the C/ESA permitting processes. A low effects HCP could also be a possibility for the surrounding area. There is also the option of the project including funding for screening or other improvements to neighboring intakes in determined necessary to prevent the possibility of take (even though they are below the size on which the fish agencies have been most focused). The key is to create *no-harm*

LAND-16 (Cont. below)

[3] "[S]mall agricultural Delta agricultural diversions are likely to have a minor effect on pelagic (open water) fish, such as the [D]elta smelt." (Ecosystem Restoration Program, Ecosystem Strategy for Stage 2 Implementation Sacramento San Joaquin Delta Ecological Management Zone July 21, 2010 report, p. 50, citing Nobriga, M., Z. Matica, and Z. Hymanson. 2004. Evaluating Entrainment Vulnerability to Agricultural Irrigation Diversions: A Comparison Among Open-Water Fishes. American Fisheries Society Symposium 39:281-295, available at: http://www.fws.gov/stockton/afrp/SWRCB/12.%20Nobriga%20et%20al.%202004.pdf. As a result, larger diversions (over 250 cfs), have been the focus for consideration of screening by state and federal agencies.

strategy for existing Delta water users, which will in turn prevent negative impacts on neighboring agricultural land uses. We discussed this issue extensively with DWR staff in the context of the now abandoned BDCP, and are willing to continue the dialogue in the context of this project, which should be much more straightforward in comparison.

LAND-16 (Cont.)

Issue 7 – Adaptive Management

The project needs to include functional adaptive management features, specifically including an operable gate to control the connection of the slough to the restoration. The only means by which the project can minimize or mitigate its salinity intrusion and methylmercury production is through operable water control structures. These structures can also be used to manage aquatic and terrestrial weeds and aquatic primary production. While a passive spill system may seem ideal from an engineering standpoint, it fails to meet several significant environmental considerations. Currently, incoming water to the island is managed through a controlled gate, and to apply adaptive management in any substantive sense, gates and/or other operable structures will be necessary. We understand an adaptive management plan is being prepared, and would like to have input into the final plan.

LAND-17

II. CONCLUSION

LAND and local communities continue to desire a positive outcome from the Prospect Island restoration. With successful collaboration, this project *could be* the hallmark of ecological improvements and functional restoration with minimal impacts on adjacent flood control structures and agriculture. Alternatively, this project could become the hallmark of irresponsible reclamation that is not sensitive to existing adjacent land uses and users. LAND would like to see this project succeed not just on paper, but in practice. To do anything less will create yet more barriers to the completion of future restoration projects.

Very truly yours,

SOLURI MESERVE
A Law Corporation

By: 
Osha R. Meserve

ORM/mre

Enclosures: Exhibit A - DWR Bulletin 168 (October 1978), Table A-5
Exhibit B – DWR Good Neighbor Checklist

cc: Dennis McEwan, Department of Water Resources
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EXHIBIT A

TABLE A-5
1976-77 Estimated Crop Et Values
Delta Service Area
(in inches)

Land Use Category	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Total Oct.76-Sep.77	Oct.77	Total Nov.77-Oct.77
Sacramento-San Joaquin Delta															
Irrigated Pasture	3.2	1.5	1.0	0.7	1.5	3.6	5.4	4.8	6.9	7.7	6.4	4.7	47.4	3.4	47.6
Alfalfa	3.2	1.5	1.0	0.7	1.5	3.2	4.9	4.4	6.5	7.5	6.5	4.9	45.8	3.4	46.0
Deciduous Orchard (Fruits & Nuts)	2.6	1.5	1.0	0.7	1.5	2.7	3.8	4.0	6.1	7.4	6.1	4.3	41.7	2.6	41.7
Tomatoes	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.6	4.0	8.2	6.0	2.3	34.3	1.9	33.8
Sugar Beets	2.4	1.5	1.0	0.7	1.5	1.9	2.2	3.7	7.6	8.3	6.4	4.4	41.6	2.4	41.6
Grain Sorghum (Milo)	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.0	5.9	7.3	4.3	2.5	33.2	1.9	32.7
Field Corn	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.3	5.7	6.9	5.1	2.6	33.8	1.9	33.3
Dry Beans	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.7	5.7	6.2	2.7	2.5	30.0	1.9	29.5
Safflower	2.4	1.5	1.0	0.7	1.5	1.9	2.5	4.8	8.7	7.7	4.4	2.5	39.6	1.9	39.1
Asparagus	2.4	1.5	1.0	0.7	1.5	1.9	2,2	1.0	3.5	7.7	6.4	4.7	34.5	2.4	34.5
Potatoes	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.7	4.3	7.4	5.5	2.8	32.9	1.9	32.4
Irrigated Grain	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	1.0	1.0	1.6	26.1	1.6	24.7
Vineyard	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.8	5.3	6.5	5.3	3.4	34.5	2.4	34.5
Rice	3.2	1.5	1.0	0.7	1.5	1.9	2.8	5.6	8.8	9.8	8.1	5.5	50.4	3.4	50.6
Sudan	2.4	1.5	1.0	0.7	2.0	4.3	5.7	4.8	6.9	7.7	4.9	4.7	46.6	2.4	46.6
Misc. Truck	2.4	1.5	1.0	0.7	1.5	1.9	3.2	4.6	6.7	7.4	5.2	3.7	39.8	1.9	39.3
Misc. Field	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.4	6.1	7.4	5.0	1.9	34.0	1.9	33.5
Double Cropped with Grain															
Sugar Beets	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	4.2	5.2	5.8	37.7	3.4	38.7
Field Corn	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	4.3	6.3	6.1	39.2	2.7	39.5
Grain Sorghum (Milo)	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	2.7	6.1	5.2	36.5	1.9	36.0
Sudan	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	3.6	7.7	4.9	4.7	41.6	1.9	41.1
Dry Beans	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	3.1	7.6	3.5	1.5	36.4	1.9	35.9
Tomatoes	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	2.3	6.6	6.0	5.2	40.8	1.9	40.3
Lettuce	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	4.1	7.4	5.3	4.9	42.4	2.4	42.4
Misc. Truck	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	2.3	6.6	6.0	5.2	40.8	2.4	40.8
Misc. Field	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	4.1	7.4	5.3	4.9	42.4	3.4	43.4
Fallow Lands 1/	2.4	1.5	1.0	0.7	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	14.0	1.0	12.6
Native Vegetation 2/	2.4	1.5	1.0	0.7	1.4	3.7	3.8	2.1	2.3	2.6	2.3	2.0	25.8	1.6	25.0
Riparian Veg. & Water Surface	4.6	2.4	1.4	0.8	1.9	4.5	7.4	6.6	9.7	11.8	9.7	7.0	67.8	4.3	67.5
Urban	1.6	0.8	0.6	0.7	1.0	1.0	1.9	2.4	2.4	2.5	2.4	1.9	19.2	1.6	19.2

1/ Applies also to nonirrigated grain.
2/ Applies also to nonirrigated orchards and vineyards

Metric conversion: inches times 25.4 equals millimetres.

EXHIBIT B

Good Neighbor Checklist

The Sacramento-San Joaquin Delta (Delta) is the home of numerous habitat restoration efforts. Many Delta farmers are concerned that habitat lands could harm nearby agriculture in various ways. They would like assurance that entities that establish and manage habitat projects will consult with their neighbors and find ways to avoid impacts and resolve problems if they arise.

Restoration project managers can use the following checklist to ensure that they comprehensively consider and examine the impacts of their project on neighbors, and vice versa. The checklist is based on a discussion paper, "Agricultural and Land Stewardship Strategies" (see https://agriculturallandstewardship.water.ca.gov), which identifies a menu of mitigation measures and enhancements for the Delta. The measures described in the discussion paper, called Strategies, are referenced in the checklist.

- ☐ Have project proponents consulted with all neighboring landowners and operators about the project and its potential impacts? (See Strategy E1.1, which recommends involvement of landowners in project planning.)
- ☐ Have project proponents designated a local contact person to meet with neighboring landowners and discuss any issues of concern? (See Strategy D5.1, which suggests establishment of a public advisor position to help the public work with government agencies.)
- ☐ Will the project need access through other properties? If so, have access agreements been obtained?
- ☐ Does the management plan for the project provide for an on-site patrol or manager to deter trespass and vandalism? (See Strategy A4.3, which suggests the hiring of game wardens, sheriff's deputies, or private security guards.)
- ☐ Will the project increase the presence of vegetation susceptible to fire? (If yes, see Strategy A4.3.)
- ☐ Will the project discontinue maintenance of flood control features, involve prolonged or repeated flooding of previously dry land, or affect wind fetch across waterways? (If yes, see Strategy A1, which discusses flood protection improvements, and Strategy E1.3.2, which discusses drainage and seepage.)
- ☐ As a result of the project, are species on the project site expected to increase markedly in abundance and move from the site to neighboring lands or waterways? If yes, which species? (And see Strategy A4.2, which suggests ways to protect landowners from liability under endangered species laws.)
- ☐ Is it reasonably possible that species in the project area could damage crops or promote the growth of weeds or diseases on neighboring farms? (If yes, see Strategy A3, which suggests ways to control weeds, and Strategy A4.1, which

suggests the use of buffer zones and mechanisms for compensation for crop damages.)

- ☐ Will the project disturb utilities, roads, bridges, or other infrastructure that serve agricultural uses? (If yes, see Strategy D3, which suggests improvements to transportation infrastructure.)
- ☐ Will the project fragment or isolate farmland? (If yes, see Strategy E1.1, which encourages collaborative project planning.)
- ☐ Do domestic or feral animals or livestock occur on lands neighboring the project? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)
- ☐ Do neighboring farms use chemicals as fertilizer, or to control weeds or crop pests? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)

End of attachments to LAND

Reclamation District 501

(RD501)

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RD501
HBOCT

October 7, 2016

VIA CERTIFIED MAIL AND E-MAIL

Department of Water Resources
ATTN: Daniel Riordan
P.O. Box 942836
Sacramento, CA 94236
frpa@water.ca.gov

Re: Draft Environmental Impact Report - Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

On behalf of Reclamation District 501 ("RD 501"), we appreciate the opportunity to comment on the August 2016 Draft Environmental Impact Report for the Prospect Island Tidal Habitat Restoration Project ("DEIR"). As the public agency responsible for maintenance of levees on Ryer Island in Solano County, we are concerned about several adverse impacts that are likely to result from the Prospect Island Tidal Habitat Restoration Project ("Project"), but which are not adequately addressed in the DEIR. We provide these comments for consideration of the decision makers on the DEIR and request that a new draft environmental impact report be prepared for the Project that adequately addresses all adverse environmental impacts.

RD 501 is also providing comments from our engineering firm, KSN, Inc. These comments are attached and are incorporated by reference into RD 501's comments.

RD501
HBOCT-1
(cont. below)

Groundwater Seepage Impacts on Ryer Island

RD 501 has observed a marked increase in soil saturation and groundwater seepage on Ryer Island on every occasion when Prospect Island has been substantially inundated. As such, RD 501 is rightly concerned that the Project will result in significant seepage impacts to Ryer Island, as transformation of Prospect Island into permanent wetland habitat will increase the overall head pressure on sand lenses running beneath both islands.

On September 10, 2015, RD 501 submitted a Seepage Impact Analysis report prepared by ENGEO to the California Department of Water Resources ("DWR")[1], which provided an exhaustive review of the DWR seepage model and concluded that DWR's own data supports the existence of sand lenses connecting Prospect Island with Ryer Island through which seepage from the Project would likely impact Ryer Island.

[1] A copy of RD 501's transmittal letter to DWR is enclosed.

The Seepage Impact Analysis demonstrated that critical existing data – known to DWR – was completely ignored when developing the DWR seepage model upon which the conclusions related to seepage impacts in the DEIR are based. Specifically, the Seepage Impact Analysis points out several deficiencies in DWR's seepage analysis, including:

- Assuming homogeneous soil conditions across Prospect and Ryer Islands;
- Simplifying the soil analysis by selecting only three differing soil conditions;
- Failing to conduct trenching at or near the toe of the Miner Slough levees on the Prospect Island side;
- Spacing bore holes too far apart to be representative of soil conditions on Prospect Island;
- Ignoring three sand lenses that were discovered during DWR's subsurface investigation, which, if modeled, would have provided a conduit from Prospect Island to Ryer Island through which seepage could occur; and
- Ignoring data that would show that when Prospect Island is flooded the head pressure on Prospect increases, and there is a corresponding increase in ground water head elevation on Ryer Island.

RD501
HBOCT-1
(Cont.)

Critically, ENGEO's Seepage Impact Analysis clearly established that when the sand lenses known by DWR to exist on Prospect Island are included in the DWR seepage model, the model demonstrates that there is passage of water from Prospect when flooded through these sand lenses to Ryer Island, thus causing seepage.

The Seepage Impact Analysis was provided by RD 501 as technical input to assist DWR in the CEQA review process that led to the DEIR. However, the DEIR contains neither a mention of nor a reference to the ENGEO Seepage Impact Analysis. Rather, the discussion of potential seepage impacts in the DEIR is based solely on the faulty DWR model. An EIR is required to be responsive to opposing viewpoints. *Cadiz Land Co. v. Rail Cycle, L.P.* (2000) 83 Cal. App. 4th 74, 104; *Greenebaum v. City of Los Angeles* (1984) 153 Cal. App. 3d 391, 413,.[2] DWR's failure to disclose and discuss the ENGEO Seepage Impact Analysis in the DEIR was arbitrary and not in accordance with CEQA requirements. Therefore, the DEIR is deficient, and DWR must prepare and re-circulate a new draft environmental impact report, which addresses the ENGEO's seepage analysis and identifies the Seepage Impact Analysis report as a reference.

[2] See *also Ctr. for Biological Diversity v. U.S. Forest Serv.*, 349 F.3d 1157, 1167-68 (9th Cir. 2003) (finding "failure to disclose and analyze. . . opposing viewpoints" violates NEPA) *and California v. Block*, 690 F.2d 753, 773 (9th Cir. 1982) (NEPA obligates agencies "to provide a 'meaningful reference' to all responsible opposing viewpoints concerning the agency's proposed decision.")

Scour and Erosion Impacts

The DEIR acknowledges that increased velocities in Miner Slough and the creation of localized cross-currents caused by breaching the Prospect Island levees as contemplated by the Project "have the potential to erode the Miner Slough levee and thereby threaten the long term stability of the flood protection provided." (DEIR, at 3-29.) Based on hydrodynamic modeling, DWR determined that cross-current flows would not cause scour of the Ryer Island levee. Moreover, based on an assumption that the channel bed is composed of mostly fine-grained materials, DWR concluded that the potential for erosion of the toe of Miner Slough levees from channel bed scour is less than significant.

However, DWR admits in the DEIR that it did not collect or analyze channel-bed grain-size data to support it conclusions. The DEIR also fails to account for storm flows in its model calculations, which can create an additional ten feet of water in the system during high flood conditions and saturate levees protecting Ryer Island, making them vulnerable to erosion. Further, the DEIR fails to examine the potential for scour effects caused by changes in surface water flow related to changes in diversion and pumping practices on Prospect Island as a result of the wetland restoration Project. These effects will potentially be exacerbated by climate change and rising sea levels along the California coast, impacting water levels in the Delta.

Bed scour also increases the likelihood of groundwater seepage onto Ryer Island by intersecting and exposing interconnected sand lenses with areas within Ryer Island inside the levee system. The DEIR fails to address this potential impact.

Accordingly, we request that DWR issue a new draft environmental impact report that addresses all potential scour-related impacts from the Project.

RD501
HBOCT-2

Wind-Wave Erosion Impacts

The Prospect Island levees are the only barrier between Ryer Island and the Sacramento Deep Water Shipping Channel ("DWSC"). Thus, RD 501 is concerned about potential erosion of Prospect Island's interior-side levees resulting from the Project's inundation and levee breach activities to create wetland habitat on Prospect Island.

Currently, Prospect Island acts as a barrier to prevent large waves from the DWSC that can form during high wind events from damaging Ryer Island levees. The Project will expose Prospect Island's interior levees to larger, erosive waves from the DWSC. DWR's wind-wave erosion model in the DEIR underestimates wind speeds experienced during major storm events. The DEIR also underestimates high river stages in the delta during storm events by at least ten feet.

Once Prospect Island is inundated to create wetland habitat, access to the Island's interior by land-based equipment will become impossible. Therefore, installation of rip-rap or other measures to mitigate the impact of high waves will be entirely dependent on conditions within the waterway. The DEIR fails to consider mitigation measures – such as placement of rip-rap along Prospect Island's inland slopes *before* completion of the Project – to address potential wind-wave erosion in light of the access issues posed by the Project.

RD501
HBOCT-3

Water Temperature

DWR concludes in the DEIR that the Project would have "a beneficial effect on long-term water temperature" for supporting habitat of sensitive fish species. (DEIR, at 3-80.) However, the DEIR fails to address the impacts resulting from a potentially more advantageous fish habitat. For example, additional safeguards will be needed to reduce the risk of harm to fish from intake pumps used to divert surface water for irrigation on Ryer Island. The DEIR fails to adequately address this issue, including how to evaluate effective safeguards without disrupting pumping operations. RD501 HBOCT-4

The DEIR also fails to address the potential for creation of warm zones resulting from shallow water habitat throughout the inundated Prospect Island wetland habitat.

We thank you again for the opportunity to comment on the DEIR. Based on the significant deficiencies discussed herein, DWR should issue a new draft environmental impact report for the Project, develop appropriate mitigation measures, and allow further public comment before preparing a Final EIR. We look forward to continuing to work with DWR to ensure that all significant environmental impacts resulting from the Project are adequately addressed. RD501 HBOCT-5

Should you wish to meet and discuss these issues, please do not hesitate to contact me.

Regards,

Michael J. Van Zandt

Enclosures
1. RD 501 Transmittal Letter, September 10. 2015
2. KSN, Inc. Comment Letter, September 26, 2016

cc: RD 501
Central Valley Flood Protection Board

MICHAEL J. VAN ZANDT
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HansonBridgett

Start of attachments to RD501 HBOCT

September 10, 2015

VIA OVERNIGHT DELIVERY

Dean Messer
Chief, Environmental Services
California Department of Water Resources
3500 Industrial Blvd.
West Sacramento, CA 95691

Re: Prospect Island Fisheries Habitat Restoration—ENGEO Study

Dear Mr. Messer:

I write on behalf of Reclamation District 501 ("RD 501") regarding the Prospect Island Fisheries Habitat Restoration Project and the seepage issue on Ryer Island. For quite a long while, RD 501 has been engaged in a dialog with the Department of Water Resources ("DWR") (and before that the U.S. Army Corps of Engineers) concerning the seepage problem at Ryer Island. RD 501 has engaged the engineering firm of ENGEO Incorporated to review the various DWR studies and to provide data analysis and to form conclusions regarding the DWR reports, especially the most recent report from 2014. I am pleased to provide you with a copy of the ENGEO Study for use in your technical CEQA review.

The ENGEO Study provides an exhaustive review of the DWR model and analysis that concludes there is no sand lens that connects Prospect Island to Ryer Island. However, DWR's own data indicates that there are sand lenses ranging from 25 to 60 feet at depth beneath the water level. CPT PI 2, 9 and 10 all show lenses of higher conductivity soil intermixed with the near surface clay layer. As the ENGEO Report states at page 11, "The seepage model [used by DWR] is a further simplification of an already over-simplified lithologic model. The result is a large 10 to 20 foot layer of relatively impermeable soil covering both Prospect island and Ryer islands (Figures 19 to 23). This layer does not adequately reflect the lithologic model or the various borings and CPTs upon which the model is based."

There is data in the 2014 DWR report that supports sand lenses existing between Prospect Island and Ryer Island in the vicinity of the seeps. However, it appears that these sand lenses were inexplicably left out of the DWR model. Moreover, the bore holes used by DWR were spaced too far apart at the critical areas to provide a representative sample of the underlying sand and clay layers. ENGEO recommends additional bore holes at the historic distributary channel locations, additional subsurface exploration on Prospect Island to characterize the variability and thickness of the fine-grained soil layer and additional seepage analysis incorporating the more detailed subsurface characterization.

We are providing this report as a technical input to the CEQA process now underway. The ENGEO report, however, is not just a different opinion based on the analysis of the data in

We are providing this report as a technical input to the CEQA process now underway. The ENGEO report, however, is not just a different opinion based on the analysis of the data in question, but demonstrates that critical data that exists was overlooked by DWR, suggesting that the decision making process regarding Prospect Island seepage was arbitrarily determined. RD 501 trusts that DWR will correct these errors and provide an updated review that considers all of the data.

Should you wish to meet and discuss these issues, please do not hesitate to contact me.

Regards,

Michael J. Van Zandt

Enclosure

cc: RD 501

End of attachments to RD501 HBOCT

KJELDSEN SINNOCK NEUDECK
CIVIL ENGINEERS & LAND SURVEYORS
CELEBRATING 60 YEARS

Stephen K. Sinnock, P.E.
Christopher H. Neudeck, P.E.
Neal T. Colwell, P.E.
Barry O'Regan, P.E.

1125-006

RD501 KSN

September 26, 2016

ADVANCE EMAIL
Mr. Michael J. Van Zandt
Hanson Bridgett, LLP
425 Market Street 26 Floor
San Francisco, CA 94105
mvanzandt@hansonbridgett.com

Re: Reclamation District No 501 – Ryer Island Comments
Prospect Island Draft Environmental Impact Report (DEIR) for
Tidal Restoration Project

Dear Michael,

I have reviewed the subject document and have several comments that I suggest you weave into your overall comments on the DEIR on behalf of Reclamation District 501 – Ryer Island (**RD 501**).

Summary of Impacts and Mitigation Measures (Page xxii).

I disagree with the conclusions reached in the following sections where no mitigation is suggested as being required.

RD501 KSN-1

3.1-3 – Seepage Impacts onto Ryer – Proposed Mitigation - None Required.
See ENGEO's Seepage Impact Analysis dated 7/14/15.

RD501 KSN-2

3.1-4 – Potential wind wave erosion on interior levee slopes of Prospect – Proposed Mitigation - None Required.
Interior banks/slopes of flooded Delta Islands are highly susceptible to erosion due to never having had water against them and typical not being highly compacted soils. I will go further into this issue later in this document.

RD501 KSN-3

3.1-6 – Potential increase in seepage on adjacent lands due to Miner Slough bed scour – Proposed Mitigation - None Required.
Any bed scour has a significant likelihood of intersecting and exposing interconnected sand lenses with areas within Ryer Island inside the levee system thus increasing seepage form Miner Slough beneath the levees and onto Ryer Island.

RD501 KSN-4

3.2-5 – Long-term effects on salinity effects on salinity in water bodies adjacent to inundated Prospect Island – Proposed Mitigation - None Required.
Any increase to the Delta Tidal prism has the potential to increase salinity in the Delta Channels. Additional flooded Islands will require greater releases of fresh water from upstream reservoirs during certain flow conditions.

3.2-6 – Long-term effects in water temperature within Prospect and nearby waterbodies – Proposed Mitigation - None Required.

Shallow water habitat will result in warm zones throughout the proposed flooded Prospect Island. It is not true that the design of this project will not result in water temperature differences.

RD501
KSN-5

3.5-2 – Long-term effects on sediment deposition and erosion in the vicinity of Prospect – Proposed Mitigation - None Required.

Wind wave erosion on interior levee slopes will erode the levees particularly during high water along with bed scour will both create sediment in suspension that will ultimately deposit somewhere in the vicinity of Prospect.

RD501
KSN-6

3.12-3 – Potential effects to agricultural uses on adjacent Islands – Proposed Mitigation - None Required.

The impacts from seepage beneath Miner Slough is clearing shown on Figure 3.1-7 where they show the seepage areas on Ryer. The authors of the DEIR are not astute enough to understand the true lithologic model of underlying formations to understand the nature of the seepage caused by the flooding Prospect.

RD501
KSN-7

Areas of Controversy (Page xivi).

They appear to recognize Ryer's seepage impacts yet there is no mention of the submitted ENGEO Seepage Impact Analysis which clearly shows the potential correlation between the observed seepage on Ryer and the proposed flooding of Prospect.

RD501
KSN-8

Figure 2.2-7 Intertidal Bench Configuration (Page 2.43).

The depiction of this intertidal bench leaves off a very important design water surface elevation that is usually recognized when planning and/or designing flood control features in the Sacramento-San Joaquin Delta and that is the Base Flood Elevation(BFE)/1% annual chance flood elevation. The BFE along this reach of Miner Slough varies in elevation between 16.45' to 17.10' (NAVD88). Once this BFE is plotted and shown on the drawing one can see how high the water can actually get in the system around Prospect Island and the likelihood of severe erosion from wind whipped waves on the natural interior slopes of Prospect Island during storm events with the water being 10 feet + deeper than during normal tidal activity. The likelihood of wind waves on the natural slopes of Prospect Island interior levee slopes is a high certainty during storm events. Absent erosion protection in the form of quarry stone riprap will result in ultimate breaching of those reaches of unprotected slopes exposed to the wind waves. In 2004 over a 24 hour period the north levee of flooded Lower Jones Tract lost between 6-10 feet of levee due to a high summer wind event. The continued erosion on this flooded island in the middle of summer would have definitely led to multiple breaches but due to good County Road access the Reclamation District was able to place quarry stone riprap over the entire exposed inland slope and save the levee from being breached. Wind waves are not an uncommon impact in the Delta; sustained wind speeds in excess of 35 miles per hour are known to occur often during heavy storm conditions in this part of the Delta. I have attached one photograph from Twitchell Island during a February 1998 storm with sustained winds in excess of 35 mph causing 3 to 5 foot high waves cresting over the levee

RD501
KSN-9
(Cont. below)

along the San Joaquin River to demonstrate the likely condition that will exist on Prospect during a high water storm event.

RD501
KSN-9
(Cont.)

Regional Groundwater (Page 3-11)

This section correctly states that the regional groundwater flow gradient is from the west to the east toward the lower elevations of the central delta. This supports our findings in ENGEO's Seepage Impact Analysis Report.

RD501
KSN-10

Groundwater Ryer Island (Page 3-15, 3-16, & 3.17)

The debate with this section is all contained in ENGEO's Seepage Impact Analysis dated 7/14/15.

RD501
KSN-11

State Regulations – Reclamation Districts Page 3-18

It is important that we carbon copy the Central Valley Flood Protection Board on our comments so they are aware of our concerns. This may play to our advantage at least we have another forum to debate the impacts at.

William H. Edgar, President
Central Valley Flood Protection Board
3310 El Camino Avenue, Room 151
Sacramento, CA 95821
(916) 574-0609
(916) 712-0710 Mobile
(916) 574-0682 Fax
bedgar@edgarandassociates.com

RD501
KSN-12

Impact 3.1-3 Groundwater seepage impacts from Prospect Island to adjacent areas Page 3-26

The potential for seepage has been studied and reported on thru ENGEO's Seepage Impact Analysis Report dated 7/14/15. Tom Hester, Islands Inc. General Manager has years of empirical data of the seepage impact on the farming operations along Prospect Island. I am certain of the Ryer Island seepage causation since I have personally experienced and seen this seepage phenomenon through the multiple flood events I have worked on over the past 34 years.

RD501
KSN-13

Impact 3.1-4 Potential wind-wave erosion of the interior side of Prospect levees Page 3-28

Please refer to my comments set forth in Figure 2.2-7 Intertidal Bench Configuration (Page 2.43). The fetch/reach for the Twitchell Island attached photograph is the same distance approximately 2 miles studied for the Prospect model. You can see in the photograph that the 3-5 foot high waves generated off this fetch/reach of water are significant and very erosive. That woody debris in the photograph weighed substantially and the quarry stone riprap in excess of 60-75 pounds apiece were being washed/tossed to the inward levee toe due to these wind waves. The Prospect model does not use high enough wind speeds experienced during our major storms nor do they take into account the high river stages in the delta during storm events either that represents 10 foot deeper water than modeled.

RD501
KSN-14

Another reason for placing erosion protection now along the inland slopes of Prospect Island is because the area between the levee breaches along the Miner Slough levee will result in an island of land no longer accessible from land based equipment. Placement of riprap during storm events is not always an option due to the conditions within the waterway, see attached Twitchell photo. The erosion protection along the inland slopes must be placed now to prevent further breaching of the levees along Miner Slough. RD501 KSN-15

Impact 3.1-5 Potential toe-scour and erosion of Minor Slough levees affecting Ryer Island levee stability Page 3-29.

The report continues to ignore storm flows in their model calculations. As stated above the 10 additional feet of water in the system during high flood storm flow impacts sections of RD 501's levee that are typically unsaturated. Once these sections of levee do become saturated they become less strong and more likely to erode. The report should take into account the higher stage flows and impacts resulting therefrom. RD501 KSN-16

Impact 3.1-6 Potential increase in seepage on adjacent lands due to Miner Slough bed scour Page 3-34.

As stated in ENGEO's report this area of Prospect and Ryer is located in an area of former freshwater marsh traversed by numerous existing and former delta distributary channels. Many of this distributary channels were covered by man-made levees leaving behind seepage paths beneath the levees onto Prospect and Ryer. These distributary channels are interbedded with sands silts and clays. They are not homogenous and they do convey seepage water. To make findings that scour into these historic dendritic channels will not cause additional seepage onto Ryer is preposterous and unfounded. RD501 KSN-17

This concludes my comments on this document; please call me if you would like to discuss any of these issues beyond what I have stated herein.

Sincerely,
KJELDSEN, SINNOCK & NEUDECK, INC.

Christopher H. Neudeck

w/enclosures

cc: Trustees (w/encl.)
Stacey Boyd, Sec. (w/encl.)

Attachment to RD501 KSN

End of attachment to RD501 KSN

Solano County Water Agency

(SCWA)

SCWA

SOLANO COUNTY WATER AGENCY

October 7, 2016

Department of Water Resources
Attention: Daniel Riordan
P.O. Box 942836
Sacramento, CA 94236

Subject: Comments on Draft Prospect Island Tidal Habitat Restoration Project EIR dated August 2016

Dear Mr. Riordan:

The Solano County Water Agency (SCWA) provides water from the Federal Solano Project and the North Bay Aqueduct (NBA) of the State Water Project to cities, special districts and State agencies in Solano County. The agency boundaries include all of Solano County, portions of which are within the legal Delta. The NBA, which provides much of the municipal drinking water in Solano County, is owned and operated by the Department of Water Resources. The NBA's intake draws water directly from Barker Slough, located within the Cache Slough Complex (CSC) and approximately eight miles away from the proposed Prospect Island Tidal Habitat Restoration Project.

While SCWA supports habitat restoration efforts, we are deeply troubled by the tendency of some State and Federal agencies, as well as other habitat restoration proponents, to understate if not summarily dismiss the potential water quality and endangered species impacts of these projects on the NBA drinking water supply. In general, as documented by the 2015 Recirculated BDCP RDEIR/SDEIS, habitat restoration efforts in the region are likely to contribute to already elevated levels of dissolved organic carbon and other undesirable drinking water quality constituents, and increase the potential for entrainment of endangered fish species such as the Delta Smelt, by the NBA.

SCWA-1

We find the Draft Prospect Island Tidal Habitat Restoration Project EIR dated August 2016 deficient with respect to the potential water quality and endangered species impacts to the NBA. Accordingly, we object to approval of the Prospect Island Tidal Habitat Restoration Project with the current deficient EIR. However, if the EIR is revised to become legally adequate, then many of SCWA's environmental concerns would be mitigated or lessened.

In general, the analysis of potential long-term water quality impacts to the NBA drinking water supply is inadequately supported - the conclusions derived from the cited modeling

SCWA-2
(Cont. below)

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SOLANO WATER
BE GREEN, SAVE BLUE

results cannot be verified, as the underlying reference documents; SWS and WWR 2012, as well as SWS and WWR 2014, are not provided nor found to be readily available for review. Consequently, the methodology and key assumptions of the water quality analysis cannot be evaluated.

SCWA-2 (Cont.)

In the absence of sufficient modeling documentation, SCWA cannot accept the EIR's conclusion that the proposed project's incremental water quality impacts to the NBA drinking water supply would not be cumulatively significant. At the very least, this conclusion is inconsistent with the findings of the 2015 Recirculated BDCP RDEIR/SDEIS, which among other things, concludes that tidal habitat restoration projects in the region would likely increase, or at least have the reasonable potential to increase bromide, chloride and organic carbon concentrations in the northwestern Delta, including at the NBA intake at Barker Slough.

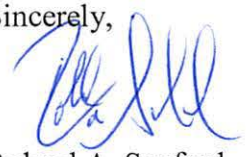
SCWA-3

Given the potential water quality and endangered species impacts to the existing NBA facilities, we do not believe the Prospect Island Tidal Habitat Restoration Project, as presently proposed, is consistent with the Legislature's 2009 Delta Reform Act, the Governor's California Water Action Plan, or the Delta Stewardship Council's Delta Plan. The 2009 Delta Reform Act sets forth the co-equal goals of protecting, restoring and enhancing the Delta ecosystem, while simultaneously improving water supply reliability. Both the California Water Action Plan and Delta Plan affirm the policies set forth by the 2009 Delta Reform Act. Although the proposed Prospect Island Tidal Habitat Restoration Project will most likely provide ecological benefits, based on the information provided, it remains uncertain whether the project will provide those ecological benefits without adversely impacting existing NBA facilities.

SCWA-4

We appreciate the opportunity to comment on the Draft Prospect Island Tidal Habitat Restoration Project EIR. Please do not hesitate to contact me at 707-455-1103 or rsanford@scwa2.com if you have any questions.

Sincerely,



Roland A. Sanford
General Manager

Solano County — Department of Resource Management

(SOLC)

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October 7, 2016

Department of Water Resources
Attention: Daniel Riordan
P.O. Box 942836
Sacramento, CA 94236

RE: SOLANO COUNTY COMMENTS ON PROSPECT ISLAND TIDAL RESTORATION PROJECT DRAFT ENVIRONMENTAL IMPACT REPORT

Dear Mr. Riordan:

Thank you for the opportunity to comment on the draft Environmental Impact Report for the Prospect Island Tidal Habitat Restoration Project. Solano County has the following comments on the document, focusing primarily on the protection of levees and other infrastructure and agricultural lands. We appreciate your inclusion of and adherence to the County's General Plan policies as you move forward with the project in a collaborative manner.

SOLC-1

In the Goals and Objectives section and in Chapter 3 of the document, water quality enhancement is mentioned; we assume this is water quality enhancement for fish? Water quality for fish may be different than water quality for other purposes, such as agriculture and municipal purposes, which also occur in the region. What water quality impacts will occur with this enhancement, to other intakes in the area?

The Goals and Objectives section refers to the creation of rearing habitat for endangered and threatened species; we agree this is a critically important goal. But we question the documents assertion that there will be no impacts on agriculture or other land uses. The document should evaluate impacts to adjacent and other land uses and outline actions that will be used to mitigate project impacts. Impacts to agriculture from avian and terrestrial species as well as impacts to water supply from increasing numbers of endangered and other fish species need to be addressed in the document.

SOLC-2

The project also calls for a significant amount of dredging (47,000 cubic yards, page 3-110) to occur in Miner Slough, which is a freshwater corridor to a number of water supply intakes adjacent to the project as well as downstream, as shown in Figure 3.1-2. What specific impacts will occur to other users of surface and groundwater supply as a result of dewatering, dredging and other soil excavation?

SOLC-3

Ryer Island lies to the east and south of the proposed project. Ryer Island consists of well over 11,000 acres of actively farmed prime agricultural land, yet potential impacts to this area seem to be absent in the analysis. What are water quality and water supply impacts of this project on Ryer Island agriculture and infrastructure (intakes, drainage, roads, levees, etc.)? How will the presence of increasing numbers of endangered and other species affect agricultural operations and crops? We are well aware of impacts associated with increasing numbers of terrestrial and aquatic species and subsequent effects on nearby land uses, and so a thorough analysis may avoid conflict.

SOLC-4

In Chapter 3, seepage appears to have been addressed in the document and has been largely dismissed (Section 3.12-3) as a potential impact, perhaps prematurely, given documented historical seepage issues on Ryer Island. Future impacts associated with the project, including increased inundation acreage and/or longer periods of inundation in areas within Prospect may increase seepage impacts and have an impact on Ryer levees, especially if other Prospect levee sections should fail. Adaptive management practices should be taken into account as well, as project elements may change over time, creating additional, unforeseen impacts. SOLC-5

Potential scour impacts with changed hydrology associated with levee breaches also seems too possible to ignore, as these issues, where unintended, are not uncommon and can be problematic. For this reason, we urge you to reexamine the effects of unintended levee breaches, scour and other potential hydraulic redesign elements on adjacent lands and infrastructure that could be impacted. SOLC-6

Highway 84 runs along Miner Slough; potential impacts to the levee (from seepage, scour or other potential impact) would impact this transportation route and the people that utilize it. On page 3-342 it is unclear how transport of aggregate and fill via barge would occur and how roadways would not be used. Is there appropriate depth and unloading facilities to allow for barge transport of these materials? Would unloading facilities of some kind have to be built? Other construction traffic is deemed insignificant; how much additional construction-related traffic would occur? SOLC-7

In Section 4.2.5 the concept of a project alternative that included breaching the Deepwater Ship Channel levee was discussed and rejected. Where perhaps not practicable at this time, it would seem advantageous for an alternative to be included that looks at reuniting Prospect Island with the Yolo Bypass should circumstances change with the Deepwater Ship Channel over time, making this alternative more feasible. SOLC-8

We disagree with the notion that the project would have no cumulative impact to land uses as described on page 3-369. The cumulative effects of habitat restoration projects in the region will be significant, relative to the ability of agriculture to remain economically viable and with respect to the ability of agriculture and habitat projects to co-exist in a manner that is productive to both. Therefore the environmental document should evaluate the cumulative impact of this project with other habitat projects in the region relative to agriculture, water supply, water quality, other existing land uses and infrastructure. SOLC-9

Finally, we question why the Environmental Impact Report does not include the Federal Environmental Impact Statement component, given that the underlying purpose of the restoration addresses specific habitat restoration requirements of the U.S. Fish and Wildlife Service (USFWS) and NOAA's National Marine Fisheries Service (NMFS) Biological Opinions (BiOp) for the State Water Project (SWP) as well as Central Valley Project (CVP) operations. SOLC-10

Thank you for the opportunity to comment on the DEIR.

Sincerely,

Bill Emlen
Solano County
Director of Resource Management

U.S. Bureau of Reclamation

(USBR)

Prospect Island EIR Review Document Comment Form

Document: Prospect Island EIR

Comment Source: USBR
Submittal Date: 10/7/2016

	Page	Line #	Comment	Response
1.	3.1.1	Second paragraph	CSC is last mentioned on page 2-11. The acronym should be reintroduced here but people just reading section 3. The Sacramento River Flood Control Project needs to reintroduce the acronym (SRFCP) here. In Environmental setting you need to reintroduce what 'Delta' means. The next paragraph says the whole thing, but no acronym in parenthesis. Reintroduction in section 3 of all acronyms should be done, currently it's inconsistent and looks sloppy. This again shows up on page 3-2 in the last paragraph. Cache Slough Complex (page 3-2). Yolo Bypass (Bypass), SWP, (page 3-3). DWR (page 3-2). Cache Slough Complex is spelled out, after the acronym has been used multiple times (page 3-22). ~	USBR-1
2.	3-2		Assume the reader knows what tides are… "or the rise and fall of sea levels due to gravitational forces exerted by the moon, sun, and the rotation of the Earth" can be removed. But later in the document (3-22) 'tidal prism' is used and not explained. Define that instead.	USBR-2
3.	3-3		This relates to the 'Projected mean sea level rise' section, but is applicable to the whole document. The author goes between using a dash between numbers and units (e.g., 30-ft, 53,000-ac) and not using one (8 inches, 0.7 ft), please be consistent. Also, inch is spelled out but foot is abbreviated. Rule of thumb for publications is whole numbers below ten should be spelled and numbers >10 can be numerical text. Fifteen is spelled out (page 3-22). General lack of consistency in document.	USBR-3
4.	3-23		Reword- "Generally, tide range reductions varied under 1 inch up to 3 inches (Table 3.1-3)."	USBR-4
5.	3-29		"In the potential for bed scour" section the second sentence should have a reference too why it can be assumed the channel bed is mostly fine-grained materials.	USBR-5
6.	3-36		Stylistic change, but instead of using 'about' maybe use '≈' as it gives a less passive feel to the number, 'approximately' would also work better.	USBR-6 (Cont. below)

			There are multiple occurrences of this throughout the document. Page 3-36 is just a location where 'about' is used multiple times in succession.	USBR-6 (Cont.)
7.	3-41		This is just one case, but the last sentence refers to this as 'the Project' and other areas in the paper, including the very next sentence, it's referred to as 'Proposed Project.' Just call it Project throughout the paper to avoid confusion and to stay consistent.	USBR-7
8.	3-78		Paragraph that starts "For Delta Smelt and Chinook-" These fish have not been properly introduced yet. To just state optimal temperatures for them with no context is not useful. It should be rephrased as "Temperature sensitive fishes in the Delta (e.g., delta smelt, Chinook salmon, steelhead)" Also, the second part of the paragraph is only talking about delta smelt reproduction behavior, not Chinook, and it's not clear. Plus, there is no citation.	USBR-8
9.	3-84		3.3- Again, in back to back sentence it changes between 'proposed project' and 'project' really making it seem like two things are happening. Also, the last sentence is really choppy and run-on.	USBR-9
10.	3-85		3.3.1- Since you are discussing the listing status of fishes you need to include the DPS name of the Central Valley steelhead.	USBR-10
11.	3-88		Delete "Although fish sampling does not regularly occur"	USBR-11
12.	3-88		When describing you fish sampling methods stop pointing out the weaknesses and state the methods in a more confident way, such as, "Fish assemblage was sample under different conditions to understand the species utilization under different conditions." Also, the fish species need their latin names here. They have only been introduced in tables, but when they are introduced in text for the first time the latin name is appropriate as well.	USBR-12
13.	3-89		These brief fish descriptions need to be re-read and edited. Please remove all unnecessary 'fluff' in sentences (e.g., "Like other lampreys in California," words like "only"). Reorganize so they are easier to follow (Pacific Lamprey: the first three sentences are out of order. It should go 2,3,1). They need citations for bold statements (i.e, The ecology of the Pacific Lamprey has not been extensively studied). Any sentence that begins with "Because" should be reworded as a non-passive statement. Make sure all fish that haven't been introduced in text up to this point have latin names. Stay consistent with capitalization of common names (this is for the whole document, stick with one style). Don't capitalize words such as 'survey' unless it's in the name of the survey. Watch for redundancies. This applies to all the fish bio's as they are present in nearly each one. Have someone edit that is not the author.	USBR-13
14.	3-112		Impact 3.3.-3: Describe the work window better. Delta Smelt could still be present. This is really for the salmonids.	USBR-14

15.	3-120		Mitigation Measure 3.3.-7.1- It would be helpful to cite a fish rescue plan that has been approved for another, similar, project by the services. Include a sentence such as "Project fish rescue plan will be similar to that of APPROVED PROJECT. Like this rescue plan, the Project's will include consideration of numerous sampling methods."	USBR-15
16.	3-181		add to the section on giant garter snakes a brief statement on how difficult it is to determine presence of ggs through surveys because they are so elusive and rarely visible or trappable. It is important to recognize that suitable habitat within the species range is often the only indicator of their presence. Look up Eric Hansen and USFWS for references.	USBR-16

Yocha Dehe Wintum Nation

(YDWN)

YOCHA DEHE
CULTURAL RESOURCES

September 28, 2016

Dan Riordan
California Department of Water Resources
3500 Industrial Blvd
West Sacramento, CA 95691

RE: Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

Thank you for your project notification letter dated August 12, 2016 regarding cultural information on or near the proposed Prospect Island Tidal Habitat Restoration Project, Solano County, CA. We appreciate your effort to contact us and wish to respond.

The Cultural Resources Department has reviewed the project and concluded that it is within the aboriginal territories of the Yocha Dehe Wintun Nation. Therefore, we have a cultural interest and authority in the proposed project area.

Based on the information provided, Yocha Dehe Wintun Nation is not aware of any known cultural resources near this project site and a Cultural Monitor is not needed. However, if any new information or cultural items are found, please contact the following individual: YDWN-1

Mr. James Sarmento
Cultural Resources Manager
Yocha Dehe Wintun Nation
Office: (530) 723-0452, Email: jsarmento@yochadehe-nsn.gov

Please refer to identification number YD – 08252016-01 in correspondence concerning this project.

Thank you for providing us the opportunity to comment.

Sincerely,

James Kinter
Tribal Secretary
Tribal Historic Preservation Officer

Charles Chatfield

CC

September 24, 2016

Daniel Riordan
Dept. Of Water Resources
PO Box 942836

Email: trpa@water.ca.gov

Gentlemen:

I just learned this week of the plan to flood Prospect Island.

Please be advised of the dire consequences this act would cause to Ryer Island, most specifically the landowners that live and farm on the island, which is immediately adjacent to Prospect.

I am a landowner on Ryer Island. I have 150 acres located along the North side of Ryer, and we are bordered by Minor Slough on the both the North and West sides of our farm. Prospect Island is directly across the slough to the West.

On our property, we have developed and farmed 130 acres of wine grapes. It is of our opinion, and the opinion of others that farm on Ryer Island that the plan to flood Prospect will have a catastrophic effect on our ability to farm our ground.

We currently have an established water table of 4'-5' under our existing vineyard. As such, we have invested in a tiling system that allows us to effectively farm our vineyard in these conditions. Unfortunately, the existing high water table is caused by pressure already exerted from Minor Slough, and further compounded by pressure from Prospect Island. In order for us to farm our ground, we installed tile under the entire expanse of the farmable land and then we pump water into a drainage ditch.
The water is then pumped back into Miner Slough.

CC-1
(Cont. below)

Currently, it is all we can do to keep the water table at a level that allows our vineyards to grow and produce. The proposed plan of flooding Prospect Island will only add pressure to the water table and therefore increase salt contamination across the acreage, and ultimately destroy the vineyards that exist there today. The consequence of the act of flooding Prospect Island is not without casualty - you will put our vineyard out of production and our land will be unfarmable due to the pervasive salt contamination and increasing high water table.

I am sure the option of flooding Prospect Island has been on your radar for a long time. However, we purchased this property several years ago and have invested well over four million dollars to develop our vineyard. The "heads up" we were given last week by a neighbor was the VERY FIRST time we were made aware of the

plan. Suffice it to say, it is very disconcerting to learn that the State of California, for whatever reason, is directly causing our farmland and our vineyard to be worthless.

I strongly believe that if Prospect Island is flooded for whatever benefit the State has determined, the State cannot assure us – the adjacent landowner- that our property will not be affected. We are extremely concerned with the change this will cause to both the water table level and further salt-water intrusion on Ryer Island.

Therefore, the State must be prepared to compensate the landowners affected by this action for their farming losses, and perhaps purchase the acreage that this project has made unfarmable.

CC-1
(Cont.)

I apologize for the lateness of this response, but we literally just learned this week about the proposed project - and that was from our farm manager who happened to email us. I hope you understand the dire consequences your actions will have on our livelihood. Understand, if had we been notified any earlier, we would have vigorously participated much sooner in the response period.

Thank you.

Charles Chatfield
Owner, Chatfield Properties II

ranch@wildblue.net
209.747.3074

Mia S. Brown – Attorney at Law for Charles Chatfield

MSB

MIA S. BROWN
ATTORNEY AT LAW
Phone: 209.481-1548
mbrown@miabrownlaw.com
P.O. Box 523, Lockeford, California 95237

October 7, 2016

Delivery by E-Mail

Department of Water Resources
Attention: Daniel Riordan
P.O. Box 942836
Sacramento, California 94236
frpa@water.ca.gov

Re: Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan,

This office represents Mr. Chuck Chatfield, the owner of approximately 150 acres constituting the northern end of Ryer Island, which lies adjacent to Prospect Island and the Project Area for the Prospect Island Tidal Habitat Restoration Project. This comment letter is submitted on Mr. Chatfield's behalf.

Of primary concern is the conspicuous absence of an acknowledgement within the Draft EIR (DEIR) that there is a likelihood that the proposed Project will cause groundwater seepage impacts from Prospect Island to adjacent areas. This issue was identified in an Engineering Report performed by Kjeldsen, Sinnock & Neudeck, Inc. in 2015, and which was presented to the Department of Water Resources and the Department of Fish and Wildlife in association with this Project. Curiously (and more importantly, *improperly*) the DEIR identifies such impacts as "less than significant".[1] Failure to acknowledge evidence within the record showing a likelihood of a substantial impact by providing adequate mitigation measures renders the DEIR deficient. The DEIR should properly identify groundwater seepage as a significant impact and provide adequate mitigation measures accordingly. MSB-1

Additionally, Mr. Chatfield generally supports those technical and other comments submitted on behalf of Reclamation District No. 501, Ryer Island. MSB-2

Sincerely,

MIA S. BROWN
Attorney at Law

[1] See Impact No. 3.1-3: "Groundwater seepage impacts from Prospect Island to adjacent areas."

Lorraine Stringer

LS

FREEMANFIRM
A PROFESSIONAL LAW CORPORATION

1818 GRAND CANAL BOULEVARD · STOCKTON · CA 95207

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JOHN W. VISS

October 3, 2016

By email: frpa@water.ca.gov
Department of Water Resources
Attention: **Dan Riordan**
P.O. Box 942836
Sacramento, CA 94236

Re: ***Prospect Island Tidal Habitat Restoration Project*** – **Supplemental Comments on Behalf of Lorraine Stringer (APN 0042-230-010 (DWR Parcel NDP-10))**

Dear Mr. Riordan:

I am writing on behalf of Mrs. Lorraine Stringer, owner of an approximately 9 acre parcel on Prospect Island, identified as APN 0042-230-010 [DWR Parcel NDP-10]. We have reviewed the DEIR and have identified a few factual inaccuracies therein of which decision-makers at DWR should be aware. The purpose of this letter is to bring those inaccuracies to your attention.

First, in Section 2.1.4 (page 2-9), the DEIR's description of the Stringer Property states:

> Currently access to this parcel is on a gated road along Miner Slough." However, legal access to the parcel is via roadways atop the north levee and DWSC levees, then across the interior cross levee and up Miner Slough levee.

LS-1

In fact, however, Mrs. Stringer owns easements/right of way, i.e., legal access, to her parcel by way of three (3) separate routes, one of which is not currently usable. In the course of discussions with DWR in 2015, we clearly communicated this fact to Ms. Delia Grijalva of DWR by email dated September 15, 2015 (see email string appended hereto as Attachment 1). Earlier in 2015, DWR had attempted to acquire both of the usable terrestrial routes to the Stringer Property, as referenced on page 1 of the July 28, 2015 letter to Mr. Paulus, a copy of which is appended hereto as Attachment 2.

Section 3.18.1 states that the PG&E lines are currently inactive. In fact, the lines were active until the State directed that the lines be shut off in 2007. The power is still off, and after 9 years (and counting) the Stringer family is still waiting for the power to be restored.

LS-2
(Cont. below)

The DEIR also states that the power lines have been abandoned. Not so. Those lines would still be active if the State had not directed that the power be turned off. Indeed, the Stringer family paid the utility and phone bills for four (4) years without service, though they have since stopped paying. LS-2 (Cont.)

You should also know that this parcel was given a Use Permit and had a floating restaurant and boat in developed sites. This use corresponds with CBW recreational use for the Delta. LS-3

Thank you for your attention to these points.

Very truly yours,

THOMAS H. KEELING

THK:tmr
Attachments
cc: Lorraine Stringer

Start of attachments to LS

ATTACHMENT 1

Thomas H. Keeling

From: Thomas H. Keeling
Sent: Tuesday, September 15, 2015 10:32 AM
To: Grijalva, Delia@DWR
Cc: Toni Robancho; Lorraine Stringer (stringlo@att.net)
Subject: RE: Stringer Property - RE: Drilling Activities

Delia,

Please take a look at Exhibit "C" to the Judgment. It clearly lays out the three access routes, labeling them Route A, Route B and Route C. Further, to my knowledge no one, including DWR, has ever questioned the fact that the Stringers have the three access routes and, in fact, part of the earlier discussions between DWR and the Stringers included a proposal to eliminate one of those three access routes. Mrs. Stringer does not need a "permit" to use an access route that is already hers.

Regards,

Tom

Thomas H. Keeling
FREEMAN FIRM
Freeman, D'Aiuto, Pierce, Gurev, Keeling & Wolf
1818 Grand Canal Blvd., Suite 4
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From: Grijalva, Delia@DWR [mailto:Delia.Grijalva@water.ca.gov]
Sent: Monday, September 14, 2015 8:31 AM
To: Thomas H. Keeling
Subject: FW: Stringer Property - RE: Drilling Activities

I apologize for neglecting to attach the document. Here it is.

-Delia

From: Grijalva, Delia@DWR
Sent: Monday, September 14, 2015 8:29 AM

To: 'Thomas H. Keeling'
Cc: Toni Robancho; Lorraine Stringer (stringlo@att.net)
Subject: RE: Stringer Property - RE: Drilling Activities

Good morning Tom,

Yes I suppose there is some confusion. The DWR records indicate the Stringers have one access route along the Deep Water Ship Channel on the West side of the Island. The Miner Slough levee was proposed, but only on route was granted by the court from the Sakata Bros. I have attached the decision for your records.

Please have the Permit for Entry onto State Owned Property signed by Mrs. Stringer. DWR does not want to deny access to the Stringer property, but does want to have necessary Permits completed for the Stringers' use of other access routes to their property.

Please contact me if you have additional information on this issue so we can continue moving forward or if you have any other comments or questions.

Thank you.

Delia Grijalva
Associate Right of Way Agent
Department of Water Resources
Division of Engineering--Real Estate Branch
1416 9th Street, Room 425
Sacramento, CA 95814

P (916) 657-4400
F (916) 653-9405

Delia.Grijalva@water.ca.gov

From: Thomas H. Keeling [mailto:tkeeling@freemanfirm.com]
Sent: Friday, September 11, 2015 3:19 PM
To: Grijalva, Delia@DWR
Cc: Toni Robancho; Lorraine Stringer (stringlo@att.net)
Subject: RE: Stringer Property - RE: Drilling Activities

Delia,

I think there is some confusion here. The Stringers already have 3 access routes to their property, including the Miner Slough route. They don't need a permit to use that route at all. Assuming DWR doesn't plan anything that would interfere with the Stringers' Minor Slough access route, the only thing the Stringers need is advance notice as to when the south cross levee access will be blocked, so that they can then get to their property by way of the Minor Slough access route.

Tom

Thomas H. Keeling
FREEMAN FIRM

Freeman, D'Aiuto, Pierce, Gurev, Keeling & Wolf
1818 Grand Canal Blvd., Suite 4
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From: Grijalva, Delia@DWR [mailto:Delia.Grijalva@water.ca.gov]
Sent: Friday, September 11, 2015 2:39 PM
To: Thomas H. Keeling
Subject: RE: Stringer Property - RE: Drilling Activities

Hi Tom,

Thank you for the reply. I have attached a Permit for entry onto State Owned Land for the Stringers to sign. This will allow them to use the Miner Slough Levee to access their property while their access is unavailable. I included a termination date of September 30, 2015. DWR can extend this date if the drilling goes beyond September. DWR does not anticipate drilling in October, but I wanted to assure you the Stringers would have access for the duration of drilling activities along the southern cross levee.

If you have any questions or comments you may contact me at the number below.

Thank you,

Delia Grijalva
Associate Right of Way Agent
Department of Water Resources
Division of Engineering--Real Estate Branch
1416 9th Street, Room 425
Sacramento, CA 95814

P (916) 657-4400
F (916) 653-9405

Delia.Grijalva@water.ca.gov

From: Thomas H. Keeling [mailto:tkeeling@freemanfirm.com]
Sent: Friday, September 11, 2015 9:52 AM
To: Grijalva, Delia@DWR
Cc: Toni Robancho; Lorraine Stringer (stringlo@att.net)
Subject: Stringer Property - RE: Drilling Activities

Delia,

Thank you for the heads up on this. The Stringers will need to access to their property along Miner Slough during the period DWR rigs will be blocking the southern cross levee access. Therefore, please let us know when DWR will be drilling along the south cross levee, so that the Stringers will know ahead of time that they must use the Miner Slough access on those days. As long as the Stringers will have access via the Miner Slough route and some advance notice as to which days they will be required to use the Miner Sough access, I think leaving the rigs overnight while working on southern cross levee should be OK.

Tom

Thomas H. Keeling
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From: Grijalva, Delia@DWR [mailto:Delia.Grijalva@water.ca.gov]
Sent: Tuesday, September 08, 2015 3:22 PM
To: Thomas H. Keeling
Subject: Drilling Activities

Good Afternoon Mr. Keeling,

I am writing to you this afternoon to request your assistance in informing Mrs. Lorrain Stringer of some drilling activities occurring on Prospect Island that may interfere with the access to her property. Our surveyors began drilling today along the west levee of Miner Slough. The drilling will continue until September 23, 2015. They will also be drilling along the cross levee south of the gate onto the Stringer property. I cannot confirm the actual dates when the drilling will begin on the cross levee as that will be determined by the number of drill holes that can be completed each day. I will provide updates as I receive additional information.

I do have one question for Mrs. Stringer. Can the drill rigs be left in place over night when drilling is occurring along the southern cross levee? The rigs will be left in place when drilling on the Miner Slough levee.

Thank you for your assistance with this matter. If you have any questions or comments, please contact me at the information below. I appreciate your time and attention.

Sincerely,

Delia Grijalva
Associate Right of Way Agent
Department of Water Resources
Division of Engineering--Real Estate Branch
1416 9th Street, Room 425
Sacramento, CA 95814

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Delia.Grijalva@water.ca.gov

ATTACHMENT 2

FREEMAN FIRM
A PROFESSIONAL LAW CORPORATION

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July 28, 2015

Via Email Linus.Paulus@water.ca.gov and U.S. Mail
Linus A. Paulus, SR/WA
Chief, Acquisitions and Appraisal Section
Real Estate Branch
Division of Engineering
Department of Water Resources
State of California
1416 Ninth Street, Room 425
P.O. Box 942836
Sacramento, CA 94236-0001

Re: *Prospect Island Tidal Habitat Restoration Project* – Proposed Acquisition of Interests in APN 0042-230-010 (DWR Parcel NDP-10)

Dear Mr. Paulus:

On behalf of Delta landowner Mrs. Lorraine Stringer, I am writing to follow up on our meeting of July 6 and our brief telephone discussion last week.

Mrs. Stringer and her family have considered the 2015 written offer from the Department of Water Resources ("DWR"), in which DWR offered Mrs. Stringer the sum of $7,200 for the property interests (easements) described therein.

The easements DWR seeks to acquire provide the ***only*** current terrestrial access to Mrs. Stringer's 9+ acre property. Without a reliable terrestrial access, Mrs. Stringer, her family, and others will have no way to access the property other than by boat. That, of course, would significantly limit the uses of the property and negatively affect the property's value. So important is the access, in fact, that it was the subject of litigation in 1978 between the Stringers and adjoining landowners. The Stringers prevailed in that litigation, resulting in the establishment of the access easements DWR now seeks to acquire. The Stringer family's plans for the property's use and development require a terrestrial access.

SETTLEMENT RELATED COMMUNICATION SUBJECT TO THE PROVISIONS OF EVIDENCE CODE § 1152

Alternative No. 1: **Maintain the Status Quo**

Mrs. Stringer's preference is that her Delta property, including the access easements that serve that property, be left alone and unaffected by DWR's plans on other parts of Prospect Island. This would allow the Stringer family to continue, without interference, to pursue its long-term plans for the property.[1]

Alternative No. 2: **Conveyance of the Requested Property Interests (Easements) to DWR under the Terms of DWR's 2001 Offer, along with Restoration of Power to the Property.**

Mrs. Stringer recognizes that DWR may elect to proceed with the Project, notwithstanding its effect on her property, the enormous cost of the Project, and the likelihood (based on the history of failed restoration projects in the Delta) that DWR's Project will not achieve its stated objectives.

In that event, Mrs. Stringer is again prepared to accept the offer DWR made in connection with this Project in 2001. At that time, DWR obtained an appraisal of the property for the purpose of valuing the property interests it wished to acquire, for the same proposed project (then denominated the "Prospect Island Fish/Wildlife Habitat Restoration Project"[2]). For the easements, DWR offered the sum of $72,000, and, recognizing that the Stringers would need at least one reliable terrestrial access, as part of that offer DWR also offered an alternative terrestrial access to the Stringer Property. The Stringers accepted that offer and stood ready to convey the property interests DWR was seeking, contingent only upon delivery of the promised alternative access. However, that promise was never fulfilled, and the agreed-to transaction was therefore never consummated.

---

[1] Separate and apart from DWR's current efforts to acquire the access easements serving the Stringer property, there remains the matter of the Stringers' repeated requests for restoration of electrical power to their property. Even if DWR's project were to proceed without affecting the Stringer property, that issue will have to be addressed by DWR in the near future. (See discussion under Alternative No. 2.)

[2] In its January, 2014 letter to Mr. and Mrs. Stringer, DWR referred to the project as the "Prospect Island Ecosystem Restoration Project."

I should observe that consistent with DWR's policy and procedure relating to this Project, DWR always recognized the need to provide terrestrial access. Indeed, in DWR's earlier October 2000 written offer to purchase the *entire* Stringer property, DWR wrote:

> If you choose not to sell your property to the State, it is still of critical importance that we continue negotiations regarding the realignment of access routes to your property. As previously discussed, we will work to incorporate your need for access if you choose not to sell your property.

Further, DWR has not yet restored electrical power to the Stringer property. As you know, following a disruption in 1997, DWR had the power to the island shut off. DWR then restored the power, working with PG&E. In 2007, DWR again had the electricity shut off, leaving the Stringer property without electrical power. Since 2007, the Stringers have repeatedly asked that the power be restored, but to no avail. As a result, the Stringer property has been without power since 2007. The Stringers' well pumps, purchased and installed at considerable expense, require electricity, and the emergency power supplied from time to time is not sufficient to bring the pumps back into operation. This unacceptable situation has further impaired the Stringer family's ability to bring their property to its highest and best use.

Accordingly, as an alternative to her preferred alternative, described above, Mrs. Stringer is willing to convey to DWR the property interests (easements) described in DWR's most recent written offer in consideration of:

- $72,000[3]

[3] In large part, DWR's $72,000 figure was based on its valuation of the entire property at $237,000. DWR's more recent appraisal offers only $7,200 for the existing easements, without offering an alternative terrestrial access. Among the deficiencies in the appraisal summary statement, it apparently values the entire 9+ acre property based on speculation to the effect that there exists some type of required cleanup of hazardous materials on the property. The Stringer family is not aware of any such hazardous material threat on their property or of any such clean-up requirement. Nor, under the circumstances surrounding DWR's attempt to acquire interests in the property, could any speculation about such a possibility affect the amount of just compensation DWR would have to pay in eminent domain. Like DWR's 2001 valuation of the property, the valuation used for purposes of this letter does

- An alternative terrestrial access to the Stringer property; and
- Restoration of electrical power to the Stringer property.

Alternative No. 3: Eminent Domain.

Mrs. Stringer recognizes that DWR has the power of eminent domain and that, in the absence of a consensual arrangement, DWR could notice a public hearing on a proposed resolution of necessity. If convinced that all the statutory prerequisites have been met, the California Water Commission would have the power to adopt the resolution of necessity proposed by DWR staff, thereby authorizing commencement of a suit under California's Eminent Domain Law, Code Civ. Proc. §§ 1230.010 et seq.

While Mrs. Stringer would prefer to avoid litigation, she understands that this alternative provides the many procedural and substantive landowner safeguards of the Eminent Domain Law, including reimbursement for an appraisal under C.C.P. § 1263.025, judicial review on right-to-take issues, a jury determination of the fair market value of the property condemned, a noticed hearing and briefing on any requested order for pre-judgment possession, and, depending on the outcome at trial, the possibility of recovering her legal expenses.

Accordingly, if the other alternatives outlined above cannot be made to work, and if the parties cannot reach an agreed-upon resolution, Mrs. Stringer understands that the matter will most likely proceed to a public hearing before the California Water Commission and, if the Commission adopts the staff-recommended resolution of necessity, to eminent domain litigation.

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not reflect any adjustment based on speculation about hazardous material on the property. The 2001 DWR appraisal does include $12,500 for improvements on the property, some of which are no longer there. Improvements consisting of well pumps, fencing, and some electrical infrastructure remain on the property. Personal property, primarily the Stringer family's 104' boat currently dry-docked on the property, also remains. That boat, built by the Stringers over a period of years at substantial expense, is an asset suitable for multiple uses, including as a floating clubhouse in the re-establishment of a bar/restaurant business on the property. It is not a fixture, however, as reflected in DWR's written October 2000 offer to purchase the entire property without the boat and to allocate $51,000 under the Relocation Assistance Act for relocation of that asset.

Please do not hesitate to call with any questions.

Very truly yours,

THOMAS H. KEELING

THK:tmr
cc: Lorraine Stringer

SETTLEMENT RELATED COMMUNICATION SUBJECT TO THE PROVISIONS OF EVIDENCE CODE § 1152

End of attachments to LS

Appendix E

Response to Comments on the 2019 Partial Recirculated Draft Environmental Impact Report

Table of Contents

1 INTRODUCTION E-1
2 GENERAL RESPONSE TO COMMENTS E-4
A. Not a Comment on the Recirculated Sections in the 2019 Partial Recirculated DEIR E-4
B. Not a Comment on the Adequacy of the 2019 Partial Recirculated DEIR E-5
C. Negotiations Between LAND and DWR E-6
D. Social and Economic Factors under CEQA E-6
E. Potential Wind-Wave Erosion and Scour E-7
F. Potential Groundwater Seepage Impacts E-9
G. Potential Project-Specific Salinity Impacts E-13
H. Potential Cumulative Salinity Impacts E-17
I. Activities Relating to Various Monitoring Activities and Repair of Prospect Island Levees E-20
J. Climate Change E-23
3 SPECIFIC RESPONSES TO AGENCY, TRIBAL, AND INDIVIDUAL COMMENTS E-27
California Department of Transportation E-27
Central Delta Water Agency E-28
Central Valley Flood Protection Board E-30
Central Valley Regional Water Quality Control Board E-31
Delta Stewardship Council E-35
Local Agencies of the North Delta E-38
Reclamation District 501 ..... E-65
Solano County E-67
Solano County Water Agency E-72
Yocha Dehe Wintun Nation E-74
4 REFERENCES E-75

List of Attachments

Attachment 1. Governor's Office of Planning and Research, State Clearinghouse and Planning Unit, 2019 Partial Recirculated DEIR Circulation (including agency comment letters received)

Attachment 2. 2019 Partial Recirculated DEIR Comment Letters

Attachment 3. September 14, 2017 Letter from DWR to LAND

Attachment 4. DWR (2018) Review of 2015 ENGEO Seepage Impact Analysis Report

Attachment 5. DWR (2019) Review of 2018 ENGEO and KSN (RD 501) Letter on the 2018 DWR Hydrologic Data Analysis Report

1 INTRODUCTION

The public comment period for 2019 Partial Recirculation of Draft Environmental Impact Report: Prospect Island Tidal Habitat Restoration Project (2019 Partial Recirculated DEIR) was March 1, 2019 to April 15, 2019. In accordance with CEQA (CEQA Guidelines Section 15088.5(f)(2)), the public was asked to limit their comments to the changes to the recirculated portions of the DEIR, which included the *Proposed Project Description*, *Hydrology, Water Quality, Transportation and Traffic, Noise,* and *Air Quality* impact analyses chapters, in part or in full; as well as changes to the corresponding *Alternatives* analyses. The Governor's Office of Planning and Research, State Clearinghouse and Planning Unit provided a copy of the comments on the 2019 Partial Recirculated DEIR from responding state agencies in a letter dated April 16, 2019 (**Attachment 1**). DWR received comments on the 2019 Partial Recirculated DEIR from four state agencies, five local agencies, and one tribal entity. DWR identifies each comment letter with a unique identifier code and each comment with a number (**Table E-1; Attachment 2**). No individuals submitted comments. DWR appreciates and thanks the agencies and tribal entity who took the time to submit comments on the 2019 Partial Recirculated DEIR.

DWR has prepared written responses to all comments received on the 2019 Partial Recirculated DEIR in Sections 2 and 3 below. Although the comments were focused on the Proposed Project, DWR has responded to comments as if they apply to the Prospect Island Tidal Habitat Restoration Project inclusively, including the Proposed Project and the other "build" Alternatives (2 and 3). In the following responses to comments (Sections 2 and 3 of this Appendix), where the "Proposed Project" is referred to, this includes the Proposed Project and all "build" Alternatives. If a separate response is appropriate for Alternative 2 or 3, this is included, but is more common for Alternative 2 because recent technical reports focused on this alternative (see General Response C in 2019 FEIR **Appendix D**). Note that DWR has prepared written responses to all comments received on portions of the 2016 Draft Environmental Impact Report (2016 DEIR) that were not recirculated (see 2019 FEIR **Appendix D**).

DWR's response to comments is divided into two parts: the first part is a General Response to Comments, providing responses that apply to multiple comments (Section 2); and the second part includes Specific Responses to Agency and Entity comments (Section 3). At the beginning of each response, the corresponding comment code is listed, and a summary of the comment is provided. The summary is provided for ease of use only. DWR's comment responses relate to the full comment, as attached to this appendix (**Attachment**

2). Where multiple commenters provided the same comment, DWR either prepared one general response (Section 3) or refers the reader to a similar specific response. In some cases, there are references to responses to comments on the 2016 DEIR, which can be found in 2019 FEIR **Appendix D**.

Throughout this document, 2016 DEIR is used to refer specifically to the circulated 2016 DEIR, 2019 Partial Recirculated DEIR is used to refer specifically to the portions of the DEIR that were recirculated in 2019, 2019 FEIR is used to refer specifically to the 2019 FEIR, and EIR is used to refer generally to the 2016 DEIR, 2019 Partial Recirculated DEIR, and/or 2019 FEIR. The 2019 FEIR includes clarifying and amplifying changes to the 2016 DEIR and the 2019 Partial Recirculated DEIR, as well as responses to comments on the 2016 DEIR (see 2019 FEIR **Appendix D**) and responses to comments on the 2019 Partial Recirculated DEIR (this Appendix – 2019 FEIR **Appendix E**). DWR has taken the comments into consideration in preparing the 2019 FEIR.

The original impact and mitigation numbering from the 2016 DEIR remains consistent with the 2019 Partial Recirculated DEIR and the 2019 FEIR, with the exception of one additional mitigation measure in each of the *Transportation and Traffic* and *Air Quality* sections of the FEIR (refer to the Partial Recirculated DEIR for further explanation). Impact 3.3-5 *Short-term impairment of essential fish behaviors due to potential increases in turbidity during underwater sediment sampling* in Section 3.3.3 *[Aquatic Biological Resources] Impacts and mitigation* has been removed because the sediment sampling has already been completed; however, a placeholder of this previous 2016 DEIR impact has been retained so that the numbering of other impacts has not changed. In Impact 3.17-2 *Potential long-term loss of access to the Miner Slough levee* in Section 3.17.3 *[Transportation and Traffic] Impacts and mitigatio*n, Mitigation Measure 3.17-2.1 has been removed because the purchase of the Stringer property by DWR is complete.

Table E-1. List of Agencies and Tribes who Prepared Comments on the 2019 Partial Recirculated DEIR

Entity	Type	Entity Identifier
California Department of Transportation	State Agency	CalTrans
Central Delta Water Agency	Local Agency	CDWA
Central Valley Flood Protection Board	State Agency	CVFPB
Central Valley Regional Water Quality Control Board	State Agency	CVRWQCB
Delta Stewardship Council	State Agency	DSC
Local Agencies of the North Delta	Local Agency	LAND
Reclamation District (RD) 501	Local Agency	RD501
Solano County - Department of Resource Management	Local Agency	SOLC
Solano County Water Agency	Local Agency	SCWA
Yocha Dehe Wintun Nation	Tribe	YDWN

2 GENERAL RESPONSE TO COMMENTS

A. Not a Comment on the Recirculated Sections in the 2019 Partial Recirculated DEIR

Where **General Response A** is referred to, the comment was made on a section of the 2016 DEIR that was not subject to recirculation in 2019. Pursuant to the CEQA Guidelines Section 15088.5(f)(2), DWR requested that reviewers limited their comments to changes to revised chapters or portions of the EIR; therefore, this appendix need only respond to comments received during the recirculation period that relate to the chapters or portions of the EIR that were revised and recirculated. Sections of the EIR that were revised and recirculated are listed below.

- Section 2 *Proposed Project Description*.
- In Section 3.1 *Hydrology (Surface and Groundwater):*
  - 3.1.1 *Setting*
  - 3.1.2 Significance criteria
  - In Section 3.1.3 *Impacts and mitigation*, the following impacts:
    - Impact 3.1-3 *Groundwater seepage impacts from Prospect Island to adjacent areas*;
    - Impact 3.1-4 *Potential wind-wave erosion of the interior side of Prospect Island levees*;
    - Impact 3.1-5 *Potential toe-scour and erosion of Miner Slough levees affecting Ryer Island levee stability*; and
    - Impact 3.1-6 *Potential increase in seepage on adjacent lands due to Miner Slough bed scour*.
- In Section 3.2 *Water Quality (Surface and Groundwater)*:
  - 3.2.1 *Setting*;
  - 3.2.2 *Significance criteria*;
  - In Section 3.2-3 *Impacts and mitigation*, the following impacts:
    - Impact 3.2-2 *Short-term construction-related increases in turbidity and/or mobilization of contaminants from dredging and excavation of levee breaches*;
    - Impact 3.2-5 *Long-term effects on salinity in waterbodies near Prospect Island*; and
    - Impact 3.2-8 *Long-term effects on methylmercury production, bioaccumulation, and export*.

- In Section 3.7 *Air Quality*:
  - 3.7.1 *Setting*;
  - 3.7.2 *Significance criteria*;
  - In Section 3.7.3 *Impacts and mitigation*, the following impacts:
    - Impact 3.7-1 *Generation of criteria pollutant emissions that could contribute to air quality violations*; and
    - Impact 3.7-2 *Conflict with or obstruct applicable general plans or regional air quality plans.*
- In Section 3.10 *Noise*:
  - 3.10.1 *Setting*;
  - 3.10.2 *Significance criteria*;
  - In Section 3.10.3 *Impacts and mitigation*, the following impacts:
    - Impact 3.10-1 *Potential for short-term noise disturbance to nearby residents*.
- In Section 3.17 *Transportation and Traffic*:
  - 3.17.1 *Setting*;
  - 3.17.2 *Significance criteria*;
  - In Section 3.17-3, the following impacts:
  - Impact 3.17-1 *Potential traffic impacts during construction*;
  - Impact 3.17-2 *Potential long-term loss of access to the Miner Slough levee*.
- Section 4 *Alternatives*.

Commenters were asked to restrict their comments to the portions of the above listed sections that changed, as shown in underline and strikethrough in the 2019 Partial Recirculated DEIR. Therefore, any comments made during the 2019 Partial Recirculated DEIR period that do not relate to the revised portions of the EIR may not be responded to. In some cases, further information is given so that the public and decision makers can have a better understanding of these issues. Note that if equivalent comments were made on the 2016 DEIR, responses are included in 2019 FEIR **Appendix D**.

B. Not a Comment on the Adequacy of the 2019 Partial Recirculated DEIR

Where this **General Response B** is referred to in Section 3, **General Response A** does not apply, and no issues related to the adequacy of the environmental

impact analysis in the 2019 Partial Recirculated DEIR are raised by the commenter. Since no relevant issues regarding adequacy of the environmental impact analysis are raised, these comments are not generally further addressed. In some cases, further information is given so that the public and decision makers can have a better understanding of these issues.

C. Discussions Among LAND, RD 501 and DWR

DWR entered into discussions with Local Agencies of the North Delta (LAND) and Reclamation District (RD) 501 in early May 2017 with the intent to foster a free exchange of ideas in furtherance of compromise to avoid litigation, openly discuss LAND and RD 501's concerns, and to identify potential avenues for reducing neighbor concerns regarding the Prospect Island Tidal Habitat Restoration Project. DWR ended these discussions on September 14, 2017 and confirmed this on February 20, 2019. LAND has included a number of communications before May 2017 and after September 14, 2017 as Exhibits to its comment letter. LAND's Exhibit 5 quotes from DWR's September 14, 2017 letter, but did not include the letter. For the sake of completeness, DWR has included this letter as **Attachment 3**. LAND also included a copy of DWR's February 20, 2019 letter as Exhibit 1, but the letter did not include the attachment identified as *DWR's Review of 2015 ENGEO Seepage Impact Analysis Report.* DWR has included DWR's review as **Attachment 4**.

DWR reviewed the information submitted by LAND and the "mitigation measures" requested by LAND. While DWR did not agree to all of the measures requested by LAND, it did carry out a number of actions requested and committed to carry out other actions. These are discussed in General Response D of 2019 FEIR **Appendix D** and in **General Response I** below.

D. Social and Economic Factors under CEQA

CEQA provides guidance regarding how to assess potential economic and social changes resulting from a project within the context of determining physical effects on the environment. Pursuant to CEQA, lead agencies must analyze potentially significant adverse impacts of a project to the physical environment only. The term 'environment' means "*the physical conditions which exist within the area which will be affected by a proposed project including land, air, water, minerals, flora, fauna, ambient noise, and objects of historical or aesthetic significance… The "environment" includes both natural and man-made conditions"* (CEQA Guidelines Section 15360). Under CEQA, potential effects from implementing a project, such as reductions in property values, loss of property tax revenues, and

increases in energy costs, that are solely social or economic in nature, would not constitute an impact to the physical environment.

CEQA Guidelines Section 15131 states the following regarding consideration of economic or social factors as part of an EIR:

> *(a) Economic or social effects of a project shall not be treated as significant effects on the environment. An EIR may trace a chain of cause and effect from a proposed decision on a project through anticipated economic or social changes resulting from the project to physical changes caused in turn by the economic or social changes. The intermediate economic or social changes need not be analyzed in any detail greater than necessary to trace the chain of cause and effect. The focus of the analysis shall be on the physical changes.*
>
> *(b) Economic or social effects of a project may be used to determine the significance of physical changes caused by the project…. Where an EIR uses economic or social effects to determine that a physical change is significant, the EIR shall explain the reason for determining that the effect is significant.*
>
> *(c) Economic, social, and particularly housing factors shall be considered by public agencies together with technological and environmental factors in deciding whether changes in a project are feasible to reduce or avoid the significant effects on the environment identified in the EIR. If information on these factors is not contained in the EIR, the information must be added to the record in some other manner to allow the agency to consider the factors in reaching a decision on the project.*

E. Potential Wind-Wave Erosion and Scour

Levee erosion impacts within Miner Slough, as well as on the interior side of the eastern Prospect Island levee, are assessed in EIR Impacts 3.1-4 and 3.1-5. The potential for scour along the channel bed of Miner Slough, as well as toe scour affecting levee stability, is assessed in Impact 3.1-5 of the EIR. DWR has met with representatives of neighboring landowners and reclamation districts (see General Response D in 2019 FEIR **Appendix D**) on several occasions to discuss their concerns with EIR Impacts 3.1-4 and 3.1-5. These impacts were revised and recirculated in Section 5.2 *Revisions to the DEIR Hydrology Analysis* of the 2019 Partial Recirculated DEIR. The 2019 Partial Recirculated DEIR and **General Response I** explain reasons for the changes since the 2016 DEIR.

Potential Levee Erosion

As discussed in Impact 3.1-4, within Prospect Island, the Proposed Project and Alternative 2 include planted toe berm features within areas expected to be exposed to wind generated waves. In addition, DWR will establish riparian and wetland plantings along the toe berm, as well as allow up to one year from the time of planting prior to levee breaching, which will serve to further reduce any potential for erosion of the levee due to wind waves. With these wave-dampening features, neither the Proposed Project nor Alternative 2 are expected to result in a significant effect in erosion on the interior side of the eastern Prospect Island levee.

The potential for wind-wave exposure to result in future erosion of the Ryer Island levee along Miner Slough through planned breaches of the Prospect Island levee along Miner Slough is analyzed in EIR Impact 3.1-5. The Ryer Island levee is vegetated and currently contains revetment along portions of Miner Slough, which would protect against any wind-wave exposure from the Proposed Project. For Alternatives 2 and 3 of the EIR, the placement and orientation of the breaches would not lead to wind-wave exposure because of the predominant west-southwest wind direction for the project vicinity. Due to the orientation of the breaches, the prevailing wind direction of concern is only from the northwest, which occurs at a frequency of about 5% to 10% in the winter and is negligible in the summer (which is the period of greatest wind).

Impact 3.1-5 also shows that hydrodynamic modeling results indicate no cross-currents with the potential to create levee scour, as the low velocity flows leaving Prospect Island through the levee breaches would converge rapidly with the primary Miner Slough flow path. Cross-current flows would not reach or impact the Ryer Island side of the Miner Slough levee, and therefore would not have the potential to scour the levee (Appendix K in SWS and WWR 2012).

Potential Scour

As discussed in Impact 3.1-5, exceedance of published erosion thresholds for various grain sizes and materials were compared between base-flow conditions, as well as two modeled scenarios, described below, intended to capture storm conditions:

1. a strong neap-spring tide cycle during summer, which was expected to generate maximum velocities during periods not influenced by storm flows in Miner Slough; and

2. high North Delta inflow conditions occurring during winter which represent periods when Miner Slough carries storm flows.

The highest velocities modeled in Miner Slough occurred during storm flows that do not result in overtopping of the restricted height levees surrounding Prospect Island (i.e., levees that are designed to overtop in flood events). Modeling results for all build alternatives examined indicate lower velocities at all locations in Miner Slough upstream of the southern breach location, with small velocity increases at locations downstream of breach locations that remain below scour thresholds of bed materials found in recent surveys. During high flow conditions peak cross-sectionally averaged velocities across four locations in Miner Slough for the Proposed Project and EIR Alternatives are below the 4 fps scour threshold for fine-grained materials (Fischenich 2001) (Appendix K in SWS and WWR 2012). To assess the potential for scour under higher storm flow conditions, detailed modeling of 100- and 200-year flood events has been undertaken for Alternative 2 of the EIR, with Miner Slough velocities limited to <0.1 fps increase during peak stage relative to baseline conditions for both the 100- and 200-year flood events (RMA 2016a). Peak velocities upstream of the Prospect Island during 100 year and 200 year flood events would not exceed 5 fps. This modeling supports the conclusion in the EIR that the impact of scour would not be significant.

F. Potential Groundwater Seepage Impacts

Potential seepage impacts to Ryer Island are assessed in EIR Impacts 3.1-3 and 3.1-6. DWR has met with representatives of neighboring landowners and reclamation districts (see General Response D in 2019 FEIR **Appendix D**) on several occasions to discuss their concerns with these impacts. These impacts were revised and recirculated in Section 5.2 *Revisions to the DEIR Hydrology Analysis* of the 2019 Partial Recirculated DEIR, with the results of both the original (DWR 2014) and recent (DWR 2018a) technical analyses incorporated. In addition to DWR (2014) and DWR (2018a), which formed the bases of the EIR groundwater seepage analyses, DWR (2013) summarizes the data collection methods used. The 2019 Partial Recirculated DEIR and **General Response I** explain reasons for the changes since the 2016 DEIR.

Analysis Required by CEQA

Even after recirculation of the DEIR, some commenters still do not think that the groundwater seepage analysis is adequate or accurate.

For context, the relevant hydrology significance criteria for the potential seepage impact in the EIR (Section 3.1.2) are *would the Proposed Project cause the following*:

- Substantial alteration of the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, to the extent that the rate or amount of surface runoff is altered in a manner that would result in flooding, erosion, or siltation on- or off-site. [CEQA Guidelines, Appendix G].
- Substantial groundwater seepage changes to adjacent properties. [Note that this is an additional significance criterion, specific to the Proposed Project].

Although comments claim that the "thresholds of significance" used for potential groundwater seepage impacts lack legal or scientific basis, no comments have suggested alternative significance criteria, or changes to the significance criteria used. DWR disagrees with these comments, and considers that the significance criteria are sound, because they are consistent with CEQA and relate directly to the scientific studies undertaken for the Proposed Project.

Commenters also dispute the EIR's significance conclusions for EIR Impacts 3.1-3 and 3.1-6, which determine that the impacts are *less than significant* without a need for mitigation. For CEQA EIRs, data and information are typically used to determine whether the Proposed Project has a significant effect on the environment (CEQA Guidelines, Section 15084[b]). Analyses may rely upon data summaries, maps, plot plans, diagrams, and similar relevant information sufficient to permit full assessment of significant environmental impacts (CEQA Guidelines, Section 15147). In assessing the impact of the Proposed Project on the environment, DWR, as the Lead Agency, is required to examine changes to the existing physical conditions in the affected area as they exist at the time the Notice of Preparation is published (i.e., 2013). Short-term and long-term direct and indirect significant effects of the Proposed Project on the environment are required to be described using specifics of the area, resources involved, physical changes, alterations to ecological systems, and the human use of land, among other specific details (CEQA Guidelines, Section 15126.2).

Based on the best available technical data in DWR's comprehensive studies documented in the 2013 and 2014 reports, DWR determined in the 2016 DEIR that the Proposed Project would not substantially alter the neighboring properties in a manner which would result in groundwater seepage leading to ponding, or erosion, siltation, or flooding on Ryer Island.

Following comments on the DEIR, DWR re-considered in the Partial Recirculated DEIR whether development of seepage-related mitigation measures was warranted, but further technical evidence using the best available science does not indicate any seepage-related impacts to neighboring properties, thus developing seepage-related mitigation measures was not pursued as a viable option under CEQA. Further, as explained below, comments received on the 2019 Partial Recirculated DEIR do not provide a basis for making additional changes to the impact analyses or significance determinations.

DWR 2014 and 2018 Studies

The findings of DWR's comprehensive, multi-year hydrogeologic study in the vicinity of Prospect Island (DWR 2014) indicate that, while there does not appear to be a relationship between the stage on Prospect Island and groundwater levels on Ryer Island, there does appear to be a relationship between stage in Miner Slough and stage, precipitation, and groundwater levels on Ryer Island. The results of a supplemental study covering the years 2013-2017 (DWR 2018a) are summarized in Impact 3.1-3 of the 2019 Partial Recirculated DEIR. As with DWR (2014), DWR (2018a) concluded that there is no significant relationship between Ryer Island groundwater levels and Prospect Island surface water levels that is not explained by Miner Slough stage and local precipitation. Numerous examples were identified in the new period of record in which Ryer Island groundwater levels moved in the opposite direction from surface water levels on Prospect Island. The DWR (2018a) analysis is discussed further below, in response to comments received from ENGEO in 2018 on behalf of RD 501.

ENGEO 2015 Seepage Impact Analysis Report Review

Separate from the above, DWR reviewed a *Seepage Impact Analysis,* dated July 14, 2015, prepared by ENGEO (2015) ("ENGEO Report"), submitted to DWR via a letter dated September 10, 2015, on behalf of RD 501 (DWR 2018b). Numerous issues were noted during the review (**Attachment 4**), including: mischaracterization of DWRs analysis of the available data, inaccurate statements, misleading data comparisons and figures, and flawed hypothetical modeling of subsurface geology and water levels in the Proposed Project area. For example, contentions that coarse-grained sediments within the interior of Prospect Island provide significant connectivity for Prospect Island surface waters through the Upper Clay Hydrogeologic Unit (HU) to the underlying Main Sand HU were not evident in any of the cone penetrometer tests, borings, and trenches evaluated by DWR (2014). Seepage modeling presented in the ENGEO Report assumed a "no flow" boundary underlying Miner Slough, which is

inconsistent with the known significant hydrologic connections between Miner Slough and the subsurface. The hypothesized sand layers included in the model were implausible based on geologic principles regarding sediment deposition (DWR 2018b). DWR's review and consideration of the ENGEO Report did not change its conclusions that Miner Slough is the dominant hydrologic feature controlling Ryer Island seepage observations based on its stage relative to all other surface water and groundwater levels, its location between the two islands, and its extensive connectivity between Ryer Island groundwater through the Upper Clay and Main Sand HUs along Miner Slough (as documented in DWR 2014). Local precipitation also appears to play a significant role in the rise of groundwater levels on Ryer Island, and this likely plays a contributing role in seepage reported by RD 501.

ENGEO 2018 Letter Review of 2013-2017 Hydrologic Data Analysis

DWR also reviewed a letter with the subject heading "Comments on February 2018 DWR Hydrologic Analysis Report Prospect Island Tidal Habitat Restoration Project Solano County, California", dated August 20, 2018, prepared by ENGEO (ENGEO 2018), which is Exhibit 6 to LAND's comments on the 2019 Partial Recirculated DEIR. The ENGEO (2018) letter provides comments on the DWR (2018) report titled "*Prospect and Ryer Island Hydrologic Data Analysis October 1, 2013 to April 1, 2017 Prospect Island Tidal Habitat Restoration Project Solano County, California: Memorandum Report*". The Hydrological Data Analysis Plan for this report was reviewed by RD 501 and some Ryer Island landowners represented by LAND (see General Response D in 2019 FEIR **Appendix D**).

DWR's 2019 technical review of ENGEO (2018) is included at **Attachment 5**. The DWR (2019) review states that evaluation of the new hydrologic data (2013-2017) did not result in any changes to the original project findings and conclusions; specifically, no significant impacts to Ryer Island's reported seepage were found with implementation of the Proposed Project. DWR (2019) discusses each issue raised by ENGEO (2018), including: the methods of analysis, including need for a statistical correlation analysis; interpretation of data; significance of the hydrographs before and after the tidal gate repair; similarities and differences of water levels recorded in wells; importance of the Ryer Island drainage system; and water surface elevations of Prospect Island, Miner Slough and Ryer Island. None of these issues are found to be material evidence for seepage from Prospect Island to Ryer Island, and do not provide any new data or analysis which would cause DWR to change its EIR findings regarding potential seepage impacts on Ryer Island.

G. Potential Project-Specific Salinity Impacts

Salinity impacts are assessed in EIR Impact 3.2-5, which was revised and recirculated in Section 5.3 *Revisions to the DEIR Water Quality Analysis* in the 2019 Partial Recirculated DEIR. DWR is responding in this Appendix to project-specific salinity comments relating to EIR Impact 3.2-5 received on both the 2016 DEIR (including comments from Contra Costa Water District (CCWD)) and the 2019 Partial Recirculated DEIR, to provide a complete and comprehensive response to public and agency concerns relating to salinity. Note that potential cumulative salinity impacts are discussed in **General Response H.**

Salinity Modeling Approach was Comprehensive and Representative

A description of the alternatives considered in assessing local and regional salinity impacts is provided in the supporting modeling report (Appendix D in WWR and SWS 2014) used to develop EIR Impact 3.2-5. The Proposed Project (two breaches), EIR Alternative 2 (two breaches and weir), and EIR Alternative 3 (three breaches), correspond to Phase 2 modeling Alternatives 26, 4, and 31, respectively. The EIR has been updated to clarify these alternatives. For all of the alternatives, the salinity modeling captured a dry year hydrology (2009), which is classified as a minimum monthly flow rate of 4,000 cfs in October and 4,500 cfs in November and December in the lower Sacramento River at Rio Vista. For comparison, a critically dry year hydrology would be classified for a minimum monthly flow rate of 3,000 cfs and 3,500 cfs for the same months at the same location (see Table 2.6 of WWR and SWS 2014, as well as SWRCB 2006 and SWRCB 2018). Although no additional modeling has been conducted to assess conditions in critically dry water years, given that D-1641 standards allow for elevated ECs during critically dry years, and modeling has shown that Delta salinity levels under the Proposed Project are well within D-1641 for other water year types, compliance would be reasonably expected.

The period of analysis used for salinity modeling related to the Prospect Island Tidal Habitat Restoration Project for both the Proposed Project and Alternatives (Appendix D in WWR and SWS 2014) and Alternative 2 (RMA 2016a) was February 1, 2009 to November or December 2010, for which conditions were compared with implementation of proposed alternative tidal restoration configurations at Prospect Island, with other environmental conditions assumed unchanged. The primary reason that the 2009-2010 modeling period was selected was because it covers both a dry year hydrology, associated with more severe salinity impacts than normal water year types, as well as a near-normal year hydrology. As interannual variability in salinity is closely related to water-

year type, a later modeling period for the same water year types (i.e., including dry years) would be expected to return similar results.

Modeling reported in support of the EIR considered the seven D-1641 compliance locations (SWRCB 2000) within the Delta. Assessments were made on a comparative basis to baseline conditions, with various project restoration design configurations, as well as with D-1641 compliance standards. As discussed in Impact 3.2-5, the seven modeled and reported locations (Appendix D in WWR and SWS 2014) were selected to provide broad spatial representation, and the effects of the restoration project at these locations are considered representative of the effects of the project in various portions of the Delta as a whole. Designated beneficial uses at the modeled and reported locations are agriculture, fish and wildlife, as well as municipal and industrial beneficial uses (as shown in Table 3.2-16 of the 2019 FEIR). Additional modeling was undertaken for eight supplemental locations (Appendix D in WWR and SWS 2014), and the results have also been considered in developing EIR Impact 3.2-5.

None of the Alternatives Exceeded or Approached Exceedances of D-1641 Salinity Standard

The salinity analysis includes reference to background concentrations and applicable water quality objectives. The standards for salinity in the Delta are set by D-1641.

Modeling undertaken during restoration planning of the Proposed Project and Alternatives (*Phase 2 Screening Level Modeling Report*, Appendix D in WWR and SWS 2014), did not indicate any instance of exceedance of D-1641 standards. No violations of D-1641 chloride standards (SWRCB 2000) are identified for any of the locations modeled, including the CCWD intake at Rock Slough (Appendix D in WWR and SWS 2014). During summer and fall when Delta outflows are lowest, results showed less than 1% increase in salinity (EC values ranging from 0 to 32 uS/cm) for the majority of the modeled compliance locations. At a few stations, small increases and decreases were modeled, but the Proposed Project would not cause any water quality degradation that would cause any of the locations to approach D-1641 exceedance for *agriculture, municipal,* or *fish and wildlife* beneficial uses.

Releases of Stored Water a Non-Issue

The assessment of compliance with D-1641 does not rely on offsets or releases of stored water from other water sources, including the State Water Project

(SWP) or Central Valley Project (CVP). Impact 3.2-5 of the 2019 Partial Recirculated DEIR is *less than significant*, without any need for offsets or other forms of mitigation. D-1641 standards are always met, and therefore no releases from the SWP or CVP storage triggering Term 91 would occur. In response to comments on the 2016 DEIR, supplemental information was incorporated into the impact analysis to specifically assess the potential salinity changes at municipal intakes, and this did not change the impact determination. Please see the discussion below on CCWD impacts.

Modeled Salinity Increases are Small for the Proposed Project and EIR 'Build' Alternatives and the Maximum Modeled Increase is Location and Time Specific

Salinity model results vary in space and time, including with water year type. As discussed in Appendix D of WWR and SWS (2014), results for breach configurations corresponding to the Proposed Project and Alternatives generally showed decreases in computed electrical conductivity (EC) in the western Delta, with only small increases for central and south Delta locations, including interior Delta locations near CCWD's Old River intake and Victoria Canal intake. For the Proposed Project and Alternative 2, modeled salinity change is below a 5% increase for virtually all times and locations, with two exceptions to this trend described below for locations that are not designated for *municipal and industrial* beneficial uses.

For both the Proposed Project (Alternative 26 of the Phase 2 Modeling) and Alternative 2 of the EIR (Alternative 4 of the Phase 2 Modeling), maximum salinity increases during a dry-year hydrology (2009) are less than 6% at all seven modeled and reported D-1641 compliance locations within the Delta, and the largest potential salinity increase (i.e., the only modeled increase more than 3.2%) is within part of the Delta which is not designated for *municipal, industrial, or agricultural* beneficial uses – at the San Joaquin river at Prisoners Point (D29) (see Table I, Appendix D in WWR and SWS 2014). During a below-normal / near-normal-year hydrology (2010), modeled salinity increases are considerably less, and would not exceed 2% for the Proposed Project or Alternative 2 at any of the seven modeled and reported locations during any month. All of the seven modeled and reported locations are within D-1641 salinity (EC / chloride) compliance limits for all beneficial uses (Appendix D in WWR and SWS 2014), and the Proposed Project does not cause any of the locations to approach exceedance levels during relevant compliance periods.

For the eight supplemental compliance stations modeled, maximum salinity increases under the Proposed Project are less than 1% for all locations, except for the San Joaquin River at San Andreas (C-4), which shows a potential maximum salinity increase up to 7.8% during a dry-year hydrology, and up to 2.9% during a below normal-year hydrology (Tables 34 and 35 of Appendix D in WWR and SWS 2014).

Several comments refer to the modeled increase of 7.8% at the San Joaquin River at San Andreas (C-4). This potential increase occurs only during October of a dry year hydrology at the specified location and should not be used to extrapolate system-wide increases as a result of the Proposed Project. At the C-4 location, during a below- or near-normal year hydrology all months modeled except October and November showed decreases of EC, or increases less than 1%. Modeling showed that EC may increase by up to a maximum of 4% in November. During a dry-year hydrology, modeling showed decreases of EC, or increases less than 2% for the months of February through August. Modeling showed that in Fall (from September to November) of a dry-year hydrology Base EC could increase by 4% to 10% for Phase 2 Alternatives 3, 23, and 26 (Proposed Project) at the C-4 location. However, even during a below- or near-normal year hydrology, Base EC is below 300 uS/cm for all months during the compliance period (April–August). Please see the response to CCWD-7 in 2019 FEIR **Appendix D** for more explanation on the C-4 site, including an explanation that the EC for the C-4 location may have been overestimated.

Potential Salinity Change at CCWD Intakes

Locations modeled for salinity change associated with the Proposed Project (Appendix D in WWR and SWS 2014) include the CCWD Contra Costa Canal (C5) intake at Rock Slough, as well as other interior Delta locations, including West Canal at Clifton Court Forebay Intake (C9) and Delta-Mendota Canal at the Tracy Pumping Plant, which are near CCWD's Old River intake and CCWD's Victoria Canal intake (see Figure 13 of Appendix D in WWR and SWS 2014 and Figure 11 of RMA 2018). Small changes in computed salinity were modeled at D-1641 compliance locations, with no violations of D-1641 standards (Appendix D in WWR and SWS 2014). As part of the 2019 Partial Recirculated DEIR, DWR included supplemental timeseries of modeled EC at Rock Slough, Old River, Victoria Canal, and Mallard Slough in EIR Impact 3.2-5 in Section 3.2.3 *[Water Quality (Surface and Groundwater)] Impacts and mitigation*, using data generated for, but not tabled in, Appendix D in WWR and SWS (2014). Similar timeseries, showing monthly average Base EC, Alternative 2 EC, and the

percentage change from monthly average Base EC, are provided in RMA (2018) for all four of CCWD's drinking water intakes, as follows:

- Contra Costa Canal (C5) intake at Rock Slough (Figure 15 of RMA 2018);
- Mallard Slough intake (Figure 22 of RMA 2018);
- Old River intake (Figure 23 of RMA 2018); and
- Victoria Canal intake (Figure 24 of RMA 2018).

Alternative 2 results are described further in EIR Section 4.5.2 *[Alternative 2: Two Breaches and Weir] Environmental impacts*.

Appendix D in WWR and SWS (2014) and RMA (2018) show similar salinity results for multiple design configurations. The Project would not cause salinity at CCWD's intakes to approach D-1641 exceedance levels.

In its comments on the 2016 DEIR, CCWD suggested that any increase could be significant if it means that CCWD might have to release water from Los Vaqueros to meet other internal or external standards CCWD determines it must meet. DWR does not agree. D-1641 standards were established by the SWRCB, after hearings, to adequately protect water quality for entities, including *agricultural*, *municipal and industrial*, and *fish and wildlife* beneficial uses. D-1641 remains the operable regulatory protections for beneficial uses of water in the region. Objectives that apply at the three D-1641 compliance stations ensure that the municipal and industrial beneficial uses of surface water in the west Delta (at or close to CCWD's intakes) are adequately protected from adverse salinity. As described above, modeled changes in salinity for the Proposed Project and Alternatives are small, would not unreasonably affect present and anticipated beneficial uses, and would not result in degradation of water quality such that D-1641 exceedance is more likely. Therefore, there will not be adverse effects to CCWD's municipal and industrial beneficial uses of water.

H. Potential Cumulative Salinity Impacts

Although the discussion on cumulative impacts of salinity was not recirculated as part of the 2019 Partial Recirculated DEIR, DWR is responding to cumulative salinity comments received on both the 2016 DEIR and 2019 Partial Recirculated DEIR, to provide a complete and comprehensive response to public and agency concerns relating to salinity. Therefore, this response covers comments made by CCWD on the 2016 DEIR.

Proposed Project Plus other EcoRestore Projects

DWR stated in the Notice of Preparation and the EIR that the Proposed Project is designed to partially fulfill the 8,000 ac tidal habitat restoration obligations of DWR contained within Reasonable and Prudent Alternative (RPA) 4 of the U.S. Fish and Wildlife Service (USFWS) Delta Smelt Biological Opinion (BiOp) for long-term coordinated operations of the State Water Project (SWP) and the federal Central Valley Project (CVP) (USFWS 2008). As discussed in General Response G in 2019 FEIR **Appendix D**, although the Prospect Island Tidal Habitat Restoration Project may be considered as belonging to any of a number of restoration initiatives, including the USFWS Delta Smelt Biological Opinion requirement for 8,000 acres, it has independent utility and other projects are not a necessary consequence. DWR could have done a master or program EIR, but was not required to do so. DWR did a comprehensive analysis of cumulative effects, including past, current, and potential future tidal and subtidal restoration projects. Please refer to EIR Table 3.19-1 for a list of the projects considered.

BDCP/California WaterFix Studies Related to Tidal Restoration Projects

The EIR acknowledges outcomes of the Bay Delta Conservation Plan (BDCP), and associated California WaterFix and California EcoRestore Project analyses, which replaced the BDCP. Recognizing that locations and project-specific details of tidal habitat restoration obligations may have differing effects upon Delta hydrodynamics and thus salinity and water quality at water supply intakes, impact assessments for the BDCP / California WaterFix Final EIR/EIS (DWR and USBR 2016 – Appendix 5A, Section D, Attachment 2 *Evaluation of Tidal Marsh Restoration Effects using RMA Bay-Delta Model*) relied upon geographically explicit modeling of reasonably foreseeable near-term, early long-term, and late long-term restoration acreages in several regions of the Delta and Suisun Marsh. Salinity modeling conducted in support of the BDCP / California WaterFix Final EIR/EIS used breach configurations at Prospect Island similar to the Proposed Project, in combination with other reasonably foreseeable restoration projects in the Delta. The conclusions included that: tidal flow, net flow, and tidal trapping affect salt intrusion, and any change to these competing mechanisms would affect how salinity responds in time; maximum potential changes from Base EC are modeled to occur in late September and October; upstream of restored areas, EC tends to be reduced due to tidal flow and mixing; increased net flows in Sacramento River below the Delta Cross Channel would reduce EC in the vicinity of Rio Vista and Emmaton (i.e., a reduction near CCWD's intake); and a reduction of average flows in Georgina Slough and the Delta Cross Channel would increase EC in the San Joaquin River in the vicinity of San Andreas

Landing (see the response to CCWD-7 in 2019 FEIR **Appendix D** for further details regarding San Andreas Landing).

Regardless of the California WaterFix Project analysis, the EIR salinity analysis for the Prospect Island Proposed Project does not change. This is because the project-specific salinity changes modeled for the Proposed Project show both increases and decreases of salinity depending on the water-year type and time of year; any increases are small and would not approach exceedances of D-1641 salinity standards at compliance locations, and thus avoid unreasonable effects on beneficial uses of water (see **General Responses G** and **H**). Salinity impacts are, thus, not cumulatively significant.

Tule Red Cumulative Salinity Analysis

CCWD comments on the 2016 DEIR considered that the 'Cumulative Effects Salinity Modeling Analysis in Support of the Proposed Tule Red Tidal Marsh Restoration, Grizzly Island, California' (RMA 2016b) (Tule Red Salinity Analysis) is relevant. The commenter states that the study shows that even a 4% increase of salinity at CCWD's intakes could result in significant withdrawals from CCWD storage. DWR has reviewed the Tule Red Salinity Analysis, as well as CCWD's letter dated March 2, 2016 and attachment titled: 'Tule Red Water Quality Modeling and Impacts to the Contra Costa Water District'. RMA (2016b) models and reports cumulative salinity impacts from seven tidal restoration projects: Tule Red Tidal Restoration Project (focus project); Mallard Farms Conservation Bank; Honker Bay Conservation Bank; Dutch Slough Tidal Marsh Restoration Project; Lower Yolo Restoration Project; Prospect Island Tidal Restoration Project; and the McCormack Williamson Tract Project. Computed EC was analyzed at Beldons Landing, Mallard Island (CCWD), Jersey Point, Emmaton, Rock Slough (CCWD), Old River at Highway 4 (CCWD), Victoria Canal (CCWD), Clifton Court intake, and at the CVP intake. Modeled cumulative change in EC from base conditions (i.e., without any of the seven projects) to post-implementation of all seven projects did not exceed 9%, with the highest modeled changes reported at Rock Slough in October and November.

The incremental cumulative contribution to salinity impacts in the Delta of the Prospect Island Tidal Habitat Restoration Project is not specifically assessed in the Tule Red Salinity Analysis (RMA 2016b); therefore, it is not possible to know what percentage of the potential maximum 9% increase could be attributed to the Prospect Island Project and when such increases, if any, would occur. It appears, based on CCWD's analysis of that study, the McCormack Williamson Project, not

the Prospect Island Tidal Restoration Project, would be the largest contributor to potential cumulative salinity impacts to CCWD's intakes on the Delta.

CCWD also raised concern specifically with the potential cumulative effects associated with the Proposed Project in combination with the Tule Red Wetland Enhancement Project and McCormack Williamson Project. The baseline for the Proposed Project did not include these projects. The period of analysis used for salinity modeling related to Prospect Island (Appendix D in WWR and SWS 2014) was February 1, 2009 to November 30, 2010, for which baseline conditions were compared with implementation of proposed alternative tidal restoration configurations at Prospect Island, with other environmental conditions assumed unchanged. This means that conditions post-implementation of the Tule Red Wetland Enhancement Project and McCormack Williamson Project were not incorporated into the salinity modeling reported in Appendix D in WWR and SWS (2014). However, both of these projects, as well as other proposed restoration projects and increased sea level rise, were considered in addition to the Proposed Project in the 2016 DEIR cumulative impact analysis (refer to Table 3.19-1 of the EIR). If a significant and adverse cumulative salinity impact does occur as a result of numerous restoration and other projects in the Delta, the project specific analysis for Prospect Island (Appendix D in WWR and SWS 2014) supports the conclusion that the incremental salinity impact of the Proposed Project, in combination with these other projects, would not be cumulatively considerable. Table 11 of Appendix D in WWR and SWS 2014 specifically assesses the potential salinity impact of the Proposed Project and its Alternatives. Maximum EC changes resulting from the Proposed Project or Alternatives at the CCWD Rock Slough intake are only on the order of 3% maximum for a few months during dry years, and are often less than 3%, or result in reductions of EC.

I. Post-Proposed Project Monitoring Activities and Repair of Prospect Island Levees

Several commenters expressed concern that DWR removed portions of the impact assessment narratives from the DEIR relating to monitoring of groundwater and surface water levels, and to monitoring and repairing levees, following project completion.

The portions of the seepage and erosion impact assessment narratives removed from the EIR are shown in strikethrough in *Hydrology* Impacts 3.1-3 through 3.1-6 of the 2019 Partial Recirculated DEIR. The statements removed from the 2016 DEIR *Hydrology* impacts were related to continued groundwater and surface

water monitoring during and after implementation of the Proposed Project, potential levee monitoring in the future, as well as a discussion of levee repairs for public safety reasons in the event that damage to Miner Slough – Ryer Island levees were caused by the Proposed Project. Additionally, in Section 2.2.3 *Description of Proposed Project components and construction activities – Post construction site maintenance, monitoring, and adaptive management activities*, text relating to monitoring of the northern Prospect Island cross-levee, levee stability, invasive plants, invasive fish, and algal blooms was removed.

These supplemental statements made in *Hydrology* impacts and the Proposed Project description were not included as mitigation measures. The removal of these supplementary statements more clearly distinguishes the impact analyses from good neighbor policy discussions. There is a discernable difference between Proposed Project mitigation and good neighbor project monitoring. Pursuant to CEQA Section 15126.4, mitigation measures are introduced to feasibly minimize significant adverse impacts in proportion with the scale of the impact, and must be fully enforceable through permit conditions, agreements, or other legally binding agreements. Where effects are not found to be significant, mitigation measures are not required (CEQA Section 15126.4(a)(3)). Good neighbor monitoring is separate from, and addition to, the effect's analyses for the Proposed Project under CEQA. Removal of these statements from the EIR did not affect the significance determinations that EIR Impacts 3.1-3 through 3.1-6, relating to seepage and erosion, are *less than significant* with regard to CEQA, or result in changes to any significance determinations elsewhere in the EIR. As shown in the 2019 Partial Recirculated DEIR, no mitigation is required for the EIR *Hydrology* impacts. As shown in the 2016 DEIR, no mitigation is required for EIR *Water Quality* Impact 3.2-7 relating to algal blooms, nor for *Aquatic Biological Resources* EIR Impact 3.3-9 relating to predation on native fish, or Impact 3.3-11 relating to potential for Asian Clam invasion. Potential for establishment of invasive plants has been considered following public comments (see General Response F in **Appendix D**). No comments, or new information, have resulted in any change to the significance determinations for the above-mentioned impacts in the 2019 Partial Recirculated DEIR or 2019 FEIR. The significance determinations are based on substantial technical evidence and supported by the best available science.

Some commenters considered that EIR Impacts 3.1-3 through 3.1-6 require mitigation for groundwater seepage, bed- and toe-scour, and levee erosion. CEQA requires implementation of feasible and enforceable mitigation measures when an EIR identifies significant adverse environmental impacts. Significant

impacts were fully disclosed in the 2016 DEIR and 2019 Partial Recirculated DEIR, and mitigation measures are included in the EIR. Where effects are not found to be significant, as is the case for EIR Impacts 3.1-3 through 3.1-6, mitigation measures are not required under CEQA. Pre-mitigation for speculative impacts that are not supported by scientific evidence is not fiscally responsible, and not required by CEQA.

Although not required by CEQA, DWR has committed, as mentioned in General Responses D of 2019 FEIR **Appendix D**, to carry out the following good neighbor monitoring activities:

If DWR decides to move forward with the Proposed Project or one of the Alternatives, DWR intends to continue monitoring existing wells on Prospect and Ryer Island as part of its ongoing efforts to document hydrologic activity in the area.

In areas downstream of breach locations where hydrodynamic modeling of the Proposed Project or Alternatives (Appendix K in SWS and WWR 2012; RMA 2016a) showed increased velocities, DWR will conduct pre-project monitoring of channel bathymetry. Follow-up surveys will be conducted post-breach in years one, three, and five.

In addition to the monitoring described above, DWR has considered the Proposed Project against its own Good Neighbor Checklist (see General Response D in 2019 FEIR **Appendix D**). Section 1 of General Response D in 2019 FEIR **Appendix D** (see *Completed Actions* and *Modification of the Restoration Design)* includes a full list of good neighbor actions that DWR has agreed to undertake, and/or already undertaken to alleviate concerns of neighboring landowners.

Finally, the Prospect Island Reclamation District (RD) 1667 has been considered with regard to ongoing monitoring and maintenance, during and following the Proposed Project. Following the completion of the Sacramento DWSC in 1963, RD 1667 was formed to allow levee maintenance in support of agricultural uses. Inactive between 1995 and 2014, the RD was reactivated on April 25, 2014. The reactivation of RD 1667, and associated levee road maintenance is not a result of, or part of, the Proposed Project, but rather part of DWR's desire to be a responsible landowner and assist in maintaining the property prior to project development. Once the tidal habitat restoration project is completed, the

Prospect Island RD will determine whether there is an ongoing need for it to continue in operation into the future.

J. Climate Change

To address comments on the 2016 DEIR and 2019 Partial Recirculated DEIR related to the effects of future climate change, the following general response has been developed to address three fundamental questions related to climate change and the Proposed Project:

1. What is the impact of the Proposed Project and its Alternatives upon climate change? More specifically, how will greenhouse gas (GHG) emissions associated with its implementation contribute to elevated GHG concentrations in the atmosphere?
2. How will the Proposed Project and its Alternatives be affected by climate change? That is, are future changes in climate likely to exacerbate project-related impacts?
3. How will the Proposed Project affect the resiliency and adaptability of the study area to the effects of climate change?

Question 1: What is the impact of the Proposed Project and its Alternatives upon climate change (i.e., how will GHG emissions associated with its implementation contribute to elevated GHG concentrations in the atmosphere)?

An analysis of GHG emissions associated with the Proposed Project is presented in Section 3.8 Greenhouse Gases. As discussed in Section 3.8, the Proposed Project involves material transportation, site preparation, and construction activities that require the use of diesel-based equipment and other equipment associated with GHG emissions. The equipment list and emission estimates for each equipment type are included in 2019 FEIR **Appendix G**. Proposed Project GHG emission levels are consistent with the Greenhouse Gas Emissions Reduction Plan, so DWR has determined that the Proposed Project's incremental contribution to increasing atmospheric levels of GHGs is *less than significant*.

Land-use change was also considered in assessing potential impacts related to the exchange of GHGs between ecosystems and the atmosphere. Open-water generally releases less GHGs than wetlands with emergent vegetation. The restoration project will increase open-water tidal aquatic habitat by 122 ac and decrease wetlands and uplands habitat overall (see Table 2.2-2 of the 2019 FEIR). Restored open-water areas are not expected to have increased methane emissions compared to pre-restoration upland and seasonal wetland conditions.

This is because, without vegetation cover, the substrate for methanogenesis (organic carbon) is limiting in the underlying sediment and not provided by living plants. There is a possibility that where there is abundant floating invasive aquatic vegetation, organic material may be created along with pockets of low oxygen (i.e., “redox” or oxidation-reduction) conditions that would be conducive to methanogenesis, with methane emitted through ebullition or hydrodynamic transport. However, upon implementation of the Proposed Project, GHG emissions under increased tidal inundation are expected to be lower than those occurring under existing conditions.

Question 2: How will the Proposed Project and its Alternatives be affected by climate change? Are future changes in climate likely to exacerbate project-related impacts?

In extending recent evaluations of climate change impacts upon Delta ecosystems and infrastructure, the Proposed Project could be indirectly affected by increasing air temperature, changing precipitation and runoff patterns, increased frequency of extreme events, as well as rising sea levels (Wang et al. 2018). CEQA does not generally require an agency to consider the effects of existing environmental conditions on a Proposed Project’s future users or residents unless these changes could exacerbate project-related impacts. Climate change could cause changes in the water levels surrounding and within the restored Prospect Island, changes in seasonal salinity, water temperatures, as well as changes in the species composition. Each of these is considered below with an assessment of whether climate change is likely to exacerbate project-related impacts.

Climate Change Runoff and Sea Level Rise. Maendly (2018) found that shifts in the timing and amount of precipitation and runoff and changes in how much precipitation falls as rain or snow will have a greater impact on water surface elevation in the Delta than sea level rise *per se*. More frequent large flood events are expected, with flood-flows driving water surface elevations in the Delta during large floods. With both climate change runoff and sea level rise, the 200 year flood (0.5% annual exceedance probability) would not overtop the Sacramento River Deep Water Ship Channel levee (see Figure 2 in Maendly 2018). In a recent review of sea level rise projections, Griggs et al. (2017) estimates that there is a 67% chance that mean sea level will increase by 1 ft to 3.4 ft (0.3 to 1 m) at the Golden Gate Bridge by 2100. Closer to Prospect Island, water surface elevation is also forecast to increase by approximately one ft for the 100 year (1% annual exceedance probability) flood (see Figure 35 of Maendly 2018).

Using a probabilistic approach, the State of California Sea-Level Rise Guidance 2018 Update recommends planning for 1.1 ft of sea level rise by 2050 as the upper end of the "Likely Range" for management projects that pose low risk or low consequences of flooding (CNRA and OPC 2018), such as the Proposed Project. The complex hydraulics of channels surrounding Prospect Island does not allow sea level rise estimates to be simply added to local water-surface elevations However, modeled impacts showed projected increases in water surface elevation within the Yolo Bypass to be less than 0.08 ft under 100 year flood events (RMA 2018); therefore, given the projected rise in runoff and sea levels, the Proposed Project will not contribute to any potential future encroachment in floodway capacity.

Salinity. In support of the Bay Delta Conservation Plan (BDCP), MacWilliams and Gross (2010) used 3-dmensional modeling to evaluate salinity intrusion over one annual hydrologic cycle using existing inputs for water year (WY) 2002 and under five levels of sea level rise between 15 cm and 140 cm. For a 1.1 ft (30 cm) sea level rise scenario, projected changes in the X2 low salinity zone boundary were on the order of 1-2 km eastward, which may potentially trigger SWRCB (2000) restrictions upon seasonal CCWD diversions to Los Vaqueros reservoir, as well as diversions at the Banks Pumping plant in some years. Although MacWilliams and Gross (2010) projected larger changes in Electrical Conductivity (EC) in the vicinity of Suisun Marsh, projected changes at water supply locations in the Western and interior Delta locations were generally below 100 uS/cm. Recognizing that no more recent modeling has been conducted that integrates the effects of sea level rise with restoration projects planned in the future, the incremental effect of the projected 11-20 uS/cm EC increase due to the Proposed Project (see EIR Impact 3.2-5) upon a 100 uS/cm EC increase due to sea level rise represents a small (~10%) change and would not affect compliance with D-1641 outside of the sea level rise related impacts.

Water Temperature. As reported by Dettinger et al. (2016), water temperature increases will be one of the most significant climate-change stressors in the Delta. Statistical modeling of water temperatures by Wagner et al. (2011) has projected that water temperature will likely become stressful for Delta Smelt through much of their range during the summer, and will likely change the timing of important events in their life history, such as migration and spawning (Brown et al. 2013). Nevertheless, because tidal wetlands tend to have rates of evapotranspiration greater than open-water, the Proposed Project will generally contribute to local reductions in water temperatures, which may benefit native species (see Impact 3.2-6).

Species Composition. With increasing water levels, shifts in habitat type, along with changes in temperature and/or precipitation associated with climate change, could affect the spread and distribution of invasive plant species (Cal-IPC 2019). While climate change is expected to affect tidal datums, salinity, water temperatures, and flooding in the vicinity of the Proposed Project, the precise impacts upon species composition is complicated by adaptive responses by native and introduced fish species (Dettiinger et al. 2016). Although many of the invasive fish species present in the Delta are better adapted to warm temperatures and low inflows than are native species (Moyle et al. 2013), greater variability in habitat conditions may favor native species in the future depending upon seasonal timing. Several elements of the Proposed Project have been included to anticipate changes in habitat and to provide resiliency to these changes (see Question 3 below).

Question 3: How will the Proposed Project affect the resiliency and adaptability of the study area to the effects of climate change?

The Proposed Project site is part of the Yolo Bypass floodway and thus serves as an overflow area for floodwaters. This effectively allows for storage of riverine floodwaters and dampens storm surges. While the low site elevations (-3 to 12 ft) increase the vulnerability of the Proposed Project to sea level rise, the inclusion of sloping berms along levee remnants, as well as the construction of a sloping intertidal bench, will allow gradual migration of habitat types, as well as habitat use by aquatic and terrestrial species towards upland areas.

Overall, the Proposed Project, along with other future tidal habitat restoration projects, are expected to contribute to greater regional climate change resiliency by supporting sediment accretion and peat soil accumulation. In addition to migration of the aquatic terrestrial boundary towards upland elevations under future sea level rise, the Proposed Project has large amounts of habitat at intertidal elevations which will promote sediment accretion, as well as the accretion of detrital plant litter in the future. While it is uncertain whether sediment accretion can keep pace with more extreme sea level rise projections, based on the Phase 2 modeling results, the Proposed Project would result in a maximum annual sediment accretion amount on the order of 4 in. While accretion would be unevenly distributed across the site, over time it would likely help to reverse existing subsidence caused by drainage of the area, offset projected future subsidence (1.6 ft by 2050; Deverel and Leighton 2010), and promote resiliency to projected regional sea level rise.

3 SPECIFIC RESPONSES TO AGENCY, TRIBAL, AND INDIVIDUAL COMMENTS

California Department of Transportation (CalTrans)

CalTrans-1: Agency Objectives and Responsibilities

Commenter introduces CalTrans objectives and responsibilities in reviewing the 2019 Partial Recirculated DEIR.

DWR Response

Please refer to **General Response B**.

CalTrans-2: Project Understanding

Commenter states their understanding of the Proposed Project.

DWR Response

Please refer to **General Response B**.

CalTrans-3: Hydraulics

Commenter states that a hydraulic analysis should be provided that demonstrates that the existing hydraulic grade lines of Miner Slough under 25-, 50-, and 100-year floods will not change with Alternatives 2 or 3. Commenter also states that the EIR should address potential scour effects of Alternatives 2 and 3.

DWR Response

Summaries of hydraulic analyses, including consideration of potential scour of Miner Slough, are included in Impact 3.1-5 in Section 3.1.3 *[Hydrology (Surface and Groundwater)] Impacts and mitigation*, as well as in Section 4.5.2 *[Alternative 2: Two Breaches and Weir, Environmental impacts] Hydrology* and Section 4.6.2 *[Alternative 3: Three Breaches, Environmental impacts] Hydrology*.

Access to detailed hydraulic modeling, including comparisons of existing conditions to the restoration project, was included in Section 4.1 *Access to Technical Reports* of the 2019 Partial Recirculated DEIR (see RMA 2016a). RMA (2016a) focuses on hydrodynamic modeling for 100- and 200-year flood events for the Alternative 2 configuration. RMA (2016a) model results show potential changes in flood stage in Miner Slough are less than 0.1 ft, and suggest no effect

upon available levee freeboard along SR-84. This is consistent with previous modeling for the Proposed Project and Alternatives, which also showed minimal potential change of stage for a range of flow conditions (Appendix K in SWS and WWR 2012). Accordingly, more frequent flood events (e.g. 25- and 50-year events) would also have no impact on levee freeboard along SR-84.

Regarding potential scour at levee breach locations, please refer to **General Response E**.

CalTrans-4: Encroachment Permit

Commenter provides information on encroachment permits regarding work or traffic control that encroaches the state right-of-way.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**).

CalTrans-5: Mitigation Responsibilities

Commenter states that as the Lead Agency the project's fair share contribution, financing, scheduling, and implementation responsibilities should be fully discussed for all proposed mitigation measures.

DWR Response

DWR will prepare a Monitoring, Mitigation and Reporting Plan (MMRP), as required by CEQA.

Central Delta Water Agency (CDWA)

CDWA-1: Comments on 2016 DEIR and Continued Concern

Commenter states their organization has raised numerous concerns on the 2016 DEIR and provides supplemental comments on the 2019 Partial Recirculated DEIR.

DWR Response

Please refer to 2019 FEIR **Appendix D** for responses to comments on the 2016 DEIR.

CDWA-2: Salinity Modeling

Commenter is concerned that the Proposed Project is improperly piecemealed and that its impacts should be assessed in conjunction with other projects, including those of Ecostore. The comment gives an example regarding salinity.

DWR Response

Please refer to General Response G in 2019 FEIR **Appendix D** regarding piecemealing and the EIR analysis of cumulative impacts. Please also refer to **General Response H** regarding cumulative salinity impacts, which discusses modeling efforts that have considered cumulative impacts of some tidal restoration projects. The assertion by the commenter that there would be a 7.8% increase of Delta salinity from the Proposed Project is inaccurate. Please refer to **General Response G** and the specific response to CCWD-7 in 2019 FEIR **Appendix D** with regard to the relatively small impact of the modeled 7.8% potential maximum salinity increase at one location during a dry-year hydrology.

CDWA-3: Salinity Impacts

Commenter states that the EIR makes conclusory observations regarding potentially significant salinity impacts, and findings must be reported with facts and analysis. Commenter states that water would have to be sourced from other uses to maintain compliance with D-1641 salinity standards, and this would impact post-1914 appropriative rights; alternatively, if water would not need to be taken from other sources, this should be supported by facts and analysis. Commenter is also concerned that the salinity modeling is limited to 2009 and 2010, and salinity would have the greatest impact when conditions are driest. Finally, the commenter states that the EIR avoids analyzing individual and cumulative impacts for all environmental resources.

DWR Response

Although this comment refers to the 2016 DEIR, not the 2019 Partial Recirculated DEIR (see **General Response A**), it contains information relevant to recirculated portions of the EIR; therefore, we respond here.

Commenter refers to what it calls a conclusory observation in the EIR that “[a]t lower outflows, the combined effect of the Proposed Project in combination with other planned tidal habitat restoration projects on salinity in the Delta would [indeed] be potentially significant” (2016 DEIR, p. 3-362). Commenter has added language and taken, out of context, this statement which summarized the conclusions of an analysis prepared for a different document for a different

purpose. With regard to commenter's reference to conclusory statements, the style of the EIR, typical of many other EIRs, is that a statement of potential significance is made prior to the analysis and significance determination. The statements of potential significance are followed by facts and analysis that support the EIR's determination of significance. This style is applied throughout the EIR, including in Section 3.19.3 *Summary of cumulative impacts*.

Please refer to **General Response G** for a discussion of project-specific salinity impacts, including why stored water would not have to be released to meet D-1641 salinity standards and, therefore, why Term 91 would not apply, as well as why hydrological years 2009 and 2010 were used for the analysis (one year showed dry year hydrology, associated with the most severe salinity impacts, and one showed a near-normal year hydrology) .

In relation to cumulative impacts, please refer to General Response G in 2019 FEIR **Appendix D**, and **General Response H** regarding cumulative salinity impacts.

Finally, DWR rejects the notion that the EIR avoids analyzing impacts of all environmental resources. The EIR has analyzed project-specific and cumulative impacts for all resources. The EIRs salinity conclusions that the potential Proposed Project salinity impacts are not significant, and that the projected incremental effect on salinity due to the Proposed Project would not be cumulatively considerable, are based on facts and analysis.

CDWA-4: Noncompliance with CEQA

Commenter claims the EIR remains in noncompliance with CEQA.

DWR Response

Please refer to the response to CDWA-3.

Central Valley Flood Protection Board (CVFPB)

CVFPB-1: Title 23 Permit

Commenter states that a permit may be required from the Agency pursuant to Title 23, Section 6 of the California Code of Regulations, which relates to the CVFPB's jurisdiction for the construction, maintenance, and protection of adopted plans of flood control.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). DWR has submitted a Title 23 CCR Division 1 Encroachment Permit to the California Valley Flood Protection Board (CVFPB) in relation to the Proposed Project.

Central Valley Regional Water Quality Control Board (CVRWQCB)

CVRWQCB-1: Agency Objectives and Responsibilities

Commenter introduces their organizations objectives and responsibilities in reviewing the EIR.

DWR Response

Please refer to **General Response B**.

CVRWQCB-2: Basin Plan

Commenter provides information regarding the Basin Plan.

DWR Response

Please refer to **General Response B**.

CVRWQCB-3: Mercury Monitoring

Commenter states that no project specific methylmercury monitoring will be required for the 401 Water Quality Certification, because Prospect Island was included in the DWR's August 2018 Delta Regional Monitoring Program. If methylmercury studies identify viable and feasible management practices, DWR would need to consider incorporating those practices during construction and future operations of wetlands.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). An application for a California Water Act Section 401 Water Quality Certification has been submitted to the CVRWQCB. For more information on methylmercury impacts, see Impact 3.2-8 of the 2019 Partial Recirculated DEIR and the response to LAND-34 below.

CVRWQCB-4: Antidegradation Policy

Commenter states that all wastewater discharges must comply with the Antidegradation Policy and that the 'environmental review document' should evaluate all potential impacts to surface and groundwater quality.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). The EIR has evaluated all potential impacts to surface and groundwater quality. Additionally, an application for a California Water Act Section 401 Water Quality Certification has been submitted to the CVRWQCB.

CVRWQCB-5: Storm Water General Permit

Commenter states that certain kinds of activities require a 'General Permit for Storm Water Discharges Associated with Construction Activities' (Construction General Permit Order No. 2009-009-DWQ).

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). Mitigation Measure 3.2-1.2 of the EIR requires a Stormwater Pollution and Prevention Plan (SWPPP).

CVRWQCB-6: Phase I and II Municipal Separate Storm Sewer System Permits

Commenter states that certain kinds of activities require Phase I and II Municipal Separate Storm Water Permits.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**).

CVRWQCB-7: Industrial Storm Water General Permit

Commenter states that stormwater discharges associated with industrial sites must comply with the regulations contained in the Industrial Storm Water General Permit No. 2014-0057-DWQ.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. obtain required permits. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**).

CVRWQCB-8: Clean Water Act Section 404 Permit

Commenter states that if the Proposed Project involves the discharge of dredged or fill material into navigable waters or wetlands, then a Section 404 Permit is required.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). An application for a Clean Water Act Section 404 / Rivers and Harbors Act Section 10 Permit has been submitted to the U.S. Army Corps of Engineers (USACE).

CVRWQCB-9: Water Quality Certification

Commenter states that if the Proposed Project requires a federal permit for disturbance of waters of the United States, then a Section 401 Permit is required.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). An application for a CWA Section 401 Water Quality Certification has been submitted to the CVRWQCB.

CVRWQCB-10: Waste Discharge Requirements

Commenter states that if USACE finds that only non-jurisdictional waters of the State are affected by the Proposed Project, then a Waste Discharge Requirement Permit is required from the CVRWQCB pursuant to the California Porter-Cologne Water Quality Control Act.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). An application for a CWA Section 401 Water Quality Certification has been submitted to the CVRWQCB.

CVRWQCB-11: Dewatering Permit

Commenter states that if the Proposed Project includes construction or groundwater dewatering to be discharged to land, the proponent may apply for coverage under State Water Board General Water Quality Order (Low Risk General Order) 2003-0003 or the Central Valley Water Board's Waiver of Report of Waste Discharge and Waste Discharge Requirements (Low Risk Waiver) R5-2013-0145.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**).

CVRWQCB-12: Regulatory Compliance for Commercially Irrigated Agriculture

Commenter states that if the property will be used for commercial irrigated agricultural, the discharger is required to obtain regulatory coverage under the Irrigated Lands Regulatory Program.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**).

CVRWQCB-13: Limited Threat General National Pollutant Discharge Elimination System Permit (NPDES)

Commenter states that if the Proposed Project includes construction dewatering and it is necessary to discharge the groundwater to waters of the United States, the Proposed Project requires coverage under a National Pollutant Discharge Elimination System (NPDES) permit. Dewatering discharges may be covered

under the General Order for *Limited Threat Discharges to Surface Water* (Limited Threat General Order).

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**).

CVRWQCB-14: National Pollutant Discharge Elimination System Permit (NPDES)

Commenter states that if the Proposed Project discharges waste that could affect the quality of surface waters of the State, other than into a community sewer system, the Proposed Project requires coverage under a NPDES permit.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**).

Delta Stewardship Council (DSC)

DSC-1: Agency Objectives and Responsibilities

Commenter introduces its organization's objectives and responsibilities in reviewing the EIR.

DWR Response

Please refer to **General Response B**.

DSC-2: Certification of Consistency with the Delta Plan

Pursuant to California Water Code § 85225, commenter states that the Proposed Project appears to meet the definition of a "covered action" and that therefore DWR would need to file a Certification of Consistency with the Delta Plan prior to implementing the Proposed Project.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). DWR is planning to file a Certification

of Consistency with the Delta Stewardship Council (DSC) and appreciates the DSC's identification of potential policies that may apply.

DSC-3: General Policy 1 of the Delta Plan – Consistency with the Delta Plan

Commenter notes that its comments on the 2016 DEIR still apply. Commenter also recommends DWR verifies compliance with General Policy 1 of the Delta Plan in the EIR, including use of the best available science and implementation of adaptive management.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). Information on consistency with the General Policy 1 of the Delta Plan requirements will be included in the Certification of Consistency.

The EIR is based on the best available science and rigorous technical analysis. Please refer to General Response C in 2019 FEIR **Appendix D** for the accessibility of technical reports. For information on adaptive management, please refer to General Response H of 2019 FEIR **Appendix D**.

Note that although new mitigation measures for air quality and transportation were added to the EIR in the 2019 Partial Recirculated DEIR, no new mitigation measures were added to EIR Section 3.2 *Water Quality (Surface and Groundwater)*.

DSC-4: Ecosystem Restoration Policy 2 of the Delta Plan – Restore Habitats at Appropriate Elevations

Commenter recommends DWR verifies compliance with Ecosystem Restoration Policy 2 of the Delta Plan by describing how the proposed restoration actions are consistent with the actions described in Appendix 3 for intertidal lands.

DWR Response

Comment noted. Information on consistency with the Delta Plan will be included in the certificate of consistency.

DSC-5: Ecosystem Restoration Policy 3 of the Delta Plan – Protect Opportunities to Restore Habitat

Commenter recommends DWR verifies compliance with Ecosystem Restoration Policy 3 of the Delta Plan by describing how the project would avoid or mitigate impacts to the opportunity to restore habitat throughout the Yolo Bypass Priority Habitat Restoration Areas.

DWR Response

Comment noted. Information on consistency with the Delta Plan will be included in the Certification of Consistency.

DSC-6: Ecosystem Restoration Policy 5 of the Delta Plan – Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species

Commenter recommends DWR verifies compliance with Ecosystem Restoration Policy 5 of the Delta Plan by describing how the project would avoid introduction of new habitat, or improve existing habitat conditions, for both nonnative wildlife species and terrestrial and aquatic weeds.

DWR Response

Please refer to EIR Impacts 3.3-9 and 3.3-11 for discussions relating to nonnative aquatic species. Please refer to General Response F in 2019 FEIR **Appendix D** for information on invasive plant management and revegetation. Information on consistency with the Delta Plan will be included in the certificate of consistency.

DSC-7: Delta as Place Policy 2 of the Delta Plan – Respect Local Land Use

Commenter requests DWR verifies compliance with Delta as Place Policy 2 of the Delta Plan by describing how the project would be sited to avoid or reduce conflicts with existing or planned future uses.

DWR Response

Regarding good neighbor practices, please refer to General Response D in 2019 FEIR **Appendix D**. Regarding seepage, please also refer to **General Response F**. Information on consistency with the Delta Plan will be included in the Certification of Consistency.

DSC-8: Requests on the CEQA Regulatory Setting

Commenter requests that DWR include a discussion of the Delta Plan and the specific applicable regulatory policy or policies in the Regulatory Setting portion of each resource section of the 2019 FEIR.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). Information on consistency with the Delta Plan requirements will be included in the Certification of Consistency.

DSC-9: Continued Consultation

Commenter suggests DWR continue to engage Council staff in early consultation (prior to submittal of a Certification of Consistency) to discuss project features and mitigation measures that would promote consistency with the Delta Plan.

DWR Response

DWR will continue to engage Council staff in discussions relating to the certificate of consistency.

Local Agencies of the North Delta (LAND)

LAND-1: Current and Future Environmental Impacts

Commenter states that impacts to air quality, infrastructure, levees, roads, crops, and drainage management have not been properly or sufficiently analyzed. Commenter requests revisions to the 2019 Partial Recirculated DEIR to reduce these impacts and/or include cost-effective and adequate monitoring and mitigation for these impacts. Commenter also includes correspondence regarding discussions between commenter and DWR.

DWR Response

Please refer to General Response D in 2019 FEIR **Appendix D** and **General Response C** regarding communications with LAND and RD 501. In relation to financial concerns, please refer to **General Response D**.

In relation to potential environmental impacts, please refer to the following:

- For air quality, please refer to Section 5.4 *Revisions to the DEIR Air Quality Analysis* of the 2019 Partial Recirculated DEIR. Please also refer to Section

3.7 *Air Quality* of the 2016 DEIR for portions of this section that were not recirculated.

- The commenter does not clarify what infrastructure they are referring to, but please refer to the 2016 DEIR and 2019 Partial Recirculated DEIR for information on relevant infrastructure.
- For potential impacts to levees, please refer to Section 5.2 *Revisions to the DEIR Hydrology Analysis* of the 2019 Partial Recirculated DEIR.
- For potential impacts to roads, please refer to Section 5.6 *Revisions to the Transportation and Traffic Analysis* of the 2019 Partial Recirculated DEIR.
- For potential impacts to agriculture, please refer to Section 3.12 *Agricultural Resources* of the 2016 DEIR.
- For potential drainage impacts, please refer to 2019 Partial Recirculated DEIR Impact 3.1-3 *Groundwater seepage impacts from Prospect Island to adjacent areas*. Please also refer to **General Response F**.

LAND-2: Best Available Science and Technical Information

Commenter states that the 2019 Partial Recirculated DEIR does not fully address project impacts or avoidance and mitigation measures, despite empirical observations and technical comments from commenter. Commenter states that the identified impacts have been arbitrarily reduced to *less than significant* with no mitigation, even when impacts had been previously documented as significant.

DWR Response

DWR does not agree with the view expressed by the commenter and considers the EIR to be based on the best available science and rigorous technical analyses. The numerous technical reports for the Prospect Island Tidal Habitat Restoration Project were made available in Section 4.1 *Access to Technical Reports* of the 2019 Partial Recirculated DEIR (see General Response C in 2019 FEIR **Appendix D**). Except for the ENGEO Report discussed in **General Response F**, commenter has not undertaken any independent technical sampling or data analysis that it thinks DWR should have considered.

The statement by the commenter that DWR has determined that the Proposed Project has *no impact* or *less than significant* impacts is factually incorrect, and not consistent with the findings of the 2016 DEIR and 2019 Partial Recirculated DEIR. A summary of the significance determinations for each potential impact is provided in Table ES-1 of the EIR. The impact analyses in the EIR are

undertaken using relevant significance criteria under CEQA, as described for each potential impact in Section 3 *Environmental Setting, Impacts, and Mitigation Measures* of the EIR. Reasons for the significance determinations are also fully disclosed in each potential impact analysis. The 2019 Partial Recirculated DEIR changed the significance determination for EIR Impacts 3.7-1 and 3.7-2 [*Air Quality*] from *significant and unavoidable* to *less than significant with mitigation*, because it implemented Mitigation Measure 3.7-1.3, which reduced the impact to *less than significant*. It did not change the significance determinations for *Transportation*, but Mitigation Measure 3.17-2.1 was removed because it was no longer necessary (DWR owned property for which access had been assured) and Mitigation Measure 3.17-1.2 was added to deal with additional transportation impacts. If the commenter is referring to hydrological impacts relating to seepage and erosion, those impacts determinations have not changed from the determination of *less than significant*.

LAND-3: Good Neighbor Policies and Mitigation

Commenter suggests that DWR has not adequately addressed commenter's concerns despite extensive discussions and efforts on the part of the commenter.

DWR Response

DWR has given consideration to mitigation in developing the CEQA EIR, and EIR mitigation measures are summarized in Table ES-1 *[Executive Summary]* and discussed in EIR Section 3 *Environmental Setting, Impacts, and Mitigation Measures*. Additionally, good neighbor monitoring measures are discussed in **General Response I** and in General Response D in 2019 FEIR **Appendix D**. While DWR did not agree to all of the measures requested by commenter, DWR did agree to carry out some of the actions requested.

LAND-4: Proposed Project Mitigation and Good Neighbor Project Monitoring

Commenter expresses concern that monitoring and surveys promised by DWR have not been included in the 2019 Partial Recirculated DEIR, and requests their inclusion to better allow for enforcement of these measures.

DWR Response

DWR and commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *less than significant* are supported by substantial evidence and best available science and that they, therefore, do not require mitigation under CEQA.

As discussed in **General Response I**, text relating to measures for ongoing monitoring and levee repair regarding seepage and erosion impacts was removed from EIR Impacts 3.1-3 through 3.1-6. These measures were discussed in the EIR, but were not identified as CEQA mitigation measures. While DWR did not agree to all the measures that commenters requested as mitigation, DWR did carry out, or did agree to carry out, some of the actions requested as a good neighbor. Monitoring measures are also discussed in General Responses D and H in 2019 FEIR **Appendix D**. DWR and the commenter disagree on some of the potential impacts of the Proposed Project and Alternatives. It is DWR's opinion that the conclusions of the EIR regarding impacts relating to seepage and erosion that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

Please also refer to **General Response C** and General Response D in 2019 FEIR **Appendix D** for further details of DWR's discussions with LAND and RD 501.

LAND-5: Deferral of Mitigation Measures and Invasive Plant Species Measures

Commenter states that the mitigation included in the 2019 Partial Recirculated DEIR lacks sufficient detail and enforceable performance standards, specifically citing invasive plant control measures and is, therefore, improper deferral of mitigation measures.

DWR Response

The commenter refers to improper deferral of mitigation measures in the opening sentences of this comment, then points to a component of the Proposed Project description in the 2019 Partial Recirculated DEIR relating to invasive plant species control. Note that invasive species control measures are embedded in the Proposed Project description, rather than a CEQA-required mitigating action. The full Proposed Project description was included in the 2019 Partial Recirculated DEIR for completeness, and ease of use by reviewers. No significant changes were made to discussions relating to invasive species control or revegetation in the 2019 Partial Recirculated DEIR (see **General Response A**). Invasive plant management and revegetation is discussed in General Response F in 2019 FEIR **Appendix D**. Details of plant density would be set forth in the Revegetation Strategy and/or final design documents.

DWR does not agree with the commenter's statement that mitigation has been improperly deferred. Where mitigation measures are identified, they describe performance standards and identify the types of actions that can feasibly achieve the performance standards. The details of the mitigation measure can be developed later.

LAND-6: Good Neighbor Practices

Commenter requests inclusion of proposed good neighbor policies and additional policies as part of the tidal habitat restoration project or as mitigation measures.

DWR Response

DWR and the commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *less than significant* are supported by substantial evidence and best available science and that they, therefore, do not require mitigation under CEQA.

Please refer to General Response D in the 2019 FEIR **Appendix D** regarding good neighbor policies. Please also refer to the response to CFBF-5 in **Appendix D**.

LAND-7: Monitoring of Levees and Seepage

Commenter expresses concern over removal of references to impacts to Ryer Island levees and to monitoring of Ryer Island levees and groundwater seepage on Ryer Island.

DWR Response

No changes were made to the foundation or significance determinations for potential impacts to Ryer Island levees. As discussed in the response to LAND-4, text relating to ongoing monitoring and levee repair was removed from the EIR.

DWR and the commenter disagree on the impact of the Proposed Project with regard to potential seepage and levee damage. It is DWR's opinion that the conclusions of the EIR regarding these impacts that are assessed as *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. Please refer to **General Response F** regarding seepage and **General Response E** regarding erosion.

LAND-8: Import of Materials and Truck Trips

Commenter states that the 2019 Partial Recirculated DEIR fails to disclose a twenty-fold increase in truck trips during construction and cites it as a significant change to the project.

DWR Response

Revisions to the *Transportation and Traffic* analysis was one of the primary reasons for recirculating portions of the EIR. Potential transportation and traffic impacts are disclosed in Section 5.6 *Revisions to the Transportation and Traffic Analysis* of the 2019 Partial Recirculated DEIR, with explanation for the changes included in Section 4.7 *Transportation and Traffic*. In this section, the change of truck trips is explicitly stated on page 4-9.

LAND-9: Fill Material from San Rafael and Rio Vista

Commenter requests disclosure in the 2019 Partial Recirculated DEIR of the source and method of import of fill materials and implications for additional cumulative projects.

DWR Response

The 2019 Partial Recirculated DEIR stated that material imports would originate in Rio Vista or San Rafael; however, all EIR analyses (Transportation and Traffic, Noise, and Air Quality) were based on an assumption that material imports would originate in Rio Vista, which is the nearest regional distribution center for quarry materials. Note that quarry operations include routine transport of materials between the San Rafael Rock Quarry and Rio Vista, where materials are distributed. A clarifying change has been made in the 2019 FEIR to confirm that impacts related to import fill materials assume they would originate in Rio Vista, whether by barge or truck. Sourcing, loading, and transportation of import fill materials would be from existing facilities and equipment.

LAND-10: Consistency with the Delta Plan

Commenter states that 2019 Partial Recirculated DEIR analysis fails to apply Best Available Science and therefore fails to be consistent with the Delta Stewardship Council's Delta Plan, a necessity for approval.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis

under CEQA (see **General Response B**). DWR is planning to file a Certification of Consistency with the Delta Stewardship Council.

DWR disagrees with the commenter and believes that the conclusions in the EIR are based on best available science.

LAND-11: Section 408 Permit

Commenter requests that DWR provide a project plan or engineering information sufficient for technical review by USACE regarding DWR's request for permission to alter a USACE project under Section 408.

DWR Response

DWR and its contractors will comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). The Section 408 Permit application is currently in-process with USACE.

LAND-12: 2016 DEIR and 2019 Partial Recirculated DEIR

Commenter states that DWR must address all deficiencies in the 2016 DEIR and 2019 Partial Recirculated DEIR prior to certification of the 2019 FEIR.

DWR Response

Please refer to **General Response A** relating to responses to comments on parts of the 2016 DEIR that were not recirculated.

LAND-13: Water Rights and Potential Groundwater Seepage Impacts

Commenter states that DWR has failed to properly address the significance of potential impacts of groundwater seepage to adjacent areas and potential impacts to water rights for downstream water users. Commenter states DWR has not used the best available science to analyze the significance of these impacts.

DWR Response

Commenter refers to a summary in the DEIR of several issues of controversy which included the statement "[a]s indicated elsewhere in the Draft EIR, these potential areas of controversy were determined to be unfounded or would result in either no impact or be less than significant, based on substantial evidence."

Potential groundwater seepage impacts are discussed in EIR Impacts 3.1-3 and 3.1-6, as well as in **General Response F**.

Water rights are discussed in EIR Section 3.1 *Hydrology (Surface and Groundwater)*, in particular in Impact 3.1-1. This impact was not recirculated; please refer to **General Response A**. The absence of diversions is discussed in the response to LAND-26 below and in the response to CDWA-7 in 2019 FEIR **Appendix D**.

DWR and commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

LAND-14: Intertidal Bench Configuration

Commenter requests inclusion of the Base Flood Elevation (1% annual probability flood elevation) in Figure 2.2-7 *Intertidal Bench Configuration* of the EIR. Commenter states that this change would better depict the likelihood of severe erosion on, and possible breach of, the interior slopes of Prospect Island during storm events when water is deeper than normal.

DWR Response

The 1% probability flood (i.e., 100 year flood) reaches approximately 18.5 ft NAVD 88 on Prospect Island, thus overtops the Prospect Island – Miner Slough levee (RMA 2016a). For reference purposes, Mean High High Water (MHHW) is shown on the intertidal bench figure (Figure 2.2-7 of the EIR). Please refer to the response to RD501 KSN-9 in 2019 FEIR **Appendix D** and **General Response E**.

LAND-15: Breach Velocity Dissipation Feature

Commenter states that the plan-view diagram of the breach velocity dissipation feature in Figure 2.2-9 lacks the detail necessary for proper analysis of its fill quantity, geometry, and interference created on the flood prism. Commenter states that this figure indicates a flow path with potential for channel bottom scour induction that should be modeled under various stage heights and tidal cycles. Commenter proposes installing rip-rap on the Ryer levee shore, channel monitoring, and conducting or funding repairs in the case of a blowout.

DWR Response

The comment refers to a figure that was not updated and recirculated for review; please refer to **General Response A**. Potential for toe scour of the Ryer Island levee is assessed in Impact 3.1-5 of the 2019 Partial Recirculated DEIR, and is determined to be *less than significant*. Contrary to the commenter's assertion that specific events have not been modeled in relation to this impact, Appendix K in SWS and WWR 2012 models a 'summer-time low flow' condition at the peak of a strong spring tide cycle and a 'high north Delta inflow' condition (with a peak flow of 75,000 for the Sacramento River at Freeport), specifically towards determining the potential for flow exiting from the breaches continuing over to the opposite bank on Ryer Island. The results of this analysis were used for the assessment in EIR Impact 3.1-5. Please also refer to **General Response E** in relation to potential wind-wave impacts. Additionally, note that the purpose of the breach velocity dissipation feature is to dissipate velocity and not direct flows to Ryer Island levees, and the final engineering design specifications will reflect this purpose.

DWR and commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

LAND-16: Agricultural Water Supply and Drainage

Commenter criticizes the scope of Impact 3.1-1 and requests further analysis of changes in agricultural water supply and drainage beyond those impacts attributed to changes in tidal range. Commenter also states that impacts of changes in tidal range are improperly analyzed, lacking detail on invasive weed conditions and cumulative impacts from declining river flows.

DWR Response

Impact 3.1-1 was not subject to recirculation; please refer to **General Response A**. However, it is noted that Impact 3.1-1 was intentionally restricted to changes in tidal range because that was a potential impact of concern identified by diverters. As discussed in Impact 3.1-1, there would be no effect upon agricultural drainage operations as a result of changes in tidal range. The 2016 DEIR examined cumulative impacts related to changes in tidal range and found no potential significant impact regardless of future potential projects, including Delta conveyance facilities, that might affect river flows.

Information on invasive species control and revegetation was not subject to revision in the Partial Recirculated DEIR; please refer to **General Response A**. These issues are discussed in General Response F of 2019 FEIR **Appendix D**. The velocities in Miner Slough are reflective of a largely riverine environment with low suitability for floating and submerged aquatic vegetation. For any pumps and siphons in Miner Slough, the Proposed Project would not cause excess accumulation of invasive aquatic plant species at pump intakes. Instead of exacerbating the weed conditions over the life of the project, the Proposed Project's design would actually reduce overall cover of invasive species in and around Prospect Island.

LAND-17: Impacts of Weed Growth on Water Supply

Commenter states that the 2016 DEIR and 2019 Partial Recirculated DEIR do not disclose impacts of weed growth on total water supply.

DWR Response

Please refer to the response to LAND-16 above. Please also see EIR Impact 3.1-9, which reaches the conclusion that consumptive use would be similar to existing conditions.

LAND-18: Groundwater Seepage

Commenter states that DWR's conclusions on impacts to Ryer groundwater hydrology are unsubstantiated. Commenter states that its comments have not been properly considered or addressed in the 2019 Partial Recirculated DEIR.

DWR Response

Please refer to the response to LAND-4 above.

DWR and commenter disagree on the impact of the Proposed Project (Alternative 2) with regard to seepage. It is DWR's opinion that the conclusions of the EIR regarding seepage impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. Please also refer to **General Response F** regarding seepage.

LAND-19: Seepage Zones

Commenter states that the EIR does not characterize the potential extent or magnitude of the impact of seepage zones and lacks evidence to support the conclusion that there is *no significant impact*.

DWR Response

DWR and commenter disagree on the impact of the Proposed Project with regard to seepage. It is DWR's opinion that the conclusions of the EIR regarding seepage impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. Please refer to **General Response F** regarding seepage. Please also refer to the response to RD 501-3, which explains that the identified 'seepage zones' are located where velocities are modeled to decrease with the Proposed Project, such that there is no potential for scour associated with the Proposed Project to enhance seepage to adjacent land.

LAND-20: Seepage Significance Determination

Commenter states that a better threshold for significance is necessary for Impact 3.1-3 and that such a threshold could include what area of seepage impact is permissible. Commenter requests adequate seepage modeling supported with a tracer study and 3-dimensional erosion analysis for neighboring levees and suggests possible mitigation measures for seepage.

DWR Response

The relevant significance criteria developed under CEQA for hydrology are included in EIR Section 3.1.2 *[Hydrology] Significance Criteria*. Criteria for determining significant impacts were not changed in the 2019 Partial Recirculated DEIR, compared with the 2016 DEIR (see **General Response A**). **General Response F** discusses the significance criteria with regard to seepage.

Commenter states that seepage has been documented as directly damaging crops and requiring additional water management. However, studies supporting the EIR conclusions demonstrate that there would be no alteration of the existing drainage pattern on Ryer Island or groundwater seepage changes to properties adjacent to Prospect Island as a result of the Proposed Project, and thus no impact to agricultural operations. Therefore, regardless of whether a permissible area of seepage (or area of increased seepage compared with historical extents) is identified or not, the impact would be *less than significant*.

DWR and commenter disagree on the impact of the Proposed Project with regard to seepage. It is DWR's opinion that the conclusions of the EIR regarding seepage impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. Please refer to **General Response F** regarding seepage. Although DWR did not include groundwater monitoring as a mitigation measure in the 2019 Partial Recirculated DEIR, DWR has agreed to carry out these (and other) monitoring and surveys. Please refer to **General Response I** and General Response D in 2019 FEIR **Appendix D.**

LAND-21: Thresholds of Significance for Potential Toe Scour and Seepage

Commenter states that Impacts 3.1-5 and 3.1-6 are improperly analyzed and require better reasons for, and descriptions of, thresholds of significance. Commenter also requests that the 2019 Partial Recirculated DEIR address how to identify when erosion exceeds these thresholds.

DWR Response

The relevant significance criteria developed under CEQA for hydrology are included in Section 3.1.2 *[Hydrology] Significance Criteria* in Section 5 *Recirculated Portions of the DEIR* of the 2019 Partial Recirculated DEIR. Criteria for determining significant impacts were not changed in the 2019 Partial Recirculated DEIR, compared with the 2016 DEIR (see **General Response A**). **General Responses E** and **F** discuss potential toe scour and seepage.

DWR and commenter disagree on the impact of the Proposed Project with regard to potential toe scour and seepage. It is DWR's opinion that the conclusions of the EIR regarding these impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. Please refer to **General Response F** regarding seepage and **General Response E** regarding erosion. Although DWR did not include bathymetric studies as a mitigation measure in the 2016 DEIR or the 2019 Partial Recirculated DEIR, DWR has agreed to carry out these (and other) monitoring and surveys as a good neighbor. Please refer to **General Response I** and General Response D in 2019 FEIR **Appendix D.**

LAND-22: Mid-breach Water Velocities

Commenter disagrees with the 2019 Partial Recirculated DEIR's conclusion that there are no appreciable increases in water velocities through the middle breach

directed at the Ryer Island levee, that increases are below bed scour velocities, and that mobilization of the bed is unlikely in the south breach area.

DWR Response

Modeled velocity changes are explained in EIR Impact 3.1-5 in relation to relevant stability thresholds for sediment mobilization, because such thresholds are more relevant to assessing impacts than the magnitude of velocity change. Should velocities double in specific locations with the Proposed Project, if they remain below the stability thresholds there would be no scour impact. Upstream of breach locations velocities are expected to decrease, with some small increases farther downstream. DWR and commenter disagree on the impact of the Proposed Project with regard to potential scour. It is DWR's opinion that the conclusions of the EIR regarding these impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. Please refer to **General Response E** regarding erosion and scour.

LAND-23: Drainage Pumping

Commenter requests data from a "dry Prospect" condition to allow for better comparison of potential impacts and identification of saturated elevations.

DWR Response

Note that the lowest water surface elevations on Prospect Island during the modeling period, between January 2011 and March 2017, occurred in early autumn, with the lowest recorded stage in this period -1.5 ft (NAVD 88) (DWR 2018a). Data from a "dry Prospect" is, therefore, already available. Please refer to the responses to LAND-4, LAND-18, and LAND-24 with regard to monitoring and seepage impacts.

LAND-24: Seepage Monitoring

Commenter proposes establishment of seepage monitoring criteria and action level triggers. Commenter also suggests development of mitigation measures like interceptor or relief wells on RD 501.

DWR Response

Please refer to the response to LAND-4 above.

DWR and commenter disagree on the impact of the Proposed Project (Alternative 2) with regard to seepage. It is DWR's opinion that the conclusions of the EIR regarding seepage impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. Please also refer to **General Response F** regarding seepage

LAND-25: Erosion and Scour

Commenter suggests armoring and periodic monitoring of the bathymetry of Miner Slough. Commenter also states the need for pumping funds in the event of seepage.

DWR Response

DWR and commenter disagree on the impact of the Proposed Project (Alternative 2) with regard to seepage, erosion and scour. It is DWR's opinion that the conclusions of the EIR regarding erosion impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. Please refer to **General Response E** regarding erosion and **General Response F** regarding seepage.

As discussed in **General Response I**, text relating to measures for ongoing monitoring and levee repair regarding seepage and erosion impacts was removed from EIR Impacts 3.1-3 through 3.1-6. These measures were discussed in the EIR, but were not identified as CEQA mitigation measures. While DWR did not agree to all the measures that commenters requested as mitigation, DWR did carry out, or did agree to carry out, some of the actions requested as a good neighbor (including bathymetric studies). Monitoring measures are also discussed in General Responses D and H in 2019 FEIR **Appendix D**. DWR and the commenter disagree on some of the potential impacts of the Proposed Project and Alternatives. It is DWR's opinion that the conclusions of the EIR regarding impacts relating to seepage and erosion that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

LAND-26: Water Rights Impacts

Commenter states the need for the EIR to follow the SWRCB requirements for diversions of water as they relate to beneficial use and users of water, in regard to Impact 3.1-9.

DWR Response

Impact 3.1-9 was not subject to recirculation; please refer to **General Response A**. As noted in EIR Impact 3.1-9, water that flows uncontrolled, such as through the proposed open-water breaches on Prospect Island, does not qualify as a diversion which is subject to the SWRCB water rights process. This is also explained in the response to CDWA-7 in 2019 FEIR **Appendix D**. SWRCB requirements regarding water quality are discussed in the appropriate impact sections.

LAND-27: Authorization for Diversion

Commenter states that DWR needs legal authorization from SWRCB to change its point of diversion. Commenter also states that DWR must make the claim of no impact to beneficial users at a State Water Resources Control Board (SWRCB) hearing.

DWR Response

Please refer to the response to Land-26.

LAND-28: Consumptive Losses of Water

Commenter states that the 2019 Partial Recirculated DEIR uses the incorrect baseline to calculate evaporation and transpiration rates.

DWR Response

Please refer to **General Response A**. The EIR discussion of Section 5.1-9, including the appropriate baseline, was not subject to recirculation.

LAND-29: Authorization for Diversion

Commenter states that DWR failed to disclose the necessary petition process with SWRCB for a change in point of diversion in the EIR's list of required agency approvals and permits.

DWR Response

DWR and its contractors comply with all applicable regulatory requirements. This is not an issue relating to the adequacy of the environmental impact analysis under CEQA (see **General Response B**). Please refer to the response to LAND-26 above regarding the SWRCB water rights process.

LAND-30: Groundwater Quality Objectives and Sustainable Groundwater Management Act

Commenter states that the 2016 DEIR and 2019 Partial Recirculated DEIR ignore groundwater quality objectives and the Sustainable Groundwater Management Act (SGMA).

DWR Response

The Sustainable Groundwater Management Act (SGMA 2014) provides for the sustainable management of groundwater basins, primarily by designating basin priority and overdraft, and requiring groundwater sustainability plans to be developed, where required. Prospect Island is within the Sacramento-San Joaquin Northern Delta Groundwater Basin, which is managed by the Northern Delta Groundwater Sustainability Agency (https://www.ndgsa.org/). The Northern Delta Groundwater Basin is designated as high-priority, but is not critically overdraft; therefore, a groundwater sustainability plan is required to be developed by January 31, 2022. Given that the Proposed Project would not significantly impact groundwater levels (see potential Impacts 3.1-1 and 3.1-10 of Section 3.1.3 *[Hydrology] Impacts and mitigation* of the EIR), and that the groundwater sustainability plan is in the early stages of preparation, including reference to SGMA in the EIR would not add clarity or alter the impact analyses.

The surface and groundwater quality objectives presented in Table 3.2-8 of the EIR are sourced directly from the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins (CVRWQCB 2011). Furthermore, the potential effects on groundwater quality are assessed in Impact 3.2-9 in Section 3.2.3 *[Water Quality (surface and groundwater)] Impacts and mitigation* of the EIR and were found to be not significant.

DWR and commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding groundwater impacts that are considered *less than significant* (groundwater seepage) or *no impact* (groundwater supplies) are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

LAND-31: Dissolved Organic Carbon and Algal Productivity

Commenter states that the use of a single modeled year (2010) to calculate dissolved organic carbon and algal productivity is inappropriate and not reflective of drought conditions or climate change.

DWR Response

EIR Impact 3.2-7 was not subject to recirculation; please refer to **General Response A**. However, the significance determination was based on the fact that recent studies have documented only a minor role of river discharge upon transport of algae and DOC, and that modeling demonstrated that increased tidal exchanges under the Proposed Project did not result in significant changes in the transport of algae and DOC originating from within Prospect Island to locations other than the immediate vicinity.

In relation to climate change, please also refer to **General Response J**.

LAND-32: Algal Blooms

Commenter states that the EIR lacks a threshold of significance or rationale for classifying the impact of algal blooms as *less than significant*.

DWR Response

Please refer to EIR Section 3.2.2 *[Water Quality (Surface and Groundwater)] Significance criteria* and the response to LAND-31.

LAND-33: Cyanobacterial Blooms

Commenter states that the 2019 Partial Recirculated DEIR's analysis and conclusions regarding the risk of cyanobacterial blooms differs from, and ignores, DWR's prior technical analysis on Prospect Island under the Fish Restoration Program Agreement.

DWR Response

EIR Impact 3.2-7 was not subject to recirculation; please refer to **General Response A**. Cyanobacteria are present at varying concentrations at all times of year in the Delta, and mixing and particle retention time metrics used in restoration planning were considered in the impact assessment.

LAND-34: Methylmercury

Commenter states that the EIR does not frame mercury impacts in terms of beneficial uses, but in general terms, and does not determine how the Proposed Project would impact the Sacramento-San Joaquin Delta methylmercury total maximum daily load (TMDL). Commenter states that the methylmercury accumulation impact is both individually and cumulatively significant. Commenter states that the Delta tunnel analysis by DWR assessed methylmercury impacts as *significant and unavoidable*, because any increase would make mercury-related impairment measurably worse. Commenter also states that the EIR fails to describe the mechanics of methylation, the spatial extent of those processes, their annual timing, the forcing processes, and the role of increased DOC.

DWR Response

Background information on methylmercury is provided in Section 3.2.*1 [Water Quality] Setting* of the EIR. The Delta TMDL for methylmercury has been given due consideration in developing potential Impact 3.2-8, which is determined to be *less than significant* using the best available scientific data. As discussed in EIR Section 3.2 *Water Quality (Surface and Groundwater)*, the Regional Quality Control Boards have regulatory jurisdiction with regard to methylmercury. DWR and its contractors will comply with all regulatory requirements. Please refer to comment CVWRQCB-3 in which the commenter states that no project-specific methylmercury monitoring will be required for the 401 Water Quality Certification, because Prospect Island was included in the DWR's August 2018 Delta Regional Monitoring Program.

DWR has undertaken sediment sampling and analysis of the Miner Slough Spur Channel and interior of Prospect Island (Kinnetic Laboratories, 2016a,b). Total mercury in Prospect Island soils ranged from 60 to 300 µg kg^{-1}. Test results showed minor exceedances of terrestrial life screening levels for total mercury, only one exceedance of the plant life screening value, but were generally within the range of Delta background soil levels set forth in the Delta Dredging and Reuse Strategy (CVRWQCB et al. 2002). Although there are no criteria concentration levels for methylmercury, methylmercury concentrations in the Miner Slough Spur Channel sediment samples are < 1 µg kg^{-1} (Kinnetic Laboratories 2016b). This analysis supports the conclusion that potential effects associated with release of mercury and methylmercury during dredging under the Proposed Project would be *less than significant*. Alternative 2 does not include any dredging, so would not involve releases of mercury or methylmercury during dredging.

In the long-term, the small increase in the area of infrequently flooded habitat associated with higher methylmercury production, would be offset by a large increase in open-water habitat associated with lower methylmercury production. This conclusion is based upon the CALFED Science Program Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) conceptual model of methylmercury production. Therefore, little, if any, increases in methylmercury export and bioaccumulation would occur as a result of the Proposed Project. This impact would be *less than significant*. As mentioned in the 2019 Partial Recirculated DEIR, the Proposed Project would not affect the California State Lands Commission (CSLC) ability to comply with TMDL requirements.

Although scientific studies are currently sparse, existing science suggests that methylmercury levels in restoration sites are no higher than reference (non-restored and muted) sites and there is no increase of methylmercury in response to restoration (Robinson et al. 2014; Robinson et al. 2018). One study found that tidal wetlands more frequently act as sinks, rather than sources, of methylmercury (Lee et al. 2015). Another study suggests that methylmercury production within tidal marshes has greater consequences for biota inhabiting the marsh and salt marsh food-web, than for the efflux of methylmercury from the marsh and the coastal zone (Mitchell et al. 2012). These studies, together with the analysis in the EIR, document the best available science regarding methylmercury impacts associated with wetland restoration.

The Proposed Project-specific potential methylmercury impact is independent of other projects in the Delta. DWR considers that the methylmercury impacts are *less than significant*, which is supported by substantial evidence and the best available science, and DWR, therefore, does not require mitigation for methylmercury under CEQA.

LAND-35: Long-term Salinity Effects

Commenter expresses concern that Impact 3.2-5 [*Long term effects on salinity in waterbodies near Prospect Island*] modeling is inadequate and that the 2019 Partial Recirculated DEIR fails to establish practical standards and assure compliance with D-1641.

DWR Response

Please refer to **General Responses G** and **H**. DWR does not agree that modeling deficiencies exist. Any salinity increases are small, location-specific, and well within D-1641 standards.

LAND-36: Long-term Methylmercury Effects

Commenter states that the 2019 Partial Recirculated DEIR fails to properly analyze methylmercury subject to SWRCB regulation and under a TMDL.

DWR Response

Please refer to the response to LAND-34 above.

LAND-37: Asian Clam

Commenter states that the project will impermissibly create ideal habitat conditions for the Asian clam, a major contributor to ammonia and nutrient depletions generally in the Delta. Commenter proposes an invasive clams and mussels monitoring and response plan or actionable performance standards for invasive species density.

DWR Response

EIR Impact 3.3-11 *Altered habitat and food web from invasion by Asian clam* was not subject to recirculation; please refer to **General Response A**.

In response to comments on the 2016 DEIR and 2019 Partial Recirculated DEIR, no changes to the conclusions or significance determinations for *Hydrology* impacts were made; therefore, there is no need to revise the Asian clam analysis as the commenter has suggested. There is no evidence of Asian clams currently on Prospect Island; however, EIR Impact 3.3-11 has diligently considered the potential for establishment in the future, and concluded that the impact is *less than significant*.

DWR and the commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

LAND-38: Food Web Impacts from Methylmercury Bioaccumulation

Commenter states that the EIR fails to adequately analyze methylmercury impacts, including food chain impacts.

DWR Response

Please refer to the response to LAND-34 above.

LAND-39: Sediment Deposition and Erosion

Commenter states that the EIR fails to properly consider sediment deposition and erosion, including cumulative impacts of the Delta tunnel project.

DWR Response

Impact 3.5-2 *Long-term effect on sediment deposition and erosion in Prospect Island* was not subject to recirculation; please refer to **General Response A**. Due to sediment trapping effects within Prospect Island, the Proposed Project is modeled to result in small reductions of turbidity in the Cache Slough region; however, this reduction is not expected to have a cumulatively considerable effect on scour or reduce habitat suitability for Delta Smelt. Please refer to the response to CSLC-7 in 2019 FEIR **Appendix D** for additional information on sediment dynamics.

DWR and the commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

LAND-40: Appendix G Air Quality

Commenter states that Appendix G regarding the air quality analysis fails to include the total number of truck trips, possible usage of a "San Rafael" source of fill material, and accurate calculations of fill volume. Commenter suggests that separation of project construction activities into 27 tasks and manipulation of the model and its results mask air quality impacts, resulting in an analysis that artificially reduced the maximum hourly emissions to below the Yolo Solano Air Quality Management District (YSAQMD) thresholds.

DWR Response

The 2016 DEIR concluded that Impacts 3.7-1 and 3.7-2 were *significant and unavoidable*. Following circulation of the 2016 DEIR, DWR discussed potential for truck-based materials import increasing required truck trips and possible mitigation measures with the Yolo Solano Air Quality Management District (YSAQMD) and agreed to pay YSAQMD an offset mitigation fee for air quality impacts based on monitoring of construction activities throughout the construction period (see Mitigation Measure 3.7-1.3 in Impact 3.7-1, Section 3.7.3 *[Air Quality] Impacts and mitigation* of the 2019 Partial Recirculated DEIR).

The significance determination for Impacts 3.7-1 and 3.7-2 were accordingly revised to *less than significant with mitigation*.

As part of Mitigation Measure 3.7-1.3, the increased number of truck trips will be accounted for during annual permit fee calculations, with model calculations subject to review and approval by the YSAQMD. Any variations in actual equipment used, compared with existing calculations in 2019 FEIR Appendix G *Air Quality Calculations*, would be accounted in this process and would not change the significance determinations for Impacts 3.7-1 and 3.7-2, which are *less than significant with mitigation*. This is because: a) NOx and ROG have already been assessed for exceedance of the YSAQMD significance thresholds, and b) other air pollutants are so far from the maximum daily significance thresholds that adjustments to the model inputs would not change the outputs to the extent that they exceed the thresholds. The barge-based transportation option is associated with higher air pollutant emissions than any trucking option; therefore, changes to the number or route of truck trips, would not change the fact that DWR has already assessed the option with the greatest potential impacts with regard to air quality in the EIR.

With regard to possible usage of a “San Rafael” quarry source of fill material, see the response to LAND-9 above.

LAND-41: Toxic Air Contaminants

Commenter states that the 2016 DEIR and 2019 Partial Recirculated DEIR do not adequately disclose or analyze the toxic air contaminant emissions, particularly those from mobile sources, or resulting human health impacts. Commenter states that “sensitive receptors” would be at risk and should be identified.

DWR Response

Clarifying and amplifying information has been added to Impact 3.7-3 to address the commenters concerns regarding emissions from mobile sources, including increased diesel emissions from truck traffic on the haul routes, and proximity of sensitive receptors during construction. Because diesel emissions are expected to dissipate within the distance to the nearest residences, these updates have not changed the *less than significant* determination. There are no sensitive receptors in the immediate project vicinity of Prospect Island, and the construction-related diesel particulate matter emissions are short-term, thus would not result in ongoing exposure associated with health risks.

LAND-42: Toxic Air Contaminants (TACs) in Rio Vista

Commenter states that the 2016 DEIR and 2019 Partial Recirculated DEIR do not address TAC impacts to Rio Vista residents, despite round-trip truck travel to Rio Vista for import fill, riprap, and aggregate base.

DWR Response

For import materials originating in Rio Vista, sourcing and loading would be from existing facilities and equipment. Assuming either barge or truck transport of materials to Prospect Island, diesel particulate emissions proximate to Rio Vista would primarily occur along Route 84 and the west bank of the Sacramento River, which lies to the northeast and generally downwind of city residents. Considering the existing operations in Rio Vista, import of materials to the Project site would not result in a new, or substantially enhanced, air quality impact in Rio Vista.

LAND-43: Mobile Toxic Air Contaminants Significance Threshold

Commenter expresses concern over the failure to use a threshold of significance for mobile toxic air contaminant sources, or to analyze the possible impacts.

DWR Response

The significance criteria for air quality are set forth in Section 3.7.2 *[Air Quality] Significance Criteria* of the EIR. The relevant criteria when assessing toxic air contaminant impacts is the exposure of sensitive receptors to substantial pollutant concentrations. Please see response to LAND-41 above.

LAND-44: Toxic Air Contaminants and Health Risks

Commenter states the potential significance of the health risks associated with mobile toxic air contaminant emissions and the need for the inclusion of the analysis of possible impacts.

DWR Response

Please refer to the responses to LAND-41 through LAND-43 above.

LAND-45: Ultrafine Particles (UFPs)

Commenter expresses concern that the 2016 DEIR and 2019 Partial Recirculated DEIR do not address UFPs (< 0.1 micrometers) as a potentially significant air quality impact and states the need for such analysis.

DWR Response

Particulate matter, including all particles less than 2.5 microns in diameter and all particles less than 10 microns in diameter, are considered in the EIR (see Section 3.7 *Air Quality*). While $PM_{0.1}$ is difficult to measure and not federally regulated, it is generally included in the analysis and mitigation for $PM_{2.5}$, and regard is given to the health risks associated with $PM_{2.5}$. The potential for particulate matter to contribute to air quality violations (Impact 3.7-1), and for emissions to conflict with general plans or regional air quality plans (Impact 3.7-2), are both assessed as *less than significant with mitigation* in the 2019 Partial Recirculated DEIR. Mitigation includes best management practice techniques to minimize construction equipment exhaust, reduce fugitive dust, and payment of an offsite mitigation fee for actual construction emissions to help fund future air quality protection programs. Additional consideration of potential $PM_{0.1}$ emissions would not change the significance determinations, or result in additional mitigation, as the potential health risks associated with particulate matter emissions have already been taken into account.

LAND-46: TACs and UFPs Analysis

Commenter expresses concern that DWR has not provided the "bare numbers" associated with mobile TAC or UFP emissions, or analyzed the adverse impacts given the "bare numbers." Commenter questions how a *less than significant* determination for TACs in the 2019 Partial Recirculated DEIR can be made without a full TAC analysis completed for sensitive receptors.

DWR Response

Please refer to the responses to LAND-41 and LAND-45 above.

LAND-47: Potential Seepage and Levee Damage Impacts on Agriculture

Commenter states that the 2019 Partial Recirculated DEIR fails to update the inadequate analysis of Impact 3.12-3 *Potential effects to agricultural uses on adjacent lands*. Commenter also states that Impact 3.12-3 fails to support the conclusion that the project's seepage and levee damage impacts would not impact agriculture on Ryer Island.

DWR Response

Impact 3.12-3 *Potential effects to agricultural uses on adjacent lands* is dependent on the EIR Section 3.1 *Hydrology* analysis, which was updated and recirculated, but did not require changes to the fundamental conclusions or

significance determinations. As such, there was no need to update Impact 3.12-3. DWR and commenter disagree on the impact of the Proposed Project regarding seepage and erosion. It is DWR's opinion that the conclusions of the EIR regarding seepage and erosion impacts that are considered *less than significant* are supported by substantial evidence, and the best available science, and that they, therefore, do not require mitigation under CEQA. Please refer to **General Response F** regarding seepage and **General Response E** regarding erosion.

LAND-48: Quantification of Traffic Impacts

Commenter states that the 2019 Partial Recirculated DEIR fails to properly quantify and analyze the Proposed Project's traffic impacts, and also fails to provide a qualitative analysis. A lack of clarity regarding DWR's commitment to one of the transport options is confusing.

DWR Response

One of the primary reasons for recirculating the EIR was to disclose the nature and magnitude of potential transportation and traffic impacts associated with the Proposed Project. The estimated number of truck trips associated with the Proposed Project is explicitly stated in Section 4.7 *Transportation and Traffic* and Impact 3.17-1 in Section 5 *Revisions to the Transportation and Traffic Analysis* of the 2019 Partial Recirculated DEIR. Although the number of truck trips is expressed numerically, the nature and magnitude of potential adverse transportation and traffic impacts cannot all be assessed in numerical terms. Potential traffic impacts are typical of those that occur during any construction project, and include: temporarily impeding local traffic, increased traffic loading, and pavement deterioration. A traffic control plan and road repairs to pre-project levels would reduce these impacts to *less than significant*. Although the EIR conservatively assesses the potential for access impediments, it is not anticipated that access would be blocked to any private properties; rather, traffic may be slowed while construction traffic is in transit and potentially while road repairs occur (on one side of the road at a time). There is a possibility of temporary road closures during construction mobilization and demobilization, for which flaggers would be utilized, as necessary. The nature of potential pavement deterioration is such that it cannot be quantified or qualified with any certainty prior to usage, but will be qualified during and after usage by comparing pre- and post-Proposed Project road surface conditions (see Mitigation Measure 3.17-1.2). DWR considers that this is the best possible approach to mitigate road surface impacts.

In addition to the Proposed Project-specific mitigation proposed, we note that Delta levee roads are routinely repaired and raised to compensate for foundation consolidation and settlement, ensuring design standards are achieved (DWR 2008). Any consolidation, settlement, or subsidence of levee roads during construction of, and following implementation of the Proposed Project, whether attributed to construction usage or otherwise, would be identified by the project engineers onsite.

Although the potential impacts are not expressed numerically, DWR considers that the description included in EIR Impact 3.17-1 is adequate to inform a critical discussion of the potential adverse impacts, make an assessment of necessary mitigation, and consider alternatives.

Regarding the barge or trucking options, please refer to Section 4.7 *Transportation and Traffic* of the 2019 Partial Recirculated DEIR, which explains that the preferential option would be determined by the contractor. It could include use of both trucks and barges.

LAND-49: Nature and Magnitude of Traffic Impacts

Commenter states that DWR must fully describe the nature and magnitude of potentially significant adverse traffic impacts.

DWR Response

Please refer to the response to LAND-48 above.

LAND-50: Heavy Truck Traffic Fatalities and Injuries

Commenter states the 2016 DEIR and 2019 Partial Recirculated DEIR fail to consider or disclose multiple potentially significant transportation impacts, including potential fatalities and injuries associated with additional truck traffic.

DWR Response

Please refer to the response to LAND-48 above. Potential safety issues are covered by Mitigation Measure 3.17.1-1, which requires the contractor to prepare a traffic control plan, and the plan shall include advance notice of construction work and implementation of safety measures during construction. In addition, contractor will have to meet all safety measures required by CalTrans on state highways.

LAND-51: Degradation of Local Roads

Commenter states that the 2016 DEIR and 2019 Partial Recirculated DEIR ignore transportation impacts, including degradation of local roads, impacts to infrastructure, and additional usage of heavy equipment.

DWR Response

Please refer to the response to LAND-48 above. EIR Impact 3.17-1 and Mitigation Measure 3.17-1.2 in Section 5.6 *Revisions to Transportation and Traffic Analysis* of the 2019 Partial Recirculated DEIR explicitly consider the potential for degradation to local roads and levees. Following the potential for a larger number of truck trips than originally assessed in the 2016 DEIR, Mitigation Measure 3.17-1.2 was included in the 2019 Partial Recirculated DEIR, which provides for assessment of local road surfaces, and necessary repairs to bring the road up to pre-Proposed Project construction conditions.

Regarding bridge and road limitations, length and weight restrictions advised by CalTrans have been considered. There are no plans for the Ryer Island Ferry or J-Mack Ferry to be used by trucks. The section of SR-220 between postmiles 0 and 3.2 connects to SR-84 near the Prospect Island spur channel, and Caltrans advises that trucks with King Pin to Rear Axle Distances greater than 30 ft should also avoid this length of road. There are no plans for trucks to use SR-220 between postmiles 0 and 3.2 and there would be no impact.

LAND-52: Alternative 2 Wind-Wave Impacts

Commenter states that the 2019 Partial Recirculated DEIR fails to address erosion due to velocity of waters exiting the breach into Miner Slough, wind impacts to RD 501's adjacent tip levee, or high water/flood conditions for Alternative 2. Commenter proposes various actions to mitigate the potential impacts of Alternative 2.

DWR Response

The potential wind-wave impact of Alternative 2 is similar to that of the Proposed Project and is *less than significant*. Please refer to **General Response E**.

LAND-53: Disclosure and Analysis of Impacts

Commenter concludes that DWR has failed to use expert analysis and has diminished potential impacts and application of mitigation measures in the 2019

Partial Recirculated DEIR. Commenter states that DWR must revise the 2019 Partial Recirculated DEIR to fully disclose, analyze, and mitigate all impacts.

DWR Response

DWR and commenter disagree on the impact of the Proposed Project in a number of resource areas. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *beneficial*, *no impact,* or *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

Reclamation District 501 (RD501)

RD501-1: Comments on the 2016 DEIR

Commenter states that the 2019 Partial Recirculated DEIR has left many of their original concerns unaddressed.

DWR Response

For responses to comments on the 2016 DEIR, please refer to 2019 FEIR **Appendix D**. Please also refer to **General Response C** and General Response D of 2019 FEIR **Appendix D** for more on discussions with representatives of RD 501 and others.

DWR and commenter disagree on the impacts of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding erosion, scour, and seepage impacts that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. Please refer to **General Response E** regarding wind-wave erosion and scour and **General Response F** regarding seepage, which includes a discussion of the ENGEO Seepage Impact Analysis.

RD501-2: Groundwater Seepage Impacts on Ryer Island

Commenter states the 2014 DWR Site Characterization and Groundwater Monitoring Data Analysis Summary and 2018 DWR Prospect and Ryer Island Hydrologic Data analysis is deficient, and states that the EIR should have considered the ENGEO report submitted to DWR by the commenter.

DWR Response

Please refer to EIR Impacts 3.1-3 and 3.1-6, which summarize the DWR groundwater studies (DWR 2014, 2018a). Please also refer to **General**

Response F, which provides additional explanation, including reference a discussion of the ENGEO Seepage Impact Analysis (2015) to which the commenter refers. DWR reviewed the ENGEO report but determined that it did not provide any new or additional information that would change the EIR's conclusions. A technical review of the ENGEO report is attached at **Attachment 4**.

RD501-3: Scour and Erosion Impacts on Groundwater Seepage

Commenter expresses concern regarding scour- and erosion-related groundwater seepage impacts. Commenter states that the DWSC's connectivity with Miner Slough has not been considered.

DWR Response

See the responses to RD501-1 and RD 501-2. DWR and the commenter disagree on the potential increase in seepage on adjacent lands due to Miner Slough bed scour. It is DWR's opinion that the conclusions of the EIR regarding bed scour and seepage that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. As explained in EIR Impact 3.1-5 and Section 4.5.2 *[Alternatives, Alternative 2: Two Breaches and Weir, Environmental impacts] Hydrology*, the Proposed Project is modeled to marginally exceed velocity thresholds for scour (4 fps) in the center of the channel cross-section in specific locations (Appendix K in SWS and WWR 2012), and for Alternative 2 would be limited to <0.1 fps for both the 100 and 200 year flood events (RMA 2016a). Upstream of the planned breach locations, channel velocities and peak water surface elevations are modeled to decline with the Proposed Project and Alternative 2 (Appendix K in SWS and WWR 2012; RMA 2016a). This information is reiterated in EIR Impact 3.1-6, which explains that the areas RD 501 considers to be seepage-prone lie upstream of the planned breach locations. Modeling for the Proposed Project and Alternatives has not found any evidence that there would be channel bed scour in areas of hydrologic connection that would lead to seepage on adjacent land.

DWR considers that the velocity/scour and groundwater seepage modeling and analysis for the EIR presents the best available scientific approach. For further information on the lithologic model (subsurface soils) and other components of the seepage analysis, please refer to **Attachments 4** and **5**, as well as to the technical reports accessible via General Response C of 2019 FEIR **Appendix D**.

RD501-4: Wind-Wave Erosion Impacts

Commenter disagrees with the DWR's *less than significant* determination for wind-wave erosion impacts, and requests that DWR consider mitigation measures to address effects of wind-wave erosion on constraining access issues.

DWR Response

Please refer to the response to RD501-1. Terrestrial access along the Miner Slough levee would be retained to the first breach location, and the Proposed Project would not affect potential future waterside access along Miner Slough.

RD501-5: Continued and Routine Monitoring

Commenter requests continued and routine monitoring for groundwater seepage, scour, and wind-wave erosion.

DWR Response

As discussed in **General Response I**, text relating to measures for ongoing monitoring and levee repair regarding seepage and erosion impacts was removed from EIR Impacts 3.1-3 through 3.1-6. These measures were discussed in the EIR, but were not identified as CEQA mitigation measures. While DWR did not agree to all the measures that commenters requested as mitigation, DWR did carry out, or did agree to carry out, some of the actions requested as a good neighbor. Monitoring measures are also discussed in General Responses D and H in 2019 FEIR **Appendix D**. DWR and the commenter disagree on some of the potential impacts of the Proposed Project and Alternatives. It is DWR's opinion that the conclusions of the EIR regarding impacts relating to seepage and erosion that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

Solano County (SOLC)

SOLC-1: Removal of Monitoring Measures

Commenter expresses concern that additional analyses for the Proposed Project were used to reduce the obligation of the State relative to local agencies and landowners, rather than fine-tune the Proposed Project.

DWR Response

As discussed in **General Response I**, text relating to measures for ongoing monitoring and levee repair regarding seepage and erosion impacts was removed from EIR Impacts 3.1-3 through 3.1-6. These measures were discussed in the EIR, but were not identified as CEQA mitigation measures. While DWR did not agree to all the measures that commenters requested as mitigation, DWR did carry out, or did agree to carry out, some of the actions requested as a good neighbor. Monitoring measures are also discussed in General Responses D and H in 2019 FEIR **Appendix D**. DWR and the commenter disagree on some of the potential impacts of the Proposed Project and Alternatives. It is DWR's opinion that the conclusions of the EIR regarding impacts relating to seepage and erosion that are considered *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

SOLC-2: Language Relating to Monitoring and Repair of Levees

Commenter is concerned with removal of text relating to monitoring groundwater and surface water levels, and monitoring and repairing the Miner Slough levee, especially given dredging, hydraulic head, and other 'untested' Proposed Project elements.

DWR Response

Please refer to the response to SOLC-1 above. Please also refer to **General Response F** in relation to hydraulic head. Note that should DWR move forward with Alternative 2, no dredging would be required.

SOLC-3: Piecemealing and Salinity

Commenter expresses concern over the noted salinity increases and piecemealing of the salinity analyses for the EcoRestore Project. Commenter includes an attachment relating to water quality, which includes reference to the antidegradation policy request to model salinity for critically dry years and other salinity concerns.

DWR Response

Please refer to **General Responses G** and **H** regarding project–specific and cumulative salinity impacts and the modeling approach. These General Responses respond to comments regarding small potential increases in salinity above existing conditions and critically dry year impacts. Please refer to General

Response G in 2019 FEIR **Appendix D** in relation to cumulative effects and piecemealing, including cumulative impacts relating to potential impacts to Delta conveyance facilities and other restoration projects. Overall operations of the SWP and CVP are part of existing conditions and are not part of the Proposed Project. The EIR fully disclosed potential water quality impacts and did not identify any significant adverse impacts of the Proposed Project on water quality for legal users of water and fish and wildlife in the Sacramento-San Joaquin Delta. Therefore, no mitigation is required under CEQA.

The salinity modeling report (Appendix D in WWR and SWS 2014) is accessible via General Response C in 2019 FEIR **Appendix D**. The *Municipal and Industrial Compliance Stations* section of Appendix D in WWR and SWS 2014 (page 40) explains the method used to convert modeled EC (uS/cm) to chloride concentration (mg/L), including that the conversion equations were sourced from Contra Costa Water District personnel. The equation used depends on whether the relationship is influenced by seawater or not.

The Alternatives of consequence to the EIR are the Proposed Project (Alternative 26 of the Phase 2 modeling), Alternative 2 (Alternative 4), and Alternative 3 (Alternative 31); therefore, the table selected by the commenter out of the wider salinity report (Appendix D in WWR and SWS 2014) is relevant to the extent that it shows the maximum modeled salinity increase for the Proposed Project at a certain time (October of a dry year hydrology) and location (C4 – San Joaquin River at San Andreas). The potential maximum 7.8% increase of salinity for the Proposed Project at this location is discussed in the response to CCWD-7 in 2019 FEIR **Appendix D**. As stated in **General Response G**, this maximum modeled value at one time and in one location should not be used to extrapolate system-wide increases of salinity as a result of the Proposed Project. Modeling for the Proposed Project (Appendix D in WWR and SWS 2014) generally showed decreases in computed electrical conductivity (EC) in the western Delta, with only small increases for central and south Delta locations, and the majority of modeled salinity increases were less than 1%.

SOLC-4: Hydrodynamic Analysis

Commenter requests that the additional hydrodynamic analyses for 100 and 200 year flood scenarios included in the 2019 Partial Recirculated DEIR consider prolonged flood highwater event scenarios that will occur with climate change.

DWR Response

Although RMA (2016a) does not forward-cast for climate change effects, DWR has given due consideration to potential effects of climate change in EIR Section 3.19.3 *Summary of cumulative impacts – Climate change resiliency* and **General Response J**. Please also refer to the response to LAND-15 above in relation to the breach velocity dissipation feature.

SOLC-5: Haul Trucks and Local Road Damage

Commenter expresses concern with truck travel on rural roads and favors barge access. Commenter also requests mitigation for potential damage to local roads.

DWR Response

Please refer to Section 3.17.1 *[Transportation and Traffic] Setting* of the 2019 Partial Recirculated DEIR for information on the potential transportation routes, if trucks are used for materials transport. From Rio Vista, trucks would likely use River Road (Rd. 160) to Courtland Rd., which connects with SR-84, accessing Prospect Island from the north. The primary mode of transportation–barge or truck, would be determined by the construction contractor and could include a combination of truck and barge. Contrary to the commenter's statement that existing accessibility by water was not mentioned, transporting import materials by barge remains an option in the EIR. Please refer to the responses to LAND-48 and LAND-50 for further information on traffic impacts and mitigation.

SOLC-6: Monitoring and Active Management of Vegetation

Commenter encourages vegetation monitoring and management, including dense planting, and discourages passive revegetation. Commenter is concerned with non-native species and associated nuisance abatement, safety, and costs.

DWR Response

Please refer to General Responses E (wildlife), F (invasive plants and revegetation), and H (monitoring) in 2019 FEIR **Appendix D**. Please also refer to EIR Impacts 3.3-9 and 3.3-11 for discussions relating to nonnative aquatic species.

SOLC-7: Loss of Agricultural Lands

Commenter requests clarification on the 17.7 ac of agricultural land that will be altered and potential mitigation measures.

DWR Response

Please refer to Section 3.12.1 *[Agricultural Resources] Environmental Setting* and Impact 3.12-1 in Section 3.12.3 *[Agricultural Resources] Impacts and mitigation* of the EIR. No portion of Prospect Island is designated as Prime, Unique, or Important Agricultural Land, and the only land viable for agriculture is north of the northern cross-levee. During construction activities, up to 17.7 ac of land north of the northern cross-levee (comprising of 10.9 of adjacent Fahn land currently used for agriculture, and 6.8 ac of Prospect Island land that is not currently used for agriculture) would potentially be converted to a temporary staging area. Following construction activities, the 6.8 ac of viable agricultural land that is not currently used for agriculture would be planted with a riparian mix containing both canopy and understory trees and shrubs, creating complex, high value riparian area; the other 10.9 ac would remain in agriculture. For the reasons described in in Impact 3.12-1, the 6.8 ac loss of viable agricultural land is not considered significant and no mitigation is necessary.

SOLC-8: Cumulative Impact Analysis

Commenter requests a cumulative effects analysis for water quality, flood protection, agriculture, transportation, and “other items”. Commenter also requests an updated version of reasonably foreseeable projects in the region.

DWR Response

A cumulative effects analysis is included in Section 3.19 *Cumulative Impacts* in the EIR, but was not subject to recirculation (see **General Response A**). The commenter does not suggest any specific projects that it is concerned with in relation to expanding the cumulative effects analysis, but small adjustments have been made in the 2019 FEIR in relation to other more specific agency comments (see the response to SCWA-2 below). Cumulative effects have also been considered in General Response G of 2019 FEIR **Appendix D**. **General Response H** considers potential for cumulative salinity impacts.

SOLC-9: Collaboration

Commenter requests to work more closely and collaboratively on the Proposed Project. Commenter considers that collaboration and coexistence of ecosystem restoration and active agriculture would be difficult if mitigation measures from the 2016 DEIR are withdrawn.

DWR Response

Comment noted.

Solano County Water Agency (SCWA)

SCWA-1: Introduction to Agency Objectives and Responsibilities

Commenter introduces their Agency's objectives and responsibilities in reviewing the EIR.

DWR Response

Comment noted. Please refer to **General Response B**.

SCWA-2: Cumulative Effects and Hydrodynamics

Commenter considers that the potential cumulative water quality and endangered species impacts to the North Bay Aqueduct and agricultural water diversions at SCWA's nearby Peterson Ranch are understated by failing to evaluate the Proposed Project in the context of other restoration projects, most notably Lookout Slough Restoration Project and Little Egbert Tract. Commenter is concerned that the cumulative impact of restoration projects may impact the hydrodynamics and tidal energy within the CSC which could influence water quality conditions, biological productivity, and diversions of water at existing agricultural diversion facilities.

DWR Response

Multiple technical reports model and analyze potential changes of hydrodynamics associated with the Proposed Project (see General Response C in 2019 FEIR **Appendix D**). Water quality conditions are analyzed in EIR Section 3.2.3 *[Water Quality (Surface and Groundwater)] Impacts and mitigation,* and biological resources are analyzed in Sections 3.3.3 *[Aquatic Biological Resources] Impacts and mitigation*, and 3.4-3 *[Wetland and Terrestrial Biological Resources] Impacts and mitigation*. For information on potential cumulative impacts, please refer to EIR Section 3.19-3 *Summary of cumulative impacts – Water quality*, as well as to **General Response H** on cumulative salinity impacts. Note that consideration has been given to the Lookout Slough Restoration Project and Little Egbert Tract in the 2019 FEIR cumulative impacts analysis, and this has not changed the analysis that potential cumulative *Hydrology*, *Water quality*, and *Aquatic biological resources* impacts associated with the Proposed Project are not cumulatively considerable.

With regard to 'piecemealing' of the analyses for restoration projects, please refer to General Response G in 2019 FEIR **Appendix D**. Please also refer to the numerous hydrodynamic analyses prepared for the Proposed Project in 2019 FEIR **Appendix B**. The potential impact of Proposed Project conditions on invasive species is considered in General Response F of 2019 FEIR **Appendix D**.

For information on potential impacts on local agricultural diversions, please refer to General Responses E and F of 2019 FEIR **Appendix D**.

SCWA-3: Barker Slough Description

Commenter notes that Campbell Lake only captures a small portion of the total annual runoff from Barker Creek Watershed, and Campbell Lake typically has a significant impact on water quality conditions at Barker Slough Pumping Plant during the first flush.

DWR Response

The sentence has been expanded in the 2019 FEIR to clarify that Campbell Lake only captures a small portion of the total annual runoff from Barker Creek watershed.

SCWA-4: Barker Slough Pumping Plant and NBA Ownership and Operation

Commenter clarifies Barker Slough Pumping Plant and the NBA are part of the State Water Project and are owned and operated by the DWR. SCWA holds a contract for water deliveries, but does not own or operate the facilities.

DWR Response

This sentence has been updated in the 2019 FEIR to reflect DWR ownership and management.

SCWA-5: Clarification of NBA Ownership and Management

Commenter states that the NBA supplies water to cities of Fairfield, American Canyon, and Calistoga.

DWR Response

The 2019 FEIR has been updated with the details provided by the commenter.

Yocha Dehe Wintun Nation (YDWN)

YDWN-1: Concern Regarding Impacts and Request for Site Visit

Commenter expresses concern that the project could impact unknown cultural resources within the aboriginal territories of the Yocha Dehe Wintun Nation and requests a site visit to the project area to evaluate cultural concerns.

DWR Response

Cultural resources are discussed in Impact 3.13-3 and 3.1-4. No known prehistoric or historic resources have been identified on the site. Mitigation measures are provided for pre- and post-excavation in the event unknown archeological resources or human burials exist. DWR participated in a site visit with the Yocha Dehe Wintun Nation on June 3, 2019, and will continue to cooperate pursuant to DWR Tribal Policy. If unknown cultural resources are identified that are of importance to the Yocha Dehe Wintun Nation, DWR will follow the protocols set forth in the relevant mitigation measures and DWR Tribal Policy.

4 REFERENCES

Brown L.R., W.A. Bennett, R.W. Wagner, T. Morgan–King, N. Knowles, F. Feyrer, D. Schoellhamer, M. Stacey, and M. Dettinger. 2013. Implications for future survival of delta smelt from four climate change scenarios for the Sacramento–San Joaquin Delta, California. Estuaries Coasts 36:754–774. DOI: http://dx.doi.org/10.1007/s12237-013-9585-4.

Cal-IPC (California Invasive Plant Council). 2019. California Invasive Plant Council Inventory database. Website. http://cal-ipc.org/plants/inventory (accessed May 2019).

CNRA and OPC (California Natural Resources Agency and California Ocean Protection Council). 2018. State of California Sea-Level Rise Guidance, 2018 Update. Prepared by CNRA and the California Ocean Protection Council, CA.
CVRWQCB (Central Valley Regional Water Quality Control Board). 2011. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region. 4th Ed. Sacramento, CA.

CVRWQCB (Central Valley Regional Water Quality Control Board), CDFW (California Department of Fish and Wildlife), and Delta Protection Commission. 2002. Delta Dredging and Reuse Strategy. Volume I. Sacramento, CA.

Dettinger, M., J. Anderson, M. Anderson, L.R. Brown, D. Cayan, and E. Maurer. 2016. Climate Change and the Delta. San Francisco Estuary and Watershed Science, 14(3). DOI: https://doi.org/10.15447/sfews.2016v14iss3art5

Deverel, S.J. and D.A. Leighton. 2010. Historic, recent and future subsidence, Sacramento-San Joaquin Delta, California, USA. San Francisco Estuary and Watershed Science 8(2). DOI: https://doi.org/10.15447/sfews.2010v8iss2art1

DWR (Department of Water Resources). 2008. Delta Risk Management Strategy (DRMS) Phase 1: Levee Vulnerability. Technical Memorandum. Final. Prepared by URS Corporation / Jack R. Benjamin & Associates, Inc.

DWR. 2013. Site Characterization and Groundwater Monitoring Data Collection Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum Report. DWR, North Central Region Office.

DWR. 2014. Site Characterization and Groundwater Monitoring Data Analysis Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, CA. Memorandum Report. DWR, North Central Region Office.

DWR 2018a. Prospect and Ryer Island Hydrologic Data Analysis, October 1, 2013 to April 1, 2017, Prospect Island Tidal Habitat Restoration Project, Solano County, CA. Memorandum Report. DWR, North Central Region Office, CA.

DWR 2018b. Review of ENGEO's Seepage Impact Analysis, Reclamation District 501, Prospect and Ryer Islands, Solano County, California, July 14, 2015, ENGEO Incorporated. Memorandum.

DWR. 2019. Response to RD 501 Comments on the February 2018 DWR Hydrologic Data Analysis Report, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum.

DWR and USBR. 2016. Final Environmental Impact Report/Environmental Impact Statement for the Bay Delta Conservation Plan/California WaterFix. Final EIR/EIS for the BDCP/California WaterFix. December. (DOE/EIS-0515.) (ICF 00139.14.) Prepared by ICF International, Sacramento, CA. http://baydeltaconservationplan.com/FinalEIREIS.aspx.

ENGEO. 2015. Seepage Impact Analysis, Reclamation District 501, Prospect and Ryer Islands, Solano County, California. ENGEO Incorporated, Ripon, CA.

ENGEO. 2018. Comments on February 2018 DWR Hydrologic Analysis Report Prospect Island Tidal Habitat Restoration Project Solano County, California. ENGEO Incorporated, Ripon, CA.

Fischenich, C. 2001. Stability thresholds for stream restoration materials. ERDC Technical Note EMRRP-SR-29. U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Griggs, G, J. Árvai, D. Cayan, R. DeConto, J. Fox, H. A. Fricker, R.E. Kopp, C. Tebaldi, and E. A. Whiteman. 2017. Rising Seas in California: An Update on Sea-Level Rise Science. California Ocean Science Trust and California Ocean Protection Council Science Advisory Team Working Group.

Kinnetic Laboratories, Inc. 2016a. Sediment Testing Results for Prospect Island

Letter report to Joseph Heavin, Hultgren-Tillis Engineers, prepared by Kinnetic Laboratories, Inc., Santa Cruz, CA.

Kinnetic Laboratories, Inc. 2016b. Evaluation of Miner Slough Spur Channel Dredge Material, Prospect Island Tidal Habitat Restoration Project. Sampling and Analysis Report. Kinnetic Laboratories, Inc., Santa Cruz, CA.

Lee, P., D. Bosworth., J. Manning. 2015. Progress Report – Delta Mercury Control Program: Methylmercury Import and Export Studies of Tidal Wetlands in the Sacramento-San Joaquin Delta, Yolo Bypass, and Suisun Marsh. Department of Water Resources. Sacramento, CA.

MacWilliams M.L., and E.S. Gross. 2010. UnTRIM San Francisco Bay–Delta Model sea level rise scenario modeling report. Delta Conservation Plan. Prepared for Science Applications International Corporation and the California Department of Water Resources. 562 p.

Maendly R. (California Department of Water Resources). 2018. *Development of Stage-Frequency Curves in the Sacramento – San Joaquin Delta for Climate Change and Sea Level Rise*. California's Fourth Climate Change Assessment. Publication number: CCCA4-EXT-2018-011.

Mitchell, P. J., T.E. Jordan., A. Heyes., C.C. Gilmour. 2012. Tidal exchange of total mercury and methylmercury between a salt marsh and a Chesapeake Bay sub-estuary. Biogeochemistry. DOI: https://doi.org/10.1007/s10533-011-9691-y.

Moyle P.B., J.D. Kiernan, P.K. Crain, and R.M. Quinones. 2013. Climate change vulnerability of native and alien freshwater fishes of California: a systematic assessment approach. PLoS ONE 8(5) e63883. https://doi.org/10.1371/journal.pone.0063883.

Northern Delta Groundwater Sustainability Agency. 2019. Northern Delta Groundwater Sustainability Agency. Website. https://www.ndgsa.org/ (Accessed: July 2019).

RMA (Resource Management Associates, Inc.). 2016a. Hydrodynamic Modeling Analysis for 100-year and 200-year Flood Events, Prospect Island Tidal Habitat Restoration Project. Technical Memorandum. Resource Management Associates, Davis, CA.

RMA. 2016b. Cumulative Salinity Modeling Analysis in Support of the Proposed Tule Red Tidal Marsh Restoration, Grizzly Island, California. Draft Technical Memorandum. Resource Management Associates, Davis, CA.

RMA. 2018. Modeling Evaluation for Alternative 2 Flow and Salinity Changes, Prospect Island Tidal Restoration Project. Technical Memorandum. Resource Management Associates, Davis, CA.

Robinson, A., D. Slotton., S. Lowe., and J. Davis. 2014. North Bay Mercury Biosentinel Project. Contribution #738. San Francisco Estuary Institute and the Aquatic Science Center. Richmond, CA.

Robinson, A., A. Richey., D. Slotton., J. Collins., and J. Davis. 2018. North Bay Mercury Biosentinel Project 2016-2017. Contribution #868. San Francisco Estuary Institute and the Aquatic Science Center. Richmond, CA.

SGMA (Sustainable Groundwater Management Act). 2014. Water Code, Division 6. Conservation, Development, and Utilization of State Water Resources, Part 2.74 Sustainable Groundwater Management [10720 – 10737.8]. https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management.

SWRCB (State Water Resources Control Board). 2000. Revised Water Right Decision 1641. December 29, 1999. Revised March 15, 2000.

SWRCB. 2006. Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Sacramento, CA.

SWRCB. 2018. Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Sacramento, CA.

SWS and WWR (Stillwater Sciences and Wetlands & Water Resources). 2012. 2012. Prospect Island Tidal Restoration: Synthesis of Phase 1 Screening-Level Modeling Evaluation of Conceptual Restoration Alternatives. Final Report. Prepared by Stillwater Sciences, Davis, CA, and Wetlands & Water Resources, Inc., San Rafael, CA, with assistance from Resource Management Associates, Fairfield, CA, and cbec eco-engineering, West Sacramento, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

USFWS. 2008. Formal Endangered Species Act consultation on the proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP). Biological Opinion. Prepared by USFWS, California and Nevada Region, Sacramento, California for U.S. Bureau of Reclamation, Central Valley Operations Office, Sacramento, CA.

Wagner, W., M. Stacey., Brown, L., Dettinger, M. 2011. Statistical models of temperature in the Sacramento San Joaquin Delta under climate-change scenarios and ecological implications. Estuaries Coasts 34:544-556. DOI: http://dx.doi.org/10.1007/s12237-010-9369-z.

Wang, J., H. Yin., J. Anderson., E. Reyes., T. Smith., and F. Chung. 2018. Mean and Extreme Climate Change Impacts on the State Water Project. *A Report for*: California's Fourth Climate Change Assessment. Report No. CCCA4-EXT-2018-004. Prepared by California Department of Water Resources, Bay-Delta Office, for the California Energy Commission and California Natural Resources Agency.

WWR and SWS. 2014. Phase 2 Modeling Synthesis Report, Prospect Island Tidal Habitat Restoration Project. Final Report. Prepared by Wetlands and Water Resources, Inc., San Rafael, CA and Stillwater Sciences, Davis, CA, with assistance from Resource Management Associates, Fairfield, CA and Delta Modeling Associates, San Francisco, CA, for California Department of Water Resources, West Sacramento, CA. Contract No. 4200009291.

Attachment 1

Governor's Office of Planning and Research, State Clearinghouse and Planning Unit, 2019 Partial Recirculated DEIR Circulation

STATE OF CALIFORNIA

Governor's Office of Planning and Research

State Clearinghouse and Planning Unit

Gavin Newsom
Governor

Kate Gordon
Director

April 16, 2019

APR 19 2019

Dan Riordan
Water Resources, Department of
3500 Industrial Blvd
Sacramento, CA 95691

Subject: Prospect Island Tidal Habitat Restoration Project
SCH#: 2013052056

Dear Dan Riordan:

The State Clearinghouse submitted the above named EIR to selected state agencies for review. On the enclosed Document Details Report please note that the Clearinghouse has listed the state agencies that reviewed your document. The review period closed on 4/15/2019, and the comments from the responding agency (ies) is (are) available on the CEQA database for your retrieval and use. If this comment package is not in order, please notify the State Clearinghouse immediately. Please refer to the project's ten-digit State Clearinghouse number in future correspondence so that we may respond promptly.

Please note that Section 21104(c) of the California Public Resources Code states that:

> "A responsible or other public agency shall only make substantive comments regarding those activities involved in a project which are within an area of expertise of the agency or which are required to be carried out or approved by the agency. Those comments shall be supported by specific documentation."

Check the CEQA database for submitted comments for use in preparing your final environmental document: https://ceqanet.opr.ca.gov/2013052056/3 . Should you need more information or clarification of the comments, **we recommend that you contact the commenting agency directly.**

This letter acknowledges that you have complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act. Please contact the State Clearinghouse at (916) 445-0613 if you have any questions regarding the environmental review process.

Sincerely,

Scott Morgan
Director, State Clearinghouse

cc: Resources Agency

Clear
4/15/19

CALIFORNIA
Water Boards

GAVIN NEWSOM
GOVERNOR

JARED BLUMENFELD
SECRETARY FOR
ENVIRONMENTAL PROTECTION

Central Valley Regional Water Quality Control Board

E

Governor's Office of Planning & Research

APR 10 2019

STATE CLEARINGHOUSE

8 April 2019

Dan Riordan
Department of Water Resources
3500 Industrial Boulevard
West Sacramento, CA 95691

CERTIFIED MAIL
7018 1830 0001 0062 4210

COMMENTS TO REQUEST FOR REVIEW FOR THE DRAFT ENVIRONMENTAL IMPACT REPORT, PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT, SCH#2013052056, SOLANO COUNTY

Pursuant to the State Clearinghouse's 1 March 2019 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Request for Review for the Draft Environmental Impact Report* for the Prospect Island Tidal Habitat Restoration Project, located in Solano County.

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues.

I. Regulatory Setting

Basin Plan

The Central Valley Water Board is required to formulate and adopt Basin Plans for all areas within the Central Valley region under Section 13240 of the Porter-Cologne Water Quality Control Act. Each Basin Plan must contain water quality objectives to ensure the reasonable protection of beneficial uses, as well as a program of implementation for achieving water quality objectives with the Basin Plans. Federal regulations require each state to adopt water quality standards to protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. In California, the beneficial uses, water quality objectives, and the Antidegradation Policy are the State's water quality standards. Water quality standards are also contained in the National Toxics Rule, 40 CFR Section 131.36, and the California Toxics Rule, 40 CFR Section 131.38.

The Basin Plan is subject to modification as necessary, considering applicable laws, policies, technologies, water quality conditions and priorities. The original Basin Plans were adopted in 1975, and have been updated and revised periodically as required, using Basin Plan amendments. Once the Central Valley Water Board has adopted a Basin Plan amendment in noticed public hearings, it must be approved by the State Water Resources Control Board (State Water Board), Office of Administrative Law (OAL) and in some cases,

the United States Environmental Protection Agency (USEPA). Basin Plan amendments only become effective after they have been approved by the OAL and in some cases, the USEPA. Every three (3) years, a review of the Basin Plan is completed that assesses the appropriateness of existing standards and evaluates and prioritizes Basin Planning issues.

For more information on the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins*, please visit our website:
http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

Mercury

The Draft Environmental Impact Report indicates that potential impacts from methylmercury will be less than significant (Impact 3.2-8). The Delta, including the Prospect Island project area, is subject to the Delta Mercury Control Program (also referred to as the Delta methylmercury total maximum daily load). Some wetlands can be a source of methylmercury, thus posing a potential health risk for wildlife consuming aquatic organisms within the wetland. Several entities have been conducting studies to develop management practices to minimize the production and bioaccumulation of methylmercury. If viable and feasible management practices are identified, the project proponents will need to consider incorporating those practices during construction and future operations of wetlands on Prospect Island.

The Prospect Island project was included in Department of Water Resource's August 2018 Delta Regional Monitoring Program (RMP) Participation Plan, so at this time, no project specific methylmercury monitoring will be required in the 401 Water Quality Certification. Currently the Delta RMP is monitoring methylmercury in fish and water at multiple locations within the Delta and future RMP monitoring efforts may focus on mercury monitoring near habitation restoration projects.

Antidegradation Considerations

All wastewater discharges must comply with the Antidegradation Policy (State Water Board Resolution 68-16) and the Antidegradation Implementation Policy contained in the Basin Plan. The Antidegradation Implementation Policy is available on page 74 at:
https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf

In part it states:

Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.

This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives.

The antidegradation analysis is a mandatory element in the National Pollutant Discharge Elimination System and land discharge Waste Discharge Requirements (WDRs) permitting processes. The environmental review document should evaluate potential impacts to both surface and groundwater quality.

II. Permitting Requirements

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit), Construction General Permit Order No. 2009-009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP).

For more information on the Construction General Permit, visit the State Water Resources Control Board website at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

Phase I and II Municipal Separate Storm Sewer System (MS4) Permits[1]

The Phase I and II MS4 permits require the Permittees reduce pollutants and runoff flows from new development and redevelopment using Best Management Practices (BMPs) to the maximum extent practicable (MEP). MS4 Permittees have their own development standards, also known as Low Impact Development (LID)/post-construction standards that include a hydromodification component. The MS4 permits also require specific design concepts for LID/post-construction BMPs in the early stages of a project during the entitlement and CEQA process and the development plan review process.

For more information on which Phase I MS4 Permit this project applies to, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/municipal_permits/

For more information on the Phase II MS4 permit and who it applies to, visit the State Water Resources Control Board at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/phase_ii_municipal.shtml

[1] Municipal Permits = The Phase I Municipal Separate Storm Water System (MS4) Permit covers medium sized Municipalities (serving between 100,000 and 250,000 people) and large sized municipalities (serving over 250,000 people). The Phase II MS4 provides coverage for small municipalities, including non-traditional Small MS4s, which include military bases, public campuses, prisons and hospitals.

Industrial Storm Water General Permit

Storm water discharges associated with industrial sites must comply with the regulations contained in the Industrial Storm Water General Permit Order No. 2014-0057-DWQ.

For more information on the Industrial Storm Water General Permit, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/industrial_general_permits/index.shtml

Clean Water Act Section 404 Permit

If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed from the United States Army Corps of Engineers (USACE). If a Section 404 permit is required by the USACE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements.

If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACE at (916) 557-5250.

Clean Water Act Section 401 Permit – Water Quality Certification

If an USACE permit (e.g., Non-Reporting Nationwide Permit, Nationwide Permit, Letter of Permission, Individual Permit, Regional General Permit, Programmatic General Permit), or any other federal permit (e.g., Section 10 of the Rivers and Harbors Act or Section 9 from the United States Coast Guard), is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications.

For more information on the Water Quality Certification, visit the Central Valley Water Board website at:
https://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_certification/

Waste Discharge Requirements – Discharges to Waters of the State

If USACE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project may require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation.

For more information on the Waste Discharges to Surface Water NPDES Program and WDR processes, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/water_issues/waste_to_surface_water/

Dewatering Permit

If the proposed project includes construction or groundwater dewatering to be discharged to land, the proponent may apply for coverage under State Water Board General Water Quality Order (Low Risk General Order) 2003-0003 or the Central Valley Water Board's Waiver of Report of Waste Discharge and Waste Discharge Requirements (Low Risk Waiver) R5-2013-0145. Small temporary construction dewatering projects are projects that discharge groundwater to land from excavation activities or dewatering of underground utility vaults. Dischargers seeking coverage under the General Order or Waiver must file a Notice of Intent with the Central Valley Water Board prior to beginning discharge.

For more information regarding the Low Risk General Order and the application process, visit the Central Valley Water Board website at: http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2003/wqo/wqo2003-0003.pdf

For more information regarding the Low Risk Waiver and the application process, visit the Central Valley Water Board website at: http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/waivers/r5-2013-0145_res.pdf

Regulatory Compliance for Commercially Irrigated Agriculture

If the property will be used for commercial irrigated agricultural, the discharger will be required to obtain regulatory coverage under the Irrigated Lands Regulatory Program. There are two options to comply:

1. **Obtain Coverage Under a Coalition Group.** Join the local Coalition Group that supports land owners with the implementation of the Irrigated Lands Regulatory Program. The Coalition Group conducts water quality monitoring and reporting to the Central Valley Water Board on behalf of its growers. The Coalition Groups charge an annual membership fee, which varies by Coalition Group. To find the Coalition Group in your area, visit the Central Valley Water Board's website at: https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/regulatory_information/for_growers/coalition_groups/ or contact water board staff at (916) 464-4611 or via email at IrrLands@waterboards.ca.gov.

2. **Obtain Coverage Under the General Waste Discharge Requirements for Individual Growers, General Order R5-2013-0100**. Dischargers not participating in a third-party group (Coalition) are regulated individually. Depending on the specific site conditions, growers may be required to monitor runoff from their property, install monitoring wells, and submit a notice of intent, farm plan, and other action plans regarding their actions to comply with their General Order. Yearly costs would include State administrative fees (for example, annual fees for farm

sizes from 11-100 acres are currently $1,277 + $8.53/Acre); the cost to prepare annual monitoring reports; and water quality monitoring costs. To enroll as an Individual Discharger under the Irrigated Lands Regulatory Program, call the Central Valley Water Board phone line at (916) 464-4611 or e-mail board staff at IrrLands@waterboards.ca.gov.

Limited Threat General NPDES Permit

If the proposed project includes construction dewatering and it is necessary to discharge the groundwater to waters of the United States, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. Dewatering discharges are typically considered a low or limited threat to water quality and may be covered under the General Order for *Limited Threat Discharges to Surface Water* (Limited Threat General Order). A complete Notice of Intent must be submitted to the Central Valley Water Board to obtain coverage under the Limited Threat General Order.

For more information regarding the Limited Threat General Order and the application process, visit the Central Valley Water Board website at:
https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2016-0076-01.pdf

NPDES Permit

If the proposed project discharges waste that could affect the quality of surface waters of the State, other than into a community sewer system, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. A complete Report of Waste Discharge must be submitted with the Central Valley Water Board to obtain a NPDES Permit.

For more information regarding the NPDES Permit and the application process, visit the Central Valley Water Board website at:
https://www.waterboards.ca.gov/centralvalley/help/permit/

If you have questions regarding these comments, please contact me at (916) 464-4812 or Jordan.Hensley@waterboards.ca.gov.

Jordan Hensley
Environmental Scientist

cc: State Clearinghouse unit, Governor's Office of Planning and Research, Sacramento

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY GAVIN NEWSOM, GOVERNOR

CENTRAL VALLEY FLOOD PROTECTION BOARD
3310 El Camino Ave., Ste. 170
SACRAMENTO, CA 95821
(916) 574-0609 FAX: (916) 574-0682

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March 11, 2019

Governor's Office of Planning & Research
MAR 15 2019
STATE CLEARINGHOUSE

Mr. Dan Riordan
Department of Water Resources
3500 Industrial Blvd
West Sacramento, California 95691

Subject: Prospect Island Tidal Habitat Restoration Project,
Draft Environmental Impact Report, SCH Number: 2013052056

Location: Sacramento County

Dear Mr. Riordan,

Central Valley Flood Protection Board (Board) staff has reviewed the subject document and provides the following comments:

The proposed project is adjacent to Miner Slough, Cache Slough and the Sacramento Deep Water Ship Channel, regulated streams under Board jurisdiction, and may require a Board permit prior to construction.

The Board's jurisdiction covers the entire Central Valley including all tributaries and distributaries of the Sacramento and San Joaquin Rivers, and the Tulare and Buena Vista basins south of the San Joaquin River.

Under authorities granted by California Water Code and Public Resources Code statutes, the Board enforces its Title 23, California Code of Regulations (Title 23) for the construction, maintenance, and protection of adopted plans of flood control, including the federal-State facilities of the State Plan of Flood Control, regulated streams, and designated floodways.

Pursuant to Title 23, Section 6 a Board permit is required prior to working within the Board's jurisdiction for the placement, construction, reconstruction, removal, or abandonment of any landscaping, culvert, bridge, conduit, fence, projection, fill, embankment, building, structure, obstruction, encroachment, excavation, the planting, or removal of vegetation, and any repair or maintenance that involves cutting into the levee.

Permits may also be required to bring existing works that predate permitting into compliance with Title 23, or where it is necessary to establish the conditions normally imposed by permitting. The circumstances include those where responsibility for the works has not been clearly established or ownership and use have been revised.

Other federal (including U.S. Army Corps of Engineers Section 10 and 404 regulatory permits), State and local agency permits may be required and are the applicant's responsibility to obtain.

Board permit applications and Title 23 regulations are available on our website at http://www.cvfpb.ca.gov/. Maps of the Board's jurisdiction are also available from the California Department of Water Resources website at http://gis.bam.water.ca.gov/bam/.

Please contact James Herota at (916) 574-0651, or via email at James.Herota@CVFlood.ca.gov if you have any questions.

Sincerely,

for Andrea Buckley
Environmental Services and Land Management Branch Chief

cc: Office of Planning and Research
P.O. Box 3044, Room 113
Sacramento, CA 95812-3044

DEPARTMENT OF TRANSPORTATION
DISTRICT 4
OFFICE OF TRANSIT AND COMMUNITY PLANNING
P.O. BOX 23660, MS-10D
OAKLAND, CA 94623-0660
PHONE (510) 286-5528
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TTY 711
www.dot.ca.gov

Governor's Office of Planning & Research
MAR 19 2019
STATE CLEARINGHOUSE
clear 4/15/19

Making Conservation a California Way of Life

March 19, 2019

SCH # 2013052056
GTS # 04-SOL-2018-00132
GTS I.D. 9858
Solano / 84 / 10.732

Dan Riordan
California Department of Water Resources
3500 Industrial Boulevard
West Sacramento, CA 95691

Prospect Island Tidal Habitat Restoration – Recirculated Draft Environmental Impact Report (DEIR)

Dear Dan Riordan:

Thank you for including the California Department of Transportation (Caltrans) in the environmental review process for the above referenced project. In tandem with the Metropolitan Transportation Commission's (MTC) Sustainable Communities Strategy (SCS), Caltrans' mission signals a modernization of our approach to evaluate and mitigate impacts to the State Transportation Network (STN). Caltrans' Strategic Management Plan 2015-2020 aims to reduce Vehicle Miles Traveled (VMT) by tripling bicycle and doubling both pedestrian and transit travel by 2020. Our comments are based on the review of the Recirculated DEIR.

Project Understanding

The proposed project is to restore approximately 1,600 acres of tidal habitat, with the overarching goal to restore tidal action to the interior of Prospect Island. The work would consist of constructing new internal channel networks, intertidal benches, and a weir at the north end of Prospect Island. The proposed project would also include site grading, repairing existing breached embankment segments, creating new breaches within existing embankments, planting approximately 75 acres of wetland, riparian, and upland vegetation, and removing approximately 250 acres of trees and invasive plants. Under the proposed project, the non-federal Miner Slough levee would be breached in two locations: one in the north property approximately 0.5 miles south of Arrowhead Harbor Marina and one in the south property at the location of the formerly repaired breach connecting to the Miner Slough spur channel. A portion of the internal cross levee separating the north and the south properties would also be removed. These levee breaches would result in the north and south properties being subject to daily tidal inundation. The project site is bound on the west by the Prospect Slough and on the east by State Route (SR) 84.

Hydraulics
SR 84 is built on Federal Emergency Management Agency (FEMA) accredited levees along the eastern embankment of Miner Slough. The project should provide a hydraulic analysis to assure existing hydraulic grade lines of Miner Slough under 25-, 50-, and 100-year (Base Flood) event floods will not change with the proposed alternatives 2 and 3. Alternatives 2 and 3 should also address the potential scours at levee breach locations in Miner Slough under 100-year event flood.

Encroachment Permit
Please be advised that any work or traffic control that encroaches onto the state right-of-way requires an encroachment permit that is issued by the Department. To apply, a completed encroachment permit application, environmental documentation, and five (5) sets of plans clearly indicating state right-of-way must be submitted to: Office of Permits, California DOT, District 4, P.O. Box 23660, Oakland, CA 94623-0660. Traffic-related mitigation measures should be incorporated into the construction plans during the encroachment permit process. See the website link below for more information: http://www.dot.ca.gov/hq/traffops/developserv/permits/.

Lead Agency
As the Lead Agency, the Department of Water Resources is responsible for all project mitigation, including any needed improvements to the STN. The project's fair share contribution, financing, scheduling, implementation responsibilities and Lead Agency monitoring should be fully discussed for all proposed mitigation measures.

Thank you again for including Caltrans in the environmental review process. Should you have any questions regarding this letter, please contact Danny Fung at danny.fung@dot.ca.gov.

Sincerely,

PATRICIA MAURICE
District Branch Chief
Local Development - Intergovernmental Review

Attachment 2

2019 Partial Recirculated DEIR Comment Letters

California Department of Transportation

(CalTrans)

CalTrans

DEPARTMENT OF TRANSPORTATION
DISTRICT 4
OFFICE OF TRANSIT AND COMMUNITY PLANNING
P.O. BOX 23660, MS-10D
OAKLAND, CA 94623-0660
PHONE (510) 286-5528
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www.dot.ca.gov

Making Conservation a California Way of Life

March 19, 2019

SCH # 2013052056
GTS # 04-SOL-2018-00132
GTS I.D. 9858
Solano / 84 / 10.732

Dan Riordan
California Department of Water Resources
3500 Industrial Boulevard
West Sacramento, CA 95691

Prospect Island Tidal Habitat Restoration – Recirculated Draft Environmental Impact Report (DEIR)

Dear Dan Riordan:

Thank you for including the California Department of Transportation (Caltrans) in the environmental review process for the above referenced project. In tandem with the Metropolitan Transportation Commission's (MTC) Sustainable Communities Strategy (SCS), Caltrans' mission signals a modernization of our approach to evaluate and mitigate impacts to the State Transportation Network (STN). Caltrans' Strategic Management Plan 2015-2020 aims to reduce Vehicle Miles Traveled (VMT) by tripling bicycle and doubling both pedestrian and transit travel by 2020. Our comments are based on the review of the Recirculated DEIR.

CalTrans-1

Project Understanding

The proposed project is to restore approximately 1,600 acres of tidal habitat, with the overarching goal to restore tidal action to the interior of Prospect Island. The work would consist of constructing new internal channel networks, intertidal benches, and a weir at the north end of Prospect Island. The proposed project would also include site grading, repairing existing breached embankment segments, creating new breaches within existing embankments, planting approximately 75 acres of wetland, riparian, and upland vegetation, and removing approximately 250 acres of trees and invasive plants. Under the proposed project, the non-federal Miner Slough levee would be breached in two locations: one in the north property approximately 0.5 miles south of Arrowhead Harbor Marina and one in the south property at the location of the formerly repaired breach connecting to the Miner Slough spur channel. A portion of the internal cross levee separating the north and the south properties would also be removed. These levee breaches would result in the north and south properties being subject to daily tidal inundation. The project site is bound on the west by the Prospect Slough and on the east by State Route (SR) 84.

CalTrans-2

Hydraulics
SR 84 is built on Federal Emergency Management Agency (FEMA) accredited levees along the eastern embankment of Miner Slough. The project should provide a hydraulic analysis to assure existing hydraulic grade lines of Miner Slough under 25-, 50-, and 100-year (Base Flood) event floods will not change with the proposed alternatives 2 and 3. Alternatives 2 and 3 should also address the potential scours at levee breach locations in Miner Slough under 100-year event flood. CalTrans-3

Encroachment Permit
Please be advised that any work or traffic control that encroaches onto the state right-of-way requires an encroachment permit that is issued by the Department. To apply, a completed encroachment permit application, environmental documentation, and five (5) sets of plans clearly indicating state right-of-way must be submitted to: Office of Permits, California DOT, District 4, P.O. Box 23660, Oakland, CA 94623-0660. Traffic-related mitigation measures should be incorporated into the construction plans during the encroachment permit process. See the website link below for more information: http://www.dot.ca.gov/hq/traffops/developserv/permits/. CalTrans-4

Lead Agency
As the Lead Agency, the Department of Water Resources is responsible for all project mitigation, including any needed improvements to the STN. The project's fair share contribution, financing, scheduling, implementation responsibilities and Lead Agency monitoring should be fully discussed for all proposed mitigation measures. CalTrans-5

Thank you again for including Caltrans in the environmental review process. Should you have any questions regarding this letter, please contact Danny Fung at danny.fung@dot.ca.gov.

Sincerely,

PATRICIA MAURICE
District Branch Chief
Local Development - Intergovernmental Review

Central Delta Water Agency

(CDWA)

CDWA

CENTRAL DELTA WATER AGENCY

235 East Weber Avenue • P.O. Box 1461 • Stockton, CA 95201
Phone (209) 465-5883 • Fax (209) 465-3956

DIRECTORS
George Biagi, Jr.
Rudy Mussi
Edward Zuckerman

COUNSEL
Dante John Nomellini
Dante John Nomellini, Jr.

April 15, 2019

Via Email to Dan.Riordan@water.ca.gov
and U.S. First Class Mail to:

Attn: Dan Riordan
Department of Water Resources
Fish Restoration Program
3500 Industrial Blvd, 2nd Floor
West Sacramento, CA 95691

Re: CDWA Comments on the Partial Recirculation of the Draft EIR for the Prospect Island Tidal Habitat Restoration Project.

Dear Mr. Riordan:

The CDWA raised numerous concerns over this Project in its comments on the Draft EIR dated October 7, 2016. The CDWA hereby supplements those comments with the following comments on the partially recirculated portions of the Draft EIR. CDWA-1

1. **Improper Piecemealing.**

The partially recirculated portions of the Draft EIR continue to improperly piecemeal this Project under CEQA. While the significance of the impacts of this Project are effectively assessed in isolation from the larger 30,000+ acre EcoRestore project of which it is a part, even more troubling is the fact that such impacts are assessed in isolation from the "Tidal & Sub-tidal Habitat Restoration" component of EcoRestore, which according to DWR's website is 9,000 acres. (See http://resources.ca.gov/ecorestore/ .)

Because the Project constitutes approximately 1,600 of those 9,000 acres (~18%), and 1,600 of the larger 30,000 acre project (~5%), CEQA prohibits DWR from assessing the significance of the Project's impacts on the entire gamut of environmental resources in isolation of the impacts from the broader tidal and sub-tidal component of EcoRestore, as well as the broader EcoRestore project itself. (See e.g., Tuolumne County Citizens for Responsible Growth, Inc. v. City of Sonora (2007) 155 Cal.App.4th 1214, 1223 ["the requirements of CEQA cannot be avoided by chopping up proposed projects into bite-size pieces which, when taken individually, may have no significant adverse effect on the environment"].) CDWA-2 (Cont. below)

The Draft EIR's conclusion, for example, that the modeling "shows a potential maximum salinity increase up to 7.8% during a dry-year hydrology" in the central Delta (at measuring station C-4 on the San Joaquin River) is the result of the conversion of a mere 1,600 acres out of the total 9,000 acres of land that is planned to be converted into tidal/sub-tidal land under EcoRestore. (Draft EIR, p. 5-129.) If every 1,600 acres, for example, had the potential to result in a 7.8% increase in salinity, then the entire 9,000 acre project would have the potential to cumulatively result in an undisputedly significant 44% increase in salinity.

One of the fundamental purposes of CEQA is to force lead agencies to properly take such cumulative effects into consideration. Thus far, DWR has failed to do so with respect to impacts on salinity, as well as impacts on all other environmental resources.

CDWA-2 (Cont.)

Furthermore, with regard to the Project's cumulative effects on salinity, the Draft EIR fails to explain why it would not be feasible to perform various modeling and other analysis of the potential effects that this Project, in conjunction with the other 7,400 acres of tidal and/or sub-tidal land, would have on salinity within the Delta. Various reasonable assumptions could be made in such modeling and analysis to make that modeling and analysis meaningful and to avoid analyzing this Project in isolation of the impacts from those additional 7,400 acres. Morever, CEQA analysis has already been performed on a large number of those other tidal/sub-tidal projects; hence, such analysis could be easily and feasibly incorporated into a meaningful cumulative analysis of the entire 9,000 acre tidal/sub-tidal component of EcoRestore. (Draft EIR, pp. 3-355 & 3-356.)

2. **Mishandling of Salinity Impacts.**

Without supporting modeling or other detailed analysis, the Draft EIR makes the conclusory observation that "[a]t lower outflows, the combined effect of the Proposed Project in combination with other planned tidal habitat restoration projects on salinity in the Delta would [indeed] be potentially significant." (Draft EIR, p. 3-362.) Such a conclusory observation is inadequate under CEQA. Findings of significance (or non-significance) must be supported with facts and analysis. (See e.g., Ass'n of Irritated Residents v. City of Madera (2003) 107 Cal.App.4th 1383, 1390 ["The EIR must contain facts and analysis, not just the bare conclusions of the agency"].) For example, how significant will impacts on salinity be? What time of year, and under what type of hydrological conditions, will such impacts likely occur? What environmental resources will be impacted from such impacts? Etc.

CDWA-3 (Cont. below)

The Draft EIR further states: "However, D-1641 compliance would still be required in lower outflow years, minimizing the potential significance of this impact." (Draft EIR, p. 3-362.) As the CDWA explained in its prior October 7, 2016 comments, the Draft EIR's reliance on the Projects' compliance with D-1641 is misplaced. Water will have to come from some source and, hence, be taken away from some other use, to offset the salinity degradation from this Project (and from the larger 9,000 acre project) in order to maintain compliance with D-1641. DWR's obligation under CEQA is to thoroughly analyze the potential environmental impacts from actions, such as these, taken to offset that degradation. Thus far, DWR has made no attempt to do so.

A further complication to the Draft EIR's reliance on the Projects' compliance with D-1641 to reduce the individual (or cumulative) impacts from the Project is the fact that whenever the Projects release storage water to maintain the D-1641 standards, the State Water Board curtails all post-1914 appropriative water right holders within the Delta watershed that have "Term 91" in their water permits or licenses. Thus, to the extent this Project, individually or cumulatively, triggers the need for the Projects to release storage water to maintain one or more of D-1641's salinity or other standards, a vast number of diverters within the Delta watershed, including the Delta itself, must cease diverting under their post-1914 appropriative water rights. Such cessation of diversions has the potential to cause substantial and widespread effects on numerous environmental resources including terrestrial species, air quality, groundwater recharge, etc. (Information on Term 91 is readily available on the State Water Board's website at: https://www.waterboards.ca.gov/water_issues/programs/delta_watermaster/term91.html)

Accordingly, to the extent the Draft EIR relies on the Projects' compliance with the various D-1641 standards to mitigate the impacts from the individual or cumulative impacts of the Project, the Draft EIR must analyze the extent, and under what hydrological and other conditions, those impacts will trigger the need for the Projects to the release storage water to bring those standards into compliance and analyze the entire host of environmental resources impacted by such releases, including the impacts on those resources from the widespread curtailment of post-1914 appropriative rights which contain Term 91.

CDWA-3
(Cont.)

If on the other hand DWR determines that it is not reasonably feasible that the Project, individually or cumulatively, will ever trigger the need for the Projects to release storage water to offset impacts on any D-1641 standard under any reasonably foreseeable drought or other hydrological condition, then DWR must provide sufficient facts and analysis to support such a determination. As it stands, and as noted above, the Draft EIR seeming concedes that the Project, may, at least cumulatively, trigger the need for such releases, and there are no facts or analysis in the Draft EIR that CDWA is aware of to suggest otherwise.

Lastly, the recirculated portions of the Draft EIR continue to limit the salinity analysis to the results of modeling performed under the hydrological conditions in years 2009 and 2010. With so much hydrological data conveniently available for other years, the Draft EIR provides no explanation why the analysis was limited to just those two years. Moreover, what is most important is an analysis of how this Project, along with the larger 9,000 acre project (not to mention the even larger 30,000 acre EcoRestore project), will impact salinity (and all other environmental resources) during foreseeable droughts like the state has experienced numerous times in the past, including the very recent past. It is during times when hydrological conditions are the driest that projects, such as the instant Project, will likely have the most adverse impacts on salinity and when mitigation of those impacts is most critical.

The Draft EIR, for unexplained reasons, improperly avoids analyzing the Project's individual and cumulative impacts on salinity (and all other environmental resources) under such reasonably foreseeable conditions.

///

3. **Conclusion.**

As it stands the Draft EIR remains in noncompliance with CEQA. The above and another deficiencies must first be duly corrected and addressed prior to approval of this Project. CDWA-4

Respectfully submitted,

Dante J. Nomellini, Jr.
Attorney for the CDWA

Central Valley Flood Protection Board

(CVFPB)

CVFPB

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY
GAVIN NEWSOM, GOVERNOR

CENTRAL VALLEY FLOOD PROTECTION BOARD
3310 El Camino Ave., Ste. 170
SACRAMENTO, CA 95821
(916) 574-0609 FAX: (916) 574-0682

March 11, 2019

Mr. Dan Riordan
Department of Water Resources
3500 Industrial Blvd
West Sacramento, California 95691

Subject: Prospect Island Tidal Habitat Restoration Project,
Draft Environmental Impact Report, SCH Number: 2013052056

Location: Sacramento County

Dear Mr. Riordan,

Central Valley Flood Protection Board (Board) staff has reviewed the subject document and provides the following comments:

The proposed project is adjacent to Miner Slough, Cache Slough and the Sacramento Deep Water Ship Channel, regulated streams under Board jurisdiction, and may require a Board permit prior to construction.

The Board's jurisdiction covers the entire Central Valley including all tributaries and distributaries of the Sacramento and San Joaquin Rivers, and the Tulare and Buena Vista basins south of the San Joaquin River.

Under authorities granted by California Water Code and Public Resources Code statutes, the Board enforces its Title 23, California Code of Regulations (Title 23) for the construction, maintenance, and protection of adopted plans of flood control, including the federal-State facilities of the State Plan of Flood Control, regulated streams, and designated floodways. CVFPB-1 (Cont. below)

Pursuant to Title 23, Section 6 a Board permit is required prior to working within the Board's jurisdiction for the placement, construction, reconstruction, removal, or abandonment of any landscaping, culvert, bridge, conduit, fence, projection, fill, embankment, building, structure, obstruction, encroachment, excavation, the planting, or removal of vegetation, and any repair or maintenance that involves cutting into the levee.

Permits may also be required to bring existing works that predate permitting into compliance with Title 23, or where it is necessary to establish the conditions normally imposed by permitting. The circumstances include those where responsibility for the works has not been clearly established or ownership and use have been revised.

Other federal (including U.S. Army Corps of Engineers Section 10 and 404 regulatory permits), State and local agency permits may be required and are the applicant's responsibility to obtain.

Board permit applications and Title 23 regulations are available on our website at http://www.cvfpb.ca.gov/. Maps of the Board's jurisdiction are also available from the California Department of Water Resources website at http://gis.bam.water.ca.gov/bam/.

CVFPB-1
(cont.)

Please contact James Herota at (916) 574-0651, or via email at James.Herota@CVFlood.ca.gov if you have any questions.

Sincerely,

for Andrea Buckley
Environmental Services and Land Management Branch Chief

cc: Office of Planning and Research
P.O. Box 3044, Room 113
Sacramento, CA 95812-3044

Central Valley Regional Water Quality Control Board

(CVRWQCB)

CVRWQCB

CALIFORNIA Water Boards

GAVIN NEWSOM GOVERNOR

JARED BLUMENFELD SECRETARY FOR ENVIRONMENTAL PROTECTION

Central Valley Regional Water Quality Control Board

8 April 2019

Dan Riordan
Department of Water Resources
3500 Industrial Boulevard
West Sacramento, CA 95691

CERTIFIED MAIL
7018 1830 0001 0062 4210

COMMENTS TO REQUEST FOR REVIEW FOR THE DRAFT ENVIRONMENTAL IMPACT REPORT, PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT, SCH#2013052056, SOLANO COUNTY

Pursuant to the State Clearinghouse's 1 March 2019 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Request for Review for the Draft Environmental Impact Report* for the Prospect Island Tidal Habitat Restoration Project, located in Solano County.

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues.

CVRWQCB-1

I. Regulatory Setting

Basin Plan

The Central Valley Water Board is required to formulate and adopt Basin Plans for all areas within the Central Valley region under Section 13240 of the Porter-Cologne Water Quality Control Act. Each Basin Plan must contain water quality objectives to ensure the reasonable protection of beneficial uses, as well as a program of implementation for achieving water quality objectives with the Basin Plans. Federal regulations require each state to adopt water quality standards to protect the public health or welfare, enhance the quality of water and serve the purposes of the Clean Water Act. In California, the beneficial uses, water quality objectives, and the Antidegradation Policy are the State's water quality standards. Water quality standards are also contained in the National Toxics Rule, 40 CFR Section 131.36, and the California Toxics Rule, 40 CFR Section 131.38.

CVRWQCB-2
(Cont. below)

The Basin Plan is subject to modification as necessary, considering applicable laws, policies, technologies, water quality conditions and priorities. The original Basin Plans were adopted in 1975, and have been updated and revised periodically as required, using Basin Plan amendments. Once the Central Valley Water Board has adopted a Basin Plan amendment in noticed public hearings, it must be approved by the State Water Resources Control Board (State Water Board), Office of Administrative Law (OAL) and in some cases,

the United States Environmental Protection Agency (USEPA). Basin Plan amendments only become effective after they have been approved by the OAL and in some cases, the USEPA. Every three (3) years, a review of the Basin Plan is completed that assesses the appropriateness of existing standards and evaluates and prioritizes Basin Planning issues. CVRWQCB-2 (cont.)

For more information on the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins*, please visit our website:
http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

Mercury

The Draft Environmental Impact Report indicates that potential impacts from methylmercury will be less than significant (Impact 3.2-8). The Delta, including the Prospect Island project area, is subject to the Delta Mercury Control Program (also referred to as the Delta methylmercury total maximum daily load). Some wetlands can be a source of methylmercury, thus posing a potential health risk for wildlife consuming aquatic organisms within the wetland. Several entities have been conducting studies to develop management practices to minimize the production and bioaccumulation of methylmercury. If viable and feasible management practices are identified, the project proponents will need to consider incorporating those practices during construction and future operations of wetlands on Prospect Island. CVRWQCB-3

The Prospect Island project was included in Department of Water Resource's August 2018 Delta Regional Monitoring Program (RMP) Participation Plan, so at this time, no project specific methylmercury monitoring will be required in the 401 Water Quality Certification. Currently the Delta RMP is monitoring methylmercury in fish and water at multiple locations within the Delta and future RMP monitoring efforts may focus on mercury monitoring near habitation restoration projects.

Antidegradation Considerations

All wastewater discharges must comply with the Antidegradation Policy (State Water Board Resolution 68-16) and the Antidegradation Implementation Policy contained in the Basin Plan. The Antidegradation Implementation Policy is available on page 74 at:
https://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr_201805.pdf

In part it states:

> *Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.* CVRWQCB-4 (Cont. below)
>
> *This information must be presented as an analysis of the impacts and potential impacts of the discharge on water quality, as measured by background concentrations and applicable water quality objectives.*

The antidegradation analysis is a mandatory element in the National Pollutant Discharge Elimination System and land discharge Waste Discharge Requirements (WDRs) permitting processes. The environmental review document should evaluate potential impacts to both surface and groundwater quality. CVRWQCB-4 (cont.)

II. Permitting Requirements

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit), Construction General Permit Order No. 2009-009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). CVRWQCB-5

For more information on the Construction General Permit, visit the State Water Resources Control Board website at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

Phase I and II Municipal Separate Storm Sewer System (MS4) Permits[1]

The Phase I and II MS4 permits require the Permittees reduce pollutants and runoff flows from new development and redevelopment using Best Management Practices (BMPs) to the maximum extent practicable (MEP). MS4 Permittees have their own development standards, also known as Low Impact Development (LID)/post-construction standards that include a hydromodification component. The MS4 permits also require specific design concepts for LID/post-construction BMPs in the early stages of a project during the entitlement and CEQA process and the development plan review process. CVRWQCB-6

For more information on which Phase I MS4 Permit this project applies to, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/municipal_permits/

For more information on the Phase II MS4 permit and who it applies to, visit the State Water Resources Control Board at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/phase_ii_municipal.shtml

[1] Municipal Permits = The Phase I Municipal Separate Storm Water System (MS4) Permit covers medium sized Municipalities (serving between 100,000 and 250,000 people) and large sized municipalities (serving over 250,000 people). The Phase II MS4 provides coverage for small municipalities, including non-traditional Small MS4s, which include military bases, public campuses, prisons and hospitals.

Industrial Storm Water General Permit

Storm water discharges associated with industrial sites must comply with the regulations contained in the Industrial Storm Water General Permit Order No. 2014-0057-DWQ.

For more information on the Industrial Storm Water General Permit, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/industrial_general_permits/index.shtml

CVRWQCB-7

Clean Water Act Section 404 Permit

If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed from the United States Army Corps of Engineers (USACE). If a Section 404 permit is required by the USACE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements.

CVRWQCB-8

If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACE at (916) 557-5250.

Clean Water Act Section 401 Permit – Water Quality Certification

If an USACE permit (e.g., Non-Reporting Nationwide Permit, Nationwide Permit, Letter of Permission, Individual Permit, Regional General Permit, Programmatic General Permit), or any other federal permit (e.g., Section 10 of the Rivers and Harbors Act or Section 9 from the United States Coast Guard), is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications.

CVRWQCB-9

For more information on the Water Quality Certification, visit the Central Valley Water Board website at:
https://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_certification/

Waste Discharge Requirements – Discharges to Waters of the State

If USACE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project may require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation.

CVRWQCB-10
(Cont. below)

For more information on the Waste Discharges to Surface Water NPDES Program and WDR processes, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/water_issues/waste_to_surface_water/

CVRWQCB-10 (Cont.)

Dewatering Permit

If the proposed project includes construction or groundwater dewatering to be discharged to land, the proponent may apply for coverage under State Water Board General Water Quality Order (Low Risk General Order) 2003-0003 or the Central Valley Water Board's Waiver of Report of Waste Discharge and Waste Discharge Requirements (Low Risk Waiver) R5-2013-0145. Small temporary construction dewatering projects are projects that discharge groundwater to land from excavation activities or dewatering of underground utility vaults. Dischargers seeking coverage under the General Order or Waiver must file a Notice of Intent with the Central Valley Water Board prior to beginning discharge.

CVRWQCB-11

For more information regarding the Low Risk General Order and the application process, visit the Central Valley Water Board website at: http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2003/wqo/wqo2003-0003.pdf

For more information regarding the Low Risk Waiver and the application process, visit the Central Valley Water Board website at: http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/waivers/r5-2013-0145_res.pdf

Regulatory Compliance for Commercially Irrigated Agriculture

If the property will be used for commercial irrigated agricultural, the discharger will be required to obtain regulatory coverage under the Irrigated Lands Regulatory Program. There are two options to comply:

1. **Obtain Coverage Under a Coalition Group.** Join the local Coalition Group that supports land owners with the implementation of the Irrigated Lands Regulatory Program. The Coalition Group conducts water quality monitoring and reporting to the Central Valley Water Board on behalf of its growers. The Coalition Groups charge an annual membership fee, which varies by Coalition Group. To find the Coalition Group in your area, visit the Central Valley Water Board's website at: https://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/regulatory_information/for_growers/coalition_groups/ or contact water board staff at (916) 464-4611 or via email at IrrLands@waterboards.ca.gov.

CVRWQCB-12 (Cont. below)

2. **Obtain Coverage Under the General Waste Discharge Requirements for Individual Growers, General Order R5-2013-0100.** Dischargers not participating in a third-party group (Coalition) are regulated individually. Depending on the specific site conditions, growers may be required to monitor runoff from their property, install monitoring wells, and submit a notice of intent, farm plan, and other action plans regarding their actions to comply with their General Order. Yearly costs would include State administrative fees (for example, annual fees for farm

sizes from 11-100 acres are currently $1,277 + $8.53/Acre); the cost to prepare annual monitoring reports; and water quality monitoring costs. To enroll as an Individual Discharger under the Irrigated Lands Regulatory Program, call the Central Valley Water Board phone line at (916) 464-4611 or e-mail board staff at IrrLands@waterboards.ca.gov. CVRWQCB-12 (cont.)

Limited Threat General NPDES Permit

If the proposed project includes construction dewatering and it is necessary to discharge the groundwater to waters of the United States, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. Dewatering discharges are typically considered a low or limited threat to water quality and may be covered under the General Order for *Limited Threat Discharges to Surface Water* (Limited Threat General Order). A complete Notice of Intent must be submitted to the Central Valley Water Board to obtain coverage under the Limited Threat General Order. CVRWQCB-13

For more information regarding the Limited Threat General Order and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2016-0076-01.pdf

NPDES Permit

If the proposed project discharges waste that could affect the quality of surface waters of the State, other than into a community sewer system, the proposed project will require coverage under a National Pollutant Discharge Elimination System (NPDES) permit. A complete Report of Waste Discharge must be submitted with the Central Valley Water Board to obtain a NPDES Permit.

For more information regarding the NPDES Permit and the application process, visit the Central Valley Water Board website at: https://www.waterboards.ca.gov/centralvalley/help/permit/ CVRWQCB-14

If you have questions regarding these comments, please contact me at (916) 464-4812 or Jordan.Hensley@waterboards.ca.gov.

Jordan Hensley
Environmental Scientist

cc: State Clearinghouse unit, Governor's Office of Planning and Research, Sacramento

Delta Stewardship Council

(DSC)

DSC

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Jessica R. Pearson

April 15, 2019

Dan Riordan
Department of Water Resources
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West Sacramento, CA 95691

Via email: Dan.Riordan@water.ca.gov

RE: Comments on Partial Recirculation of Draft Environmental Impact Report: Prospect Island Tidal Habitat Restoration Project, SCH#2013052056

Dear Mr. Riordan:

Thank you for the opportunity to review and comment on the Partial Recirculation of Draft Environmental Impact Report (DEIR): Prospect Island Tidal Habitat Restoration Project (proposed project). The Delta Stewardship Council (Council) recognizes the Department of Water Resources' (DWR's) effort to meet its obligations under the Biological Opinion for the long-term coordinated operations of the State Water Project through restoration of approximately 1,600 acres of tidal habitat at Prospect Island in Solano County.

The Council is an independent agency of the State of California established by the Sacramento-San Joaquin Delta Reform Act of 2009, codified in Division 35 of the California Water Code, sections 85000-85350 (Delta Reform Act). The Delta Reform Act charges the Council with furthering California's coequal goals of achieving a more reliable water supply and restoring the Sacramento-San Joaquin River Delta (Delta) ecosystem, while protecting and enhancing the Delta's cultural, recreational, and agricultural values (Cal, Water Code §85054). These goals are to be achieved through implementation of the Delta Plan, regulatory portions of which became effective on September 1, 2013, and are set forth in Title 23 of the California Code of Regulations.

DSC-1

<u>Covered Action Determination and Certification of Consistency with the Delta Plan</u>

Pursuant to the Delta Reform Act, the Council has adopted the Delta Plan, a legally enforceable management framework for the Delta and Suisun Marsh for achieving the coequal goals. The Delta Reform Act grants the Council specific regulatory and appellate authority over certain actions that take place in whole or in part in the Delta and Suisun Marsh, referred to as

DSC-2
(Cont. below)

"Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place."
– CA Water Code §85054

"covered actions." (Cal. Water Code §§ 85022(a) and 85057.5.) The Council exercises that authority through its regulatory policies (set forth in Title 23 of the California Code of Regulations, Sections 5001 through 5016) and recommendations incorporated into the Delta Plan. State and local agencies are required to demonstrate consistency with the Delta Plan when carrying out, approving, or funding a covered action. (Cal. Water Code §§ 85057.5 and 85225.) Water Code section 85057.5(a) provides a four-part test for meeting the definition of a covered action.

Based on the project location and scope, as provided in the 2016 DEIR and subsequently in the Partial Recirculated DEIR, the proposed project appears to meet the definition of a covered action set forth in Water Code section 85057.5(a) because it:

1. Will occur in whole or in part within the boundaries of the Legal Delta (Water Code §12220) or Suisun Marsh (Public Resources Code §29101). (Cal. Water Code § 85057.5(a)(1).)
2. Will be carried out, approved, or funded by the State or a local public agency. (Cal. Water Code § 85057.5(a)(2).)
3. Is covered by one or more provisions of the Delta Plan (Cal. Water Code § 85057.5(a)(3)), which includes the applicable regulatory policies contained in the Delta Plan (23 CCR section 5003-5015). The Delta Plan regulatory policies that may apply to the project are discussed below.
4. Will have a significant impact on the achievement of both of the coequal goals and the implementation of a government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta. (Cal. Water Code § 85057.5(a)(4).)

The Delta Reform Act requires the State or local agency that proposes to undertake the covered action to file a certification of consistency with the Delta Plan prior to initiating the implementation of the project. (Cal. Water Code § 85225.)

DSC-2
(Cont.)

Comments Regarding Delta Plan Policies and Potential Consistency Certification

The Council notes that DWR has prepared a partial Recirculated DEIR for this project addressing revisions to the project description, alternatives, and impact analysis related to hydrology, water quality, air quality, noise, and transportation and traffic. We understand that DWR will not respond to comments received during the recirculation period that relate to chapters or portions of the document that are not recirculated in the Recirculated DEIR. The Council submitted a comment letter on the 2016 DEIR dated October 6, 2016. The comments offered in that letter still apply to the Council's review of the project.

In the interest of focusing the environmental documentation for the project to serve as a basis for DWR's certification of consistency, we offer the following comments describing regulatory Delta Plan policies that may apply to the proposed project based on the information available in the 2016 DEIR and the Recirculated DEIR. This information may also assist DWR to better describe the relationship between the proposed project and the Delta Plan in the Final EIR.

DSC-3
(Cont. below)

General Policy 1 (G P1): Detailed Findings to Establish Consistency with the Delta Plan
Delta Plan Policy **G P1** (23 Cal. Code Regs. section 5002) specifies what must be addressed in a certification of consistency filed by a project proponent for a covered action. The following is a subset of G P1 requirements that a project must fulfill to demonstrate consistency with the Delta Plan:

Mitigation Measures
Delta Plan Policy **G P1, subsection (b)(2),** (23 CCR Section 5002(b)(2)) requires that covered actions not exempt from CEQA must include applicable feasible mitigation measures consistent with those identified in the Delta Plan Program EIR or substitute mitigation measures that are equally or more effective. Mitigation measures in the Delta Plan's Mitigation and Monitoring Report Program (Delta Plan MMRP) are available at: http://deltacouncil.ca.gov/sites/default/files/documents/files/Agenda%20Item%206a_attach%202.pdf

In addition to mitigation measures proposed in the 2016 DEIR, the Recirculated DEIR for the project identifies revised and additional mitigation measures for water quality, air quality, and transportation and traffic. Council staff recommends that DWR review the Delta Plan MMRP and include applicable Delta Plan measures in the Final EIR, or ensure that proposed project mitigation is equally or more effective than applicable Delta Plan measures. DSC-3 (Cont. below)

Best Available Science
Delta Plan Policy **G P1, subsection (b)(3),** (23 CCR Regs. section 5002(b)(3)) requires covered actions to document use of best available science as relevant to the purpose and nature of the project.

Best available science is defined in the Delta Plan as the best scientific information and data for informing management and policy decisions, which must be consistent with the guidelines and criteria found in Appendix 1A of the Delta Plan, available at http://deltacouncil.ca.gov/sites/default/files/2015/09/Appendix%201A.pdf. (Cal. Code Regs, tit. 23, § 5001, subd. (f).) Six criteria are used to define best available science: relevance, inclusiveness, objectivity, transparency and openness, timeliness, and peer review. This policy generally requires that the lead agency clearly document and communicate the process for analyzing project alternatives, impacts, and mitigation measures of proposed projects, in order to foster improved understanding and decision making. Council staff recommends that DWR explain the role of the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) technical review, the “Science Panel” convened in March 2014, and other forums such as the Fishery Agency Strategy Team (FAST) and Technical Review Panel in guiding planning and design of the project using best available science in the Final EIR.

Adaptive Management
Delta Plan Policy **G P1, subsection (b)(4),** (23 CCR Regs. section 5002(b)(4)) requires that ecosystem restoration and water management covered actions include adequate provisions for continued implementation of adaptive management, appropriate to the scope of the action. This requirement is satisfied through: a) the development of an adaptive management plan that is consistent with the framework described in Appendix 1 B of the Delta Plan that can be found at (http://deltacouncil.ca.gov/sites/default/files/2015/09/Appendix%201B.pdf); and b) documentation of adequate resources to implement the proposed adaptive management plan.

DSC-3 (Cont.)

Ecosystem Restoration Policy 2 (ER P2): Restore Habitats at Appropriate Elevations
Delta Plan Policy **ER P2** (23 Cal. Code Regs. section 5006) requires habitat restoration to be consistent with Delta Plan Appendix 3 (http://deltacouncil.ca.gov/docs/appendix-3), which provides guidance on the types of appropriate habitats given a restoration project site's location and elevation.

DWR should consider describing how the proposed restoration actions are consistent with the actions described in Appendix 3 for intertidal lands in the Final EIR.

DSC-4

Ecosystem Restoration Policy 3 (ER P3): Protect Opportunities to Restore Habitat
Delta Plan Policy **ER P3** (23 Cal. Code Regs. section 5007) states that within priority habitat restoration areas (PHRAs) depicted in Appendix 5 (http://deltacouncil.ca.gov/sites/default/files/2015/09/Appendix%205.pdf), significant adverse impacts to the opportunity to restore habitat at appropriate locations must be avoided or mitigated. The project site is located within the Yolo Bypass PHRA.

DWR should consider describing how the project would avoid or mitigate impacts to the opportunity to restore habitat throughout the Yolo Bypass PHRA in the Final EIR.

DSC-5

Ecosystem Restoration Policy 5 (ER P5): Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species
Delta Plan Policy **ER P5** (23 Cal. Code Regs. section 5009) calls for avoiding introduction of and habitat improvements for invasive, nonnative species or for mitigating these potential impacts in a manner that appropriately protects the ecosystem.

DWR should consider how the project would avoid introduction of new habitat or improve existing habitat conditions for both nonnative wildlife species and terrestrial and aquatic weeds in the Final EIR. This analysis should fully consider the potential for such introduction or improvement of habitat for nonnative invasive species. In the event that mitigation is warranted, mitigation and minimization measures should be consistent with Delta Plan Mitigation Measure 4-1, which can be found at: http://deltacouncil.ca.gov/sites/default/files/documents/files/Agenda%20Item%206a_attach%202.pdf

DSC-6

Delta as Place Policy 2 (DP P2): Respect Local Land Use when Siting Water or Flood Facilities or Restoring Habitats

Delta Plan Policy **DP P2** (23 Cal. Code Regs. section 5011) reflects one of the Delta Plan's charges to protect the Delta as an evolving place by siting project improvements/facilities to avoid or reduce conflicts with existing or planned future land uses when feasible. Policy DP P2 may also apply if mitigation habitat is required within the Delta.

The Final EIR should describe how the project would be sited to avoid or reduce conflicts with existing or planned future uses. This should include a description of measures employed by the project to mitigate conflicts with adjacent uses, and discuss how any comments received from local agencies and the Delta Protection Commission were considered by DWR. DSC-7

CEQA Regulatory Setting

In addition to the specific comments above, please include a discussion of the Delta Plan and the specific applicable regulatory policy or policies in the Regulatory Setting portion of each resource section of the Final EIR to which a Delta Plan policy is applicable. DSC-8

Closing Comments

As DWR proceeds with design, development, and environmental impact analysis of the project, we invite you to continue to engage Council staff in early consultation (prior to submittal of a certification of consistency) to discuss project features and mitigation measures that would promote consistency with the Delta Plan. As part of the Council, the Delta Science Program's Adaptive Management Liaisons are also available to provide further consultation and guidance regarding appropriate application of best available science and adaptive management. DSC-9

More information on covered actions, early consultation, and the certification process can be found on the Council website, http://deltacouncil.ca.gov/covered-actions. The Council is available to discuss issues outlined in this letter as you proceed in the next stages of your project and approval processes. Please contact Ron Melcer at (916) 284-1619 (Ronald.Melcer@deltacouncil.ca.gov) with any questions.

Sincerely,

Jeff Henderson, AICP
Deputy Executive Officer
Delta Stewardship Council

Cc: Cindy Messer, Chief Deputy Director, California Department of Water Resources

Local Agencies of the North Delta

(LAND)

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April 15, 2019

SENT VIA EMAIL (Dan.Riordan@water.ca.gov)

Dan Riordan
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

RE: Comments on the Partial Recirculation of the Draft EIR for the Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

These comments on the February 2019 Partial Recirculation of the Draft Environmental Impact Report ("RDEIR") for the Prospect Island Tidal Habitat Restoration Project ("project") prepared by the California Department of Water Resources ("DWR") are submitted on behalf of Local Agencies of the North Delta ("LAND"), Reclamation District 501 ("RD 501"), International Farming Corporation,[1] and Fahn Family Farming[2] (collectively "LAND"). LAND has significant concerns about this project not just because of the potential significant impacts on the environment, public health through air emissions, and infrastructure damage, but also because the project and its preceding operations and failures have already had a direct impact on the environment. We have already expended considerable effort to identify pre-project and

LAND-1
(Cont. below)

[1] LAND member agencies cover an approximately 118,000-acre area of the Delta. Some of these agencies provide both water delivery and drainage services, while others only provide drainage services. These districts also assist in the maintenance of the levees that provide flood protection to homes and farms. The International Farming Corporation ("IFC") recently purchased over 6,200 acres of land previously owned by Islands Inc. (Tom Hester). (See https://www.internationalfarming.com/.) IFC has a strong interest in protecting its Ryer Island lands from damage from inadequately mitigated neighboring projects, such as the Prospect restoration project.

[2] The Fahn Family owns land on Ryer Island as well as land directly north of the project site that would receive negative offsite impacts from the project if not properly mitigated. DWR also seeks to obtain certain Fahn property rights for staging and access to construct and operate the project. Resolution of the project's offsite impacts and neighboring landowner concerns is an important consideration for the Fahn Family.

project impacts, but have been rebuffed by DWR on our attempts to seek feasible mitigation. (Exhibit 1, DWR Letter, February 20, 2019.)[3]

LAND has attempted to engage DWR and the Department of Fish and Wildlife ("DFW") in a technical discussion of these and additional project impacts, and have recommended cost-effective means of monitoring and mitigating impacts from the Project. (See Exhibit 2, LAND Letter, November 4, 2014; Exhibit 3, LAND Letter, November 7, 2016; Exhibit 4, LAND Letter, February 15, 2017; Exhibit 5, LAND Letter, November 7, 2017; see also Exhibit 6, LAND et al. comments on February 2018 DWR Hydrologic Analysis Report Prospect Island Tidal Habitat Restoration Project, Solano County, California, August 20, 2018 ("ENGEO 2018").) Continuing and likely future environmental and financial impacts to levees, roads, crops and reclamation district drainage management remain insufficiently or erroneously analyzed and unmitigated. The comments in this letter are intended to inform further necessary revisions to the RDEIR to reduce those impacts through good neighbor policies, tracking and identifying impacts by low cost monitoring and adequate mitigation if and when reasonably foreseeable impacts occur. (See Exhibit 7, Proposed Good Neighbor Policies.) LAND-1 (Cont.)

LAND supports Delta restoration activities, but the impacts on the environment and adjacent land and water uses must be fully disclosed and fully mitigated in the context of CEQA, and effective coordination with adjacent landowners must continue throughout the life of the project. Unfortunately, DWR and DFW have to date taken the position that nothing done or not done on Prospect Island has had environmental impacts, and that the next proposed project activities have either no impacts, or only less than significant impacts in the context of CEQA. These conclusions are not based on, and in fact belied by, empirical observations. In addition, the conclusions are not based on best available science as required by the Delta Stewardship Council's Delta Plan. (Cal. Code Regs., tit. 23, § 5002, Appendix 1A.) LAND-2 (Cont. below)

The RDEIR fails to provide an adequate analysis of environmental impacts from the project to the environment and to adjacent land uses and infrastructure. Those impacts are not fully disclosed, analyzed or mitigated. LAND worked diligently to inform DWR and DFW about those impacts through an informal technical consultation process. Despite those technical comments, which identified in detail project impacts and associated avoidance and mitigation measures, the RDEIR fails to adequately identify, analyze or fully mitigate those impacts. Instead, the RDEIR arbitrarily reduces

[3] Pre-project impacts include seepage impacts to the adjacent Ryer Island, as well as native and non-native fish mortality from failure to effectively plan and salvage fish during at least one of the Prospect flooding events.

previously documented significant impacts to be less than significant with no mitigation. DWR needs to correct the RDEIR to fully disclose, analyze and mitigate all project impacts. LAND-2 (Cont.)

I. ONGOING PROCEDURAL FLAWS IN THE DEIR AND RDEIR

Inclusion of Enforceable Good Neighbor Policies and Mitigation Measures

Comment: As referenced above, LAND extensively discussed project impacts and ways to lessen those impacts through good neighbor policies, and mitigation measures. (See Exhibit 2, LAND Letter, November 4, 2014; Exhibit 3, LAND Letter, November 7, 2016; Exhibit 4, LAND Letter, February 15, 2017; Exhibit 5, LAND Letter, November 7, 2017.) The project's impacts require ongoing monitoring, maintenance and management, whether in the form of good neighbor policies or formal mitigation measures. Despite LAND's consistent efforts to work with DWR to create viable long-term solutions to the issues posed by the project, DWR has failed to adequately address LAND's concerns. LAND-3

Even where LAND's concerns have been acknowledged, DWR has done nothing tangible to address them. DWR's February 20, 2019 Letter included representations that DWR would conduct various monitoring and surveys in response to concerns raised by LAND. (See Exhibit 1, DWR February 20, 2019 Letter, p. 3.) However, the letter expressly states that these "ongoing efforts" are not discussed in the RDEIR because DWR does not concede that mitigation or monitoring is necessary. (*Ibid*.) This decision appears rooted in a reluctance to acknowledge specific project impacts would be significant. (*Ibid*.) This inability to concede the severity of the project's impacts should not prevent the inclusion of these measures in the RDEIR. This is why LAND has offered the measures as either good neighbor policies or mitigation, to facilitate their inclusion in the project itself, rather than relegated to hollow promises. If the measures put forward by LAND are not included in the project in some form, then the Tort Claims Act would be the only remedy available for the project's future impacts.[4] Such a scenario would be inefficient and untenable, further supporting the need for inclusion of enforceable measures in the project in some fashion. LAND-4

The minimal mitigation that is included in the RDEIR suffers from similar flaws, including insufficient detail and improper deferral. Under CEQA Guideline section 15126.4, subdivision (a)(1)(B), agencies cannot defer formulation of mitigation LAND-5 (Cont. below)

[4] Resolution under the Torts Claims Act (Gov. Code, § 810 et seq.) is a long, drawn out and inefficient process.

measures, but may include specified performance standards with multiple means of achieving those goals. The project's mitigation measures are deferred or otherwise do not include enforceable performance standards. For example, the invasive plant species control measures project component is inadequate as drafted. (RDEIR, p. 5-34.) This restoration activity does not include any enforceable density standards for either invasive terrestrial species or aquatic weeds. Without a density standard, invasive species control is not enforceable.

LAND-5
(Cont. below)

DWR must include LAND's proposed good neighbor policies as part of the project or as mitigation. Additional sources of policies, such as Mitigation Measure AG-1 from the California WaterFix Mitigation, Monitoring, and Reporting Program, should also be incorporated. (See Exhibit 7, Proposed Good Neighbor Policies; Exhibit 8, CWF MMRP.) AG-1 provides potential individual actions that, if modified to be enforceable, could serve well as a framework for development of good neighbor policies.

LAND-6

Unstable Project Description

Comment: The changes identified in the RDEIR include: removing references to project impacts to, and any monitoring and repair of the adjacent Ryer Island levees, and removal of references to monitoring of groundwater wells or monitoring of seepage on Ryer Island. These are two issues of critical concern to LAND. The documented seepage, and the obvious risk of levee damage to the adjacent Ryer Island, are problems that DWR can readily mitigate and monitor. However, DWR has abandoned those tools that identify the extent and severity of those impacts, as well as the mitigation measures required to protect life and property. (RDEIR, p. 4-1; see also Exhibit 9, DWR Letter, March 4, 2019.)

LAND-7

The RDEIR fails to update the Project Description or the Proposed Project Actions or otherwise disclose a significant change to the project, a new plan for importing riprap, fill material, and aggregate base to the project site. Specifically, the RDEIR fails to disclose that truck trips during construction would increase twenty-fold. (RDEIR, p. 4-9.) As discussed below, the RDEIR fails to adequately analyze the various impacts of a significant increase in total truck trips. Additionally, the RDEIR reveals a new "San Rafael" source for fill materials. (See RDEIR, pp. 5-175.) The RDEIR does not divulge any material information about the San Rafael barge option that would allow an assessment of its impacts. Apparently, some of the materials would be imported from San Rafael under the barge option. (RDEIR, p. 5-175.) The quarry that sources this material, or whether a new quarry would be necessary, is not disclosed. The RDEIR does not define how much imports would come from San Rafael versus Rio Vista. The RDEIR does not disclose whether additional cumulative projects are implicated by virtue

LAND-8

LAND-9
(Cont. below)

of the San Rafael material source. It is not clear whether a barge landing would need to be constructed for the barges at the unspecified San Rafael quarry.

These are only a few examples of unanswered questions arising from the newly disclosed San Rafael source option. In all, the RDEIR fails to define the San Rafael option with required specificity and to indicate which option, barges or trucks, is the proposed action.

LAND-9 (Cont.)

Failure to Apply Best Available Science

Comment: The DEIR identifies consistency with the Delta Stewardship Council's Delta Plan as a necessary approval. (DEIR, p. xlv.) Part of this consistency determination is consistency with the Delta Plan's Best Available Science ("BAS") Framework. (Exhibit 10, Delta Plan BAS Framework.) The significant errors in the DEIR and RDEIR's analysis described in detail below are failures to apply BAS according to the s Delta Plan. (Exhibit 10, Delta Plan BAS Framework.) Covered actions, like the project (see DEIR, p. xlv), must be consistent with six BAS criteria, relevance, inclusiveness, objectivity, transparency and openness, timeliness, and peer review. (Exhibit 10, Delta Plan BAS Framework, p. 4.) Unless DWR addresses the scientific flaws in the DEIR and RDEIR, DWR will not be able to demonstrate consistency with the Delta Plan's BAS standards.

LAND-10

Insufficient supporting information for Section 408 Application

Comment: LAND has previously provided comments to the U.S. Army Corp of Engineers ("USACE") regarding DWR's request for permission to alter a USACE project under section 408. (See Exhibit 11, LAND Section 408 Comments, March 29, 2018.) DWR failed to provide a project plan or engineering information sufficient for technical review. Given the impacts discussed below, such as damage to levees, more information is needed for adequate review by USACE.

LAND-11

II. THE DEIR AND RDEIR FAIL TO CONSIDER ENVIRONMENTAL IMPACTS AND PROVIDE NECESSARY MITIGATION

In this section, due to the overlap between the DEIR and RDEIR, these comments address deficiencies in both documents categorized by impacted resources. While the Notice attempts to limit comments to the RDEIR only, the DEIR has not been certified and the record for this project would be comprised of both the DEIR and RDEIR. (Pub. Resources Code, § 21167.6 (e).) DWR must address all environmental review deficiencies prior to certification of the Final EIR. DWR refuses to do so at its peril.

LAND-12

Hydrology Analysis

Areas of Controversy (DEIR, p. xlvi)

Comment: The DEIR notes two areas of controversy, the potential groundwater seepage impacts to adjacent areas and potential impacts to water rights for downstream water users from diversion of surface water, but proclaims these concerns "unfounded[.]". (DEIR, p. xlvi.) Far from being unfounded, these areas of acknowledged controversy have been substantiated by local Delta levee expert engineers and hydrogeologists. (See Exhibit 6, ENGEO 2018.) In fact, for groundwater seepage impacts, DWR's own more recent data further substantiates the impacts, and only DWR's failure to analyze those data using basic scientific methods, including the failure to use statistical methods and ignoring best available science, has resulted in any remaining question about the unambiguous significance of that impact. (DWR Prospect and Ryer Island Hydrologic Data Analysis October 1, 2013 to April 1, 2017 Prospect Island Tidal Habitat Restoration Project, Solano County, California ("DWR Hydro 2018").) These issues are discussed later in this letter. LAND-13

Figure 2.2-7 Intertidal Bench Configuration (DEIR, p. 2-43)

Comment: The depiction of this intertidal bench leaves off a design water surface elevation that is generally recognized when planning and/or designing flood control features in the Sacramento-San Joaquin Delta, the Base Flood Elevation/1% annual chance flood elevation ("BFE"). The BFE along this reach of Miner Slough varies in elevation between 16.45' to 17.10' (NAVD88). If the figure reflected the BFE, it would be evident how high the water can rise around Prospect Island and the likelihood of severe erosion from wind whipped waves on the natural interior slopes of Prospect Island during storm events with the water being 10 feet or deeper than during normal tidal activity. Wind waves on the natural slopes of Prospect Island interior levee slopes is a high certainty during storm events. Without erosion protection in the form of quarry stone riprap, breaching of unprotected slopes exposed to the wind waves will result. In 2004, over a 24-hour period, the north levee of flooded Lower Jones Tract lost between 6-10 feet of levee due to a high summer wind event. Had the erosion on this flooded island in the middle of summer continued, multiple breaches would have occurred. However, due to good County Road access, Reclamation District 501 placed quarry stone riprap over the entire exposed inland slope and saved the levee from being breached. Wind waves are common in the Delta; sustained wind speeds in excess of 35 miles per hour are known to occur often during heavy storm conditions in this region. LAND-14

Figure 2.2-9 Breach Velocity Dissipation Feature (DEIR, p. 2-47)

Comment: DEIR Figure 2.2-9 identifies a feature intended to reduce erosion on the remnant levee on Prospect Island. Nowhere in the DEIR is there a hydraulic analysis for the reduction in cross-section of Miner Slough from the lateral intrusion from this bulbout feature. As there is nothing more than this plan-view diagram, it is not possible to state how much fill would be used, its geometry, and how much interference would be created on the flood prism. However, the figure clearly shows that the flow vectors *are perpendicular* from the outlet and thus aimed directly at the Ryer levee. The potential for channel bottom scour induction in the flow path needs to be explicitly modeled under various stage heights and tidal filling cycles at high and low tides. While the breach velocity dissipation feature may accomplish minimize strong velocity gradients, it does nothing to prevent the strongest flows from causing scour. *This impact would be significant and mitigation is necessary.* LAND-15

> **Proposed Action:** Installing riprap on the Ryer levee shore, channel monitoring, and conducting or funding for repairs in case of a blowout. Similarly, the induced erosion from these project-created flows on the Ryer levee needs to be modeled on specific events, and cannot rely on averages.

Impact 3.1-1 Potential changes in agricultural water supply and drainage due to changes in tidal range (DEIR, p. 3-22)

Comment: The DEIR unreasonably constrains this analysis to project "changes due to tidal range." The impacts associated to Ryer Island come from a variety of causes and conditions created by the project, including but not limited to, changes in tidal range.

Project impacts from modifications of the tidal range are associated with increasing pumping costs and potential increased exposure of pumps and siphons to clogging from aquatic invasive weeds. The project's design would significantly exacerbate weed conditions over the live the project. The reduced tidal range is further improperly analyzed in light of concurrent impacts from the cumulative impacts associated declining Sacramento River flows and altered tidal ranges that would result from the Delta Tunnels project, which would remove about half of the average flow of the Sacramento River. This reduction in freshwater flows would also lessen flows via Sutter and Miner Slough to Ryer Island, further exacerbating water quality impacts from the Prospect Island project. *This impact would be significant and mitigation is necessary.* LAND-16

> **Proposed Action:** The invasive species control plans must be developed in further detail, including specific density standards.

Comment: The DEIR and RDEIR fail to disclose the impacts of weed growth on total water supply. Studies show that exotic invasive plant species can consume more water than naturally occurring species, impacting water available for agriculture. (See Exhibit 12, Pitcairn et al., Yellow Starthistle continues its spread in California (2006).) Given the project's potential exacerbation of invasive weeds, the potential impacts on water consumption must be disclosed and analyzed. *This impact must be disclosed and analyzed.* LAND-17

Impact 3.1-3 Groundwater seepage impacts from Prospect Island to adjacent areas (RDEIR, p. 5-79)

Comment: Impacts to Ryer groundwater hydrology from the proposed project are mischaracterized or simply rejected without a scientific basis. (Exhibit 6, ENGEO 2018, p. 2.) In any case, DWR's conclusions are unsubstantiated by materials provided in the RDEIR and in supplemental material provided by DWR in the RDEIR in the analysis of Impact 3.1-3. (RDEIR, p. 4-5.) DWR engaged with LAND and RD 501 technical experts in a series of shared analyses. (See Exhibit 6, ENGEO 2018 and DWR Hydro 2018).

LAND has made numerous comments on the Project impacts, and the failure to identify or set thresholds of significance with a legal, scientific or engineering basis, and mitigate for those impacts. (See Exhibit 2, LAND Letter, November 4, 2014; Exhibit 3, LAND Letter, November 7, 2016; Exhibit 4, LAND Letter, February 15, 2017; Exhibit 5, LAND Letter, November 7, 2017; Exhibit 6, ENGEO 2018.) In some cases, where the degree of absolute impact is difficult to precisely define given the lack of impact analysis on the topic, or due to the inadequate cumulative impact analysis, LAND has offered several means by which to monitor those impacts and assess their degree of influence adequately and inexpensively. (See Exhibit 2, Land Letter, November 4, 2014; Exhibit 3, LAND Letter, November 7, 2016; Exhibit 4, LAND Letter, February 15, 2017; Exhibit 5, LAND Letter, November 7, 2017.) However, these considerations were either simply ignored, or noted as areas of controversy in the DEIR and then dismissed. (RDEIR, p. 4-5; DEIR, p. xlvi; see also Exhibit 1, DWR Letter, February 20, 2019.) LAND-18

While the DEIR does identify seepage zones from the project, it fails to characterize the potential extent or magnitude of those impact, and instead states that the seepage from the project overall is less than significant. (DEIR, pp. 3-221 and 3-27.) The documented seepage zones on Ryer shown in the DEIR are the result of the hydraulic head elevations being higher on Prospect Island and lower on Ryer Island. Even when the slough levels were high, this gradient remained. (Exhibit 6, ENGEO p. 3.) The LAND-19 (Cont. below)

conclusion that the project as a whole does not have a significant impact is not supported by substantial evidence. LAND has already provided in comments that seepage from Prospect is significant in extent and area, and even the analysis provided on page 3-221 supports this conclusion. (Exhibit 6, ENGEO 2018, pp. 1-5.)

As the DEIR states:

> One exception to [the soil makeup of the project site] is an area of soils in the southern portion of the Project site, which falls into hydrologic group A, with low saturated run-off potential, and a very small area along the western boundary of the Proposed Project region, with soils grouped into hydrologic soils group B, with moderate saturated run-off potential (3). Where soils have low run-off characteristics (i.e., high infiltration rates, even under saturated conditions), there may be potential for groundwater seepage into adjacent diked lands.

(DEIR p. 3-221.) The DEIR specifically identifies a location and reason for seepage to Ryer Island, and then fails to explain how this knowledge does not lead to a finding of significance. *This impact would be significant and mitigation for this impact is necessary.*

LAND-19 (Cont.)

Comment: The RDEIR identifies Impact 3.1-3 as greater than No Impact, yet somehow still designated as Less than Significant. (RDEIR, p. 5-216.) The impacts on Ryer Island from seepage are improperly analyzed. The seepage has been documented as directly damaging crops and requiring additional water management. (Exhibit 2, LAND Letter, November 4, 2014, p. 6; Exhibit 3, Land Letter, November 7, 2016, p. 6.) The threshold for significance lacks any rational legal or scientific basis. There is no indication of how much seepage, how great of an area of seepage impact is permissible before it becomes significant. *This impact would be significant and mitigation is necessary*.

> **Proposed Action:** Adequate seepage modeling supported with a tracer study and 3-dimensional erosion analysis for neighboring levees would provide a more accurate picture of the impact. Optimized intake locations, operable gates, and construction of cutoff walls and interception wells would all minimize seepage impacts. Operable gates would require hardening the bottom of the breach openings with concrete apron or rock. Capping the inside of the Prospect levee would reduce percolation through the alluvial zone to the sand layer. Further, levee maintenance funds would aid in mitigating future damage to neighboring levees.

LAND-20

Impact 3.1-5 Potential toe-scour and erosion of Miner Slough levees affecting Ryer Island levee stability (RDEIR, p. 5-84) and Impact 3.1-6 Potential increase in seepage on adjacent lands due to Miner Slough bed scour (RDEIR, p. 5-90)

Comment: The RDEIR identifies Impacts 3.1-5 and 3.1-6 as greater than No Impact, yet somehow also Less than Significant. (See RDEIR, p. 5-216.) The impacts on Ryer Island from erosion of the critical levee infrastructure are improperly analyzed. There is no description as to how much levee damage is permissible. Scour of the riparian fringe is an impact to a variety of listed species, as well as a direct hazard impact. The lead agency's threshold for significance lacks a rational legal or scientific basis. Nor is there any analysis as to how to identify that the erosion exceeds the estimations and non-existent thresholds, and thus requires mitigation. The RDEIR's conclusions are not supported by substantial evidence. *These impacts would be significant and mitigation is necessary for both.* LAND-21

Substantial evidence does not support the RDEIR's conclusions that there are no appreciable increases in water velocities through the middle breach directed at the Ryer Island levee opposite the breach, that increases are below bed scour velocities, and that mobilization of the bed is unlikely in the south breach area. Moreover, it is simply inaccurate to characterize the modeled doubling of velocity as not appreciable. Where there is a much broader area of velocity it seems likely that that will result in the expansion of the scoured area as observed in the bathymetry. LAND-22

Increasing island drainage pumping does not necessarily result in dry seepage areas because the lenses are deeper and are not influenced by the existing drainage system. The Ryer Island drainage system is not developed to remove water from the areas identified as seepage zones. Having data from a "dry Prospect" condition will help support comparative data to assess the impacts of the flooded versus dry island. It could also help identify the saturated elevations of the impacted location. LAND-23

Proposed Actions: Seepage monitoring criteria and action level triggers need to be established prior to project construction that describe what monitoring results will be considered detrimental, what actions DWR will take to mitigate the impact, and what results will represent successful mitigation.

Interceptor wells on Prospect and/or relief wells on RD 501 can be installed. Interceptor wells can be installed on Prospect Island adjacent to the heavy seepage areas on RD 501 to intercept and lower the head pressure in the interconnected sand lenses between Prospect and RD 501 and eliminate the seepage on RD 501. Relief wells on RD 501 around the seepage areas could be pumped up into and LAND-24 (Cont. below)

conveyed to the RD 501's drainage system. Mitigation for these areas would require the development of detailed plans for interception of the interconnecting lenses and/or substantial drainage improvements on RD 501.

LAND-24 (Cont.)

In addition to armoring the locations where the analysis shows there are likely to be erosion and/or scour impacts, we suggest monitoring the bathymetry of Miner Slough. Periodic bathymetry surveys will be done to see how the channel changes as well as to verify the results of the velocity and sediment transport modeling studies post-project. Funds for additional pumping costs would be necessary in the event of seepage.

LAND-25

Impact 3.1-9 Potential impacts to water rights from diversion of surface water (DEIR, p. 3-36)

Comment: The potential impacts to water rights for downstream users was not adequately analyzed. The DEIR identifies a host of impairments to water rights and wholly fails to identify the need to follow the State Water Resource Control Board's ("SWRCB") requirements as they relates to beneficial use and users of water. (DEIR, p. 3-53.) The DEIR does not identify the beneficial *users* of water, and instead focuses on water quality objectives. *This impact must be disclosed and analyzed.*

LAND-26

Comment: The RDEIR identified this project impact as No Impact (RDEIR, p. 5-216), yet the agency does not have a legal authorization from the SWRCB to change its point of diversion. The RDEIR further fails to identify that it needs such permission despite proposing to create one of the largest new diversions in the Region. As the lead agency, DWR is required as a matter of law to make the claim that it has no impacts on other beneficial users of water in a SWRCB hearing and not simply assert a new legal threshold for significance. *This impact must be disclosed and analyzed*

LAND-27

Comment: The consumptive losses of water, water that is lost to the atmosphere and thus not available to downstream users occur through evaporation and transpiration ("ET") of water from the ground and water surfaces and from plant water use. These ET rates were based on a false assumption, using an incorrect project baseline. The appropriate baseline is the Project site condition as secured by DWR. As described in the DEIR, significant portions of the site were actually in farmed condition until 1995, when it was transferred for the purposes of restoration to the Bureau of Reclamation ("BOR") and maintained for agriculture until 1996, and then flooded leading to its current vegetated condition in 2008. (DEIR, p. 2-5.)

LAND-28 (Cont. below)

The DEIR's baseline does not reflect the failure of DWR and BOR to adequately maintain its drainage infrastructure and manage the ensuing weed and native plant invasion. The DEIR identifies instead, that since it is converting the new plant-covered wetlands that it created as a result of failing to maintain its infrastructure to open water, that conditions would be "such that overall consumptive use would be generally similar to or less than existing conditions." (DEIR, p. 3-37.) The similarity is only due to the conditions that are allowed to happen through mismanagement. The DEIR and RDEIR's analysis is based on an inaccurate baseline and therefore is *a failure to proceed in a manner required by law.* LAND-28 (Cont.)

Water Quality Analysis

Section 1.6 Agency Approvals and Permits (DEIR, p. 1-7)

Comment: The DEIR's list of required agency approvals and permits does not identify the required petition for a change in point of diversion from the SWRCB. (See DEIR, pp. xlv, 1-7.) Through the petition process, potentially injured users are identified and the potential injuries to beneficial uses of water are defined. Further, the process provides for a public quasi-judicial hearing. An EIR must consider related regulations and identify known areas of controversy, including those raised by other agencies. (*Banning Ranch Conservancy v. City of Newport Beach* (2017) 2 Cal.5th 918, 939-941.) An EIR is deficient if it omits consideration of other applicable environmental laws in its impact analysis. (*Ibid*.) Because the DEIR and RDEIR fail to disclose the necessary petition process with the SWRCB, the water quality impact analysis is inadequate. (*Id*. at 941.) The failure to consider the petition process also "ignored the practical reality that the project must ultimately pass muster" and obtain the petition. (*Id*. at 942.) *Therefore, DWR failed to proceed in a manner required by law.* LAND-29

Failure to properly analyze impacts to beneficial uses of water

Comment: Where beneficial uses of water are discussed in the DEIR and RDEIR, the focus is only on water quality objectives. Both documents completely reject any analysis of groundwater quality objectives erroneously as "inapplicable" and ignores the Sustainable Groundwater Management Act, both implicated by the documented groundwater seepage from the project. (DEIR, p. 3-53; RDEIR, p. 5-107.) LAND-30

The DEIR concludes for both increased Dissolved Organic Carbon ("DOC") and algal productivity that the impacts to beneficial uses of water would not be significant. (DEIR, p. 3-81.) However, this conclusion is erroneously based on only a *single modeled year*, 2010. (*Ibid*.) The use of a single model year with average or above average LAND-31 (Cont. below)

precipitation is inappropriate, and not reflective of the 2012-2017 drought conditions, nor does it take climate change into consideration. LAND-31 (Cont.)

Droughts can significantly reduce flows, and increase local temperatures and mixing leading to the formation of algal blooms from the existing harmful algal bloom ("HAB") community. This toxic impact to beneficial uses of water and listed aquatic species was even identified in the DEIR: ". . . model results indicate that the Proposed Project may produce high primary productivity with greater abundance of diatom-based phytoplankton than blue-green algal species associated with harmful blooms." (DEIR, p. 3-80.) Inexplicably, the DEIR designates this impact as less than significant. The DEIR reaches this conclusion without any identifiable threshold of significance or other rationale. (DEIR, p. 3-81.) The DEIR just assumes, despite the admission that the project would facilitate HABs growth, that the project's "increases in nearby waterbodies . . . would be low." (*Ibid*.) Further, the DEIR does not attempt to quantify the "low" increase in waterbodies. (*Ibid*.) LAND-32

The conclusion in the RDEIR differs wildly from DWR's technical analysis of residence times on Prospect Island prepared under the Fish Restoration Program Agreement ("FRPA"), which shows that the project's specific risk of creating Cyanobacterial blooms was evaluated and found to be high.[5] The FRPA analysis identifies the ideal timing for improved productivity with minimal impacts from expected bloom formation as 1-3 day retention, with worsening but still beneficial conditions at 3-5 day retention. This analysis showed that the proposed project design had 52.1% particles present in that beneficial period, then 49% into the Cyanobacterial supporting residence time, and 16.9% beyond 21 days.[6] Similar excessive residence times were found for the similar alternatives.[7] The technical analysis prepared for the project clearly demonstrates that in below normal water years between 40% and 50% of the algal community would have residence times that facilitate HABs growth. The DEIR ignores this analysis entirely. The proliferation of HABs causes severe adverse biological and LAND-33 (Cont. below)

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[5] See Prospect Island Tidal Restoration Project Analysis of Primary Productivity Enhancement and Export for Phase 2 Alternatives Evaluation. Resource Management Associates (February 2014). See also Phase 2 Modeling Synthesis Report Prospect Island Tidal Habitat Restoration Project (July 2014).

[6] Prospect Island Tidal Restoration Project Analysis of Primary Productivity Enhancement and Export for Phase 2 Alternatives Evaluation. Resource Management Associates (February 2014), p. 10.

[7] Prospect Island Tidal Restoration Project Analysis of Primary Productivity Enhancement and Export for Phase 2 Alternatives Evaluation. Resource Management Associates (February 2014), pp. 2-10.

health effects. (See Exhibit 13, Ringelberg SWRCB Testimony; Exhibit 14, HABs Factsheet; Exhibit 15, Berg & Sutula, Factors Affecting Growth of Cyanobacteria (August 2015).) *This impact would be significant and mitigation is necessary.* LAND-33 (Cont.)

Mercury accumulation is an adverse impact to beneficial uses of water including fisheries and wildlife. (RDEIR, p. 3-53.) Yet the DEIR does not frame mercury impacts in terms of beneficial uses, rather describing the impacts in general terms. (RDEIR, p. 3-152; DEIR, 3-81.) Impacts 3.2-7 and 3.2-8 are both identified as less than significant and not requiring mitigation.

The DEIR states that DWR does not understand how its actions could impact compliance with Sacramento-San Joaquin Delta methylmercury TMDL, and therefore is not subjecting itself to an impact determination and at the same time. This is impermissibly deferring feasible mitigation. "Factors controlling methylmercury production and export from restored Delta freshwater tidal wetlands have yet to be fully investigated." (DEIR p. 3-61) This feigned ignorance is misleading, as this same topic is identified in the Delta tunnel analysis by DWR as significant and unavoidable. (See Exhibit 16, Final Environmental Impact Report/Statement from the Delta Tunnels project ("CWF FEIR/S"), p. 8-949.) This impact of the project contribution of methylmercury is both individually and cumulatively significant.

LAND-34 (Cont. below)

As described in the summary of the Delta tunnels' impacts, restoration actions identical or similar to the Prospect Island activities are known sources of methylmercury: "[U]ptake of mercury from water and/or methylation of inorganic mercury may increase in localized areas as part of the creation of new, marshy, shallow, or organic-rich restoration areas. Although not quantifiable, on a local level, increases in methylmercury concentrations may be measurable." (Exhibit 16, CWF FEIR/S, p. 8-949.) The CWF FEIR/S further identifies "the potential for increases in methylmercury concentrations in the Delta result in this potential impact being considered significant because, as described in the Discussion column *any potential* measurable increase in methylmercury concentrations would make existing mercury-related impairment measurably worse." (Exhibit 16, CWF FEIR/S, p. 8-950 [italics added].) This impact was found to be significant and unavoidable. (Exhibit 16, CWF FEIRS, pp. 8-949 to 8-950.) The DEIR and RDEIR's conclusions are belied by DWR's Delta Tunnels analysis, and are *not supported by substantial evidence.*

The RDEIR makes a series of technically unsubstantiated assertions, stating that some areas of the project site would have lower potential to form methylmercury and higher potential in others, but that somehow the net production will be less than existing conditions. (RDEIR, p. 5-133.) This is a shockingly unscientific narrative discussion

that fails to describe the mechanics of methylation, the spatial extent of those processes, their annual timing, the forcing processes, and the role that the increased dissolved organic carbon ("DOC") play in exacerbating methylmercury formation. Indeed, the RDEIR points directly to studies showing that similar and identical restoration actions lead to increased methylmercury formation (RDEIR, p. 5-134). The RDEIR attempts to distinguish these studies by claiming they "are based predominantly on data from salt marshes, with limited consideration of non-tidal freshwater wetlands and agricultural wetlands (e.g., rice fields) and no instances of freshwater tidal wetlands, such as the Proposed Project." (RDEIR p. 5-134.) DWR fails to explain how this trumped up distinction actually leads to a different result. Even if so, DWR has had many years and millions of dollars to conduct appropriate studies at Prospect Island and similar wetlands, but has chosen not to. *The project's facilitation of methylmercury accumulation would be significant and must be mitigated.* LAND-34 (Cont.)

Impact 3.2-5 Long-term effects on salinity in waterbodies near Prospect Island (RDEIR, p. 5-125)

Comment: The RDEIR does include changes to the discussion of Impact 3.2-5, however underlying modeling deficiencies continue to persist. (See RDEIR, p. 5-125 to 5-129.) The project design elements affecting hydrology, discussed above, would alter local tidal dynamics and could increase salinity. The RDEIR continues to rely on inadequate modeling, fails to establish practical standards, and fails to assure compliance with D-1641. *The RDEIR's conclusion for Impact 3.2-5 is not supported by substantial evidence.* LAND-35

Impact 3.2-8 Long-term effects on methylmercury production, bioaccumulation, and export (RDEIR, p. 5-132)

Comment: The RDEIR fails to adequately characterize the generation of methylmercury, a potent bioaccumulating neurotoxin, subject to the SWRCB's regulation and under a Total Maximum Daily Load. *This impact would be significant and mitigation is necessary*. LAND-36

Aquatic Biological Resources

Impact 3.3-11 Altered habitat and food web from invasion by Asian clam (DEIR, p. 3-128)

Comment: The project will create ideal habitat conditions for the Asian clam, identified as a major contributor to ammonia, and nutrient depletions generally in the Delta. The project impermissibly makes the conditions better for the clam's invasion, while making LAND-37 (Cont. below)

assertions that better nutrient cycling for desirable organism will occur without any merit or substantiation. *This impact would be significant and mitigation is necessary*.

> **Proposed Action:** An invasive clams and mussels monitoring and response plan or actionable performance standards for invasive species density would mitigate the facilitation of invasive species.

LAND-37 (Cont.)

Impact 3.3-12 Food web impacts from increased levels of methylmercury bioaccumulation (DEIR, p. 3-129)

Comment: The DEIR's premises its conclusion for Impact 3.3-12 on the inadequate analysis of methylmercury impacts. Moreover, the DEIR fails to adequately identify the food chain impacts, bioaccumulation, and bioconcentration of this toxin to local fish stocks and through the food chain to people, and piscivores, such as otters, belted kingfishers, osprey, and bald eagles. The DEIR simply fails to provide sufficient information for the public to understand the nature and scope of the impact. (DEIR, pp. 3-129 to 3-130.) These impacts could be acute to local fishers, and cumulative for all classes of impacted people and wildlife. *This impact would be significant and mitigation is necessary*.

LAND-38

Geology and Soils

Impact 3.5-2 Long-term effect on sediment deposition and erosion in the vicinity of Prospect Island (DEIR, p. 3-230)

Comment: The DEIR claims that sediment would accumulate in a beneficial manner without harming the Cache Sough complex, but fails to consider the massive sediment depletion by the Delta tunnel project. (DEIR, p. 3-230.) The first issue with this assumption is that the project analyzed sediment impacts by DWR and the findings were clear that: "Prospect Island acts as a considerable sediment sink and captures sediment that would otherwise be transported to Cache Slough and the Sacramento River DWSC." (Effects of Prospect Island Restoration on Sediment Transport and Turbidity (2014), p. iii.)

The DEIR inaccurately characterized the baseline sediment conditions, ignored its own science, and failed to use the cumulative depletion of sediment identified as a result of the Delta Tunnels project. According to the CWF FEIR/S, 11% of the Sacramento River sediment would be removed, causing "around 11% of sediment being removed from the Sacramento River, the main source of sediment for the Delta and downstream

LAND-39 (Cont. below)

subregions. In addition, sediment could be accreted (captured) in restored areas." (Exhibit 17, CWF FEIR/S, p. 11-3198.)

DWR does not provide any evidence that Prospect Island has sufficient sediment to maintain itself from scour from the project alone. If the Delta Tunnels project goes forward, it would make the existing conditions worse. However, what sediment is actually trapped on the restoration area, would have been historically transported to Cache Slough. Thus, Cache Slough would then be further deprived of sediment, a critical last refugia for the listed Delta Smelt. (See Exhibit 18, Independent Review Panel Report for the 2016 California WaterFix Aquatic Science Peer Review; Exhibit 19, Evaluation of the Effects of Prospect Island Restoration on Sediment Transport and Turbidity Presentation.) *This impact would be significant and mitigation is necessary.* LAND-39 (Cont.)

Air Quality

DEIR Appendix G Prospect Island Restoration Project Air Quality Calculations

Comment: According to DWR Counsel Appendix G Air Model Quality Calculation were not modified to reflect the updated Project Description in the RDEIR. (See Exhibit 9, DWR Letter, March 4, 2019.) However, the project has considerably changed as now the total number of truck trips exceeds 7,000.

The air quality analysis is focused on the emissions of the three-year construction phase of the project. (DEIR, App. G, p. G-1.) The DEIR assumes the use of the nearby quarry in Rio Vista, approximately 30 road miles away. (DEIR, App. G, p. G-2) The air emissions analysis does not use the distances of the further alternate quarry only identified as the "San Rafael" source of fill material (RDEIR, p. 5-175) and consequently fails to identify the significantly greater air quality impacts from those emissions for tugs driving barges travelling from that much greater distance. LAND-40 (Cont. below)

Appendix G, Table 4, Material Deliveries identifies the assumptions for the amount and location of fill materials and the means of transportation. (DEIR, App. G, PDF p. 19.) Specifically, Appendix G identifed a total fill material quantity of 94,800 cubic yards ("CY") for import by truck. However, by adding up the Table 2 column titled, "Current PD Table 2.2-2," the total of truck imported materials is 172,760 CY. Confusingly, Table 2.2-2 Prospect Island Natural Communities: Existing, As-Built, and Future—Proposed Project does not identify fill volumes.

That notation notwithstanding, all the calculations for air emissions inexplicably use the smaller transported volume for the analysis. This error also results in the air

emissions being significantly undercalculated. Compounding this error, the analysis as not updated for the 100 times greater number of truck trips proposed in the RDEIR. Specifically, the RDEIR identifies for the new, non-barge option increasing the number of one-way truck trips from 70 to 7,840 truck trips. (RDEIR, p. 5-175.)

The basic issue of the number of acres disturbed by the project varies wildly in the DEIR and RDEIR. Table 2.2-2 does not support the assumption in Appendix G that the project would only impact 500 acres. Similarly, Table 4.5-1, Prospect Island Natural Communities: Existing, As-Built, and Future Areas of Habitat Communities for Alternative 2, does describe the net conversion of 1,521.5 acres of habitat from one category to another. (RDEIR, p. 5-191.) This is the amount of disturbance that the project will impact not the approximately 500 acres identified in the Appendix G.

The distances trucks and barges would need to travel is also inconsistent. The roundtrip distance between the site and the Rio Vista quarry is estimated to be 60 miles for trucks or 14 miles for barges. However, Table 3-B Equipment Mobilization and Demobilization, identifies the distance to Dutra as 30 road miles roundtrip. (DEIR, Appen. G, p. 18.) The model inputs are manually overridden to be 50 miles. (DEIR, Appen. G, p. 45.) Furthermore, the calculations misleadingly use the much smaller quantity of imported materials, 94,800 CY, for trucked imported material in its calculation of air emissions. (DEIR, Appen. G, p. 22.)

LAND-40
(Cont. below)

Appendix G reveals that project construction activities are separated into 27 Tasks. The implication is that this Project is so complex that it requires an entirely separate analysis from the standard analysis already built into the standard Construction Model (Road Construction Emissions Model version 7.1.5.1). This is incorrect; each task is functionally the same as the standard activities used for construction, such as clearing the site, construction dewatering, access ramp, grading, excavation, fill, berm creation, etc. The segregation of the tasks is used to separate the impacts out of the normal Roadway model and mask the air quality impacts. (DEIR, App. G, Table 1-A: Construction Tasks, p. 11.)

The manipulation of the results to reduce project impacts is also evident in the program settings. Because the model outputs were manually recalculated, it is essentially impossible to verify what was actually done in the analysis. The Emissions Model readily accepts the length of time of the project and project phasing over years and by task. (DEIR, Appen. G, p. G-3.) By its own admission, the analysis states that the model works for all emission sources but helicopter and barge. (DEIR, Appen. G, p. G-2.) The Model allows for customization even for those values, but the DEIR deconstructed the Model in an incoherent manner, thereby preventing transparency and disclosure.

Even when the model was used, the assumptions or key drivers were modified. For example, the model entry included a 4-year period for the project construction time instead of the estimated 3-year length in the Project Description and project schedule. (See DEIR, Appendix G, Table 1-B Estimated Construction Implementation Timing, p. 12; see also DEIR, p. 2-52.) Similarly, the emissions analysis grossly underestimated the Total Project Area, assuming a total of 5 acres. (Road Construction Emissions Model Version 7.1.5.1 Data Entry Worksheet, PDF p. 44; see RDEIR, Table 2.2-3 and Table 4.5-1 [over 1,500 total acres impacted under proposed project and Alternative 2].)

LAND-40 (Cont.)

By manipulating the model through its non-standard application, the emissions analysis artificially reduced the maximum hourly emissions to below the YSAQMD thresholds. This manipulation violates CEQA for failing to put forth a good faith effort at full disclosure of the projects impacts. (CEQA Guidelines, §15151.)

Impact 3.7-3 Expose sensitive receptors to air pollutants and cause higher health risks (DEIR, p. 3-269)

Comment: Neither the DEIR nor the RDEIR adequately disclose or analyze the project's toxic air contaminant ("TAC") emissions or resulting human health impacts. (DEIR, p. 3-269; see RDEIR, pp. 5-149 to 5-158.) The DEIR simply contains no quantitative analysis of TAC emissions from stationary or mobile sources. (DEIR, p. 3-269.) The threshold of significance for TAC only considers exposure from stationary sources, totally excluding mobile sources. The DEIR's perfunctory analysis of Impact 3.7-3 merely assumes that because the project "is situated in a rural agricultural setting within the Yolo Bypass" that no sensitive receptors would be at risk. (DEIR, p. 3-269.) The total number of sensitive receptors is irrelevant to the analysis of TAC emissions; what is relevant is that sensitive receptors are present in the immediate vicinity of the project—merely 175 feet north of the project at Arrowhead Harbor Marina. (DEIR, p. 3-269; RDEIR, p. 5-153.) These "live aboard" vessels occupy the marina full time, and are located north of the northern edge of the Proposed Project area. There is no discussion of the potential impacts to Arrowhead Harbor, such as what direction the prevailing winds are, which is necessary to assess the risk

LAND-41

Additional sensitive receptors of mobile TAC emissions are on Ryer Island (RDEIR, p. 5-162), and along the haul routes of trucks accessing the project (RDEIR, p. 5-162). A number of residences are located approximately 500 to 1,500 feet east, southeast, and south of the Project site, across Miner Slough on Ryer Island. However, because the DEIR couches the analysis for Impact 3.7-3 in terms of stationary sources only, these receptors are ignored.

Furthermore, the air quality impacts to Rio Vista are never addressed despite the fact that import fill, riprap, and aggregate base will all originate from Rio Vista. (DEIR, App. G, Table 4.) Importing this material from Rio Vista would require approximately 4,733 round-trips. (*Ibid*.) This substantial amount of truck traffic would expose Rio Vista residents to potentially significant TAC emissions. LAND-42

DWR cannot rely on the fact that the Yolo Solano Air Quality Management District ("YSAQMD") does not have a threshold of significance for mobile TAC sources as an excuse to avoid analyzing such impacts. "[A] threshold of significance cannot be applied in a way that would foreclose the consideration of other substantial evidence tending to show the environmental effect to which the threshold relates might be significant." (See *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1109.) While the YSAQMD's CEQA Guidelines, last updated in 2007, might only address stationary sources, such guidance is readily available from other air districts with much more updated CEQA Guidance. (Exhibit 20, SMAQMD CEQA Guidelines; Exhibit 21, BAAQMD CEQA Guidelines, pp. 8-7-8-8).) A lead agency has a duty to inform itself about available methodologies for assessing an impact. (*Berkeley Keep Jets Over the Bay Comm. v. Board of Port Comm'rs* (2001) 91 Cal.App.4th 1344, 1367.) "[I]n preparing an EIR, the agency must consider and resolve every fair argument that can be made about the possible significant environmental effects of a project, irrespective of whether an established threshold of significance has been met with respect to any given effect. (*Ibid*.) Here, there is a fair argument that the project would have potentially significant air quality impacts from mobile TAC emissions and ultrafine particle ("UFP") emissions, and methodologies exist to meaningfully quantify emissions and correlate such emissions to possible human health impacts. LAND-43

The failure to consider any mobile TAC emissions in the air quality analysis is troubling given the incredible amount of evidence of the associated health risks—some released following circulation of the original DEIR. Diesel exhaust is not only linked to increase cancer risk as a TAC, but also to physical changes in children's brain structure, and mental issues due to prenatal exposure. (Exhibit 21, Cahill, Ch. 7, p. 68.) Large trucks are a primary source of diesel emissions. (See Exhibit 21, Cahill, Ch. 7, pp. 70-71.) The decision to not consider mobile TAC sources such as diesel engines is all the more dubious because it accounts for 70 percent of all airborne toxic effects of TACs combined. (Exhibit 21, Cahill, Ch. 7, p. 68.) The RDEIR cannot ignore mobile TAC sources and associated potentially significant health risk on sensitive receptors adjacent to the project's footprint, including Rio Vista as the source of fill material. LAND-44

Beyond diesel exhaust, UFPs are another air quality impact not discussed in either the DEIR or RDEIR. UFPs, particles with diameters less than 0.1 micrometers, LAND-45 (Cont. below)

comprised mostly of metals that are known constituents of brake pads and drums, as well as additive in motor oil. (Exhibit 21, Cahill, Ch. 8, p. 80.) Generally, all engines can create UFPs, but especially diesel engines, and any vehicle's braking system. (Exhibit 23, Cahill, Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 1: 2003–2007, p. 1130.) Traffic, particularly start-and-stop, generates UFPs. (See Cahill, Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 1: 2003–2007, p. 1131.) Recent research suggests that UFPs pose considerable health risks, such as increased risk of cardio-vascular disease and ischemic heart disease death rates, and loss of lung function. (Exhibit 24, Cahill, Artificial ultra-fine aerosol tracers for highway transect studies, pp. 31-32; see also Exhibit 25, Cahill, Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 2: 1974–1991; Cahill, Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 1: 2003–2007.) "The strongest correlations to [ischemic heart disease] mortality were found in very fine . . . to ultrafine metals, with most tied to vehicular sources." (Exhibit 23, Cahill, Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 1:2003–2007, p. 1133.)

LAND-45 (Cont.)

The DEIR and RDEIR do not ever mention UFPs as a potentially significant air quality impact. The considerable construction traffic would increase UFP emissions along the shipping routes, and poses a significant health risk to sensitive receptors along those routes.

An "EIR must provide an adequate analysis to inform the public how its bare numbers translate to create potential adverse impacts or it must adequately explain what the agency does know and why, given existing scientific constraints, it cannot translate potential health impacts further." (*Sierra Club v. County of Orange* 6 Cal.5th 502, 522 (*Friant Ranch*).) Here, DWR has not even attempted to inform the public of the "bare numbers" with respect to mobile TAC or UFP emissions, let alone translate those numbers into quantifiable adverse impacts. The failure to do so is inexcusable given that recent scientific studies demonstrate that it is feasible to correlate TAC and UFP emissions levels to resulting human health risks.

LAND-46

Despite its own evidence that there are substantial new toxic sources created by the project, carcinogenic and other TACs are not analyzed, and the RDEIR simply asserts that they are less than significant. (DEIR, p. 3-269.) A full TAC analysis should be completed for these sensitive receptors in order to understand the nature and extent of these impacts on the adjacent sensitive receptors.

Agricultural and Forestry Resources

Impact 3.12-3 Potential effects to agricultural uses on adjacent lands

Comment: The seepage and levee damage described above would negatively impact agriculture on Ryer Island. The RDEIR does not update the analysis of Impact 3.12-3. (See DEIR, p. 3-306.) The analysis in the DEIR is perfunctory and deficient, relying on the inadequate analysis of seepage and levee damage caused by the project. (*Ibid*.) The DEIR implicitly acknowledges that such impacts would adversely affect agriculture on Ryer Island. (*Ibid*.) Thus due to the failure to adequately disclose and analyze the project's seepage and levee damage impacts, the conclusion that the project would not impact agriculture on Ryer Island is unsupported by substantial evidence. LAND-47

Transportation and Traffic

Impact 3.17-1 Potential traffic impacts during construction (RDEIR, p. 5-173)

Comment: The RDEIR fails to quantify the project's traffic impacts despite the massive increase in total truck trips. Rather than comply with its duty to quantify traffic impacts, the RDEIR instead hides behind meaningless generalizations, such as "traffic loading on public roads may be high" and that "mitigation may be required." (RDEIR, pp. 5-175 to 5-176.) Nowhere does the RDEIR provide an adequate quantitative or even qualitative analysis. (*Berkeley Keep Jets Over the Bay Com. v. Board of Port Cmrs*. (2001) 91 Cal.App.4th 1344, 1369-1370.) Further confusing the issue is DWR's reluctance to commit to either the barge or trucking options. LAND-48

DWR cannot rely on the imposition of mitigation to absolve its fatal analytical error. Merely claiming that a project impact would be potentially significant "does not excuse the EIR's failure to reasonably describe the nature and magnitude of the adverse effect." (*Cleveland National Forest Foundation v. San Diego Assn. of Governments* (2017) 3 Cal.5th 497, 514 (*Cleveland*); *Berkeley Keep Jets Over the Bay Com. v. Board of Port Cmrs.* (2001) 91 Cal.App.4th 1344, 1371; *Galante Vineyards v. Monterey Peninsula Water Management Dist.* (1997) 60 Cal.App.4th 1109, 1123.) An EIR must still provide an adequate description of adverse impacts in order to "inform the critical discussion mitigation measures and project alternatives at the core of the EIR." (*Cleveland, supra*, 3 Cal.5th at 515; see also CEQA Guidelines, § 15151.) Here, DWR has utterly failed to "reasonably describe the nature and magnitude" of the project's traffic impacts. (RDEIR, pp. 5-175 to 5-176.) *DWR has therefore failed to proceed in a manner required by law.* LAND-49

Comment: The DEIR failed to consider or disclose multiple potentially significant transportation impacts, and that analytical fault continues in the RDEIR. (See DEIR, pp. 3-342 to 3-344; RDEIR, pp. 5-173 to 5-177.) First, the RDEIR ignores the additional fatalities and injuries associated with additional heavy truck traffic even on multilane-divided highways. (See Exhibit 26, Moridpour et al., Impact of heavy vehicles on surrounding traffic characteristics (September 2014).) LAND-50

Second, the DEIR and RDEIR ignore degradation of local roads as a transportation impact. (See DEIR, pp. 3-342 to 3-344; RDEIR, pp. 5-173 to 5-177.) They also ignore the impacts to infrastructure including the local weight-limited bridges and kingpin-length limited roads. (Exhibit 27, Luskin & Walton, Effects of Truck Size and Weights on Highway Infrastructure and Operations: a Synthesis Report (March 2001).) As discussed above, the RDEIR discloses an exponential increase in truck traffic necessary to construct the project. (RDEIR, p. 4-9.) Given that the project would now require over 7,000 vehicle trips, DWR must disclose and analyze the impacts of those trips on local roads and infrastructure, including whether they are in adequate condition for this additional use by such heavy equipment. Indeed, neither the DEIR or RDEIR discuss the impacts on the levee roads from the heavy truck traffic, the geotechnical stability of the critical infrastructure levees following that project heavy truck traffic, or damage to the road surface (blacktop) from the traffic. The gross gaps in analysis and even basic understanding of the roadways is almost like the preparers of the RDEIR had never been to the Delta. *These impacts must be fully disclosed and analyzed.* LAND-51

Alternatives

Alternative 2: Two Breaches and Weir (RDEIR, p. 5-188)

Comment: The RDEIR's discussion of Alternative 2 is completely silent on any erosion due to velocity of exiting waters out of the breach into Miner Slough or wind impacts to RD 501's adjacent tip levee. (See RDEIR, Figure 2.2-9.) The analysis in the RDEIR, as well as the DEIR, did not account for flood or high water surface elevations. Under high water or flood conditions, when the northern weir is overtopping and substantial higher river stages are present, the likelihood of erosion would increase exponentially since the water forces will be hitting a higher elevation on the RD 501 levee that are not typically exposed to water and very susceptible to erosion. LAND-52 (Cont. below)

Proposed Actions: The buffering of the windward side of the Prospect levee is important to reduce the wave run-up and eventual degrading of the Prospect levee from the interior. Utilizing proper slopes would reduce this damage and allow the levee to remain intact with a minimum of maintenance. It is critical that this levee

be inspected annually and maintained by a qualified registered civil engineer with experience in Delta levees. DWR should commit to funding the maintenance of this levee for the life of the project. Plantings should be allowed to grow at least for 3-5 years before being exposed to deep water wave run-up.

Additionally, placing rock or riprap on the Ryer levee across from the breach, constructing dirt or rock groins on the inside of the levee to reduce wind and wave energy, and post-project monitoring of scour on the levee would be necessary to mitigate the potential impacts of Alternative 2. Without such mitigation, Alternative 2 has the potential to have even more severe impacts on the neighboring levees.

LAND-52 (Cont.)

III. CONCLUSION

DWR fails at virtually every step to take in account expert analysis contrary to its assertions. It also diminishes potential impacts and, when impacts are identified, fails to apply even basic mitigation measures. DWR must correct the RDEIR to fully disclose, analyze and mitigate all project impacts. Only through an adequate environmental review process can this project be a success both for the proponents and for the neighboring islands and land-owner.

LAND-53

Very truly yours,

SOLURI MESERVE
A Law Corporation

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Exhibits

Exhibit 1 – DWR Letter to Osha Meserve, February 20, 2019

Exhibit 2 – LAND Letter to DWR, November 4, 2014

Exhibit 3 – LAND Letter to DWR, November 7, 2016

Exhibit 4 – LAND Letter to DWR, February 15, 2017

Exhibit 5 – LAND Letter to DWR, November 7, 2017

Exhibit 6 – LAND Comments on February 2018 DWR Hydrologic Analysis Report Prospect Island Tidal Habitat Restoration Project Solano County, California, August 20, 2018

Exhibit 7 – LAND Proposed Good Neighbor Policies and Mitigation Measures

Exhibit 8 – California WaterFix Mitigation, Monitoring, and Reporting Program Excerpt

Exhibit 9 – DWR Letter to Osha Meserve, March 4, 2019

Exhibit 10 – Delta Plan Best Available Science Framework

Exhibit 11 – LAND Comments on USACE Section 408 Application, March 29, 2018

Exhibit 12 – Pitcairn et al., Yellow Starthistle continues its spread in California (2006)

Exhibit 13 – Written Testimony of Erik Ringelberg for California WaterFix State Water Resources Control Board Water Right Change Petition Hearing

Exhibit 14 – Harmful Algal Bloom Fact Sheet

Exhibit 15 – Berg & Sutula, Factors Affecting Growth of Cyanobacteria (August 2015)

Exhibit 16 – California WaterFix Final Environmental Impact Report/Statement, pp. 8-949 to 8-950

Exhibit 17 – California WaterFix Final Environmental Impact Report/Statement, p. 11-3198

Exhibit 18 – Independent Review Panel Report for the 2016 California WaterFix Aquatic Science Peer Review

Exhibit 19 – Evaluation of the Effects of Prospect Island Restoration on Sediment Transport and Turbidity Presentation, February 26 2014

Exhibit 20 – Sacramento Metropolitan Air Quality Management District CEQA Guidelines for Toxic Air Contaminants

Exhibit 21 – Bay Area Air Quality Management District CEQA Guidelines for Toxic Air Contaminants

Exhibit 22 – Cahill, I can breathe clearly now. Protecting yourself from air pollution (2017) Chapters 7 Diesel Exhaust and 8 Copper and Other Ultra-fine Transition Metals

Exhibit 23 – Cahill et al., Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 1: 2003–2007 (2011) Aerosol Science and Technology, 45:9, 1123-1134

Exhibit 24 – Cahill et al., Artificial ultra-fine aerosol tracers for highway transect studies (2016) Atmospheric Environment, 136, 31-42

Exhibit 25 – Cahill et al., Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 2: 1974–1991 (2011) Aerosol Science and Technology, 45:9, 1135-1142

Exhibit 26 – Moridpour et al., Impact of heavy vehicles on surrounding traffic characteristics (2015) Journal of Advanced Transportation, 49, 535-552

Exhibit 27 – Luskin & Walton, Effects of Truck Size and Weights on Highway Infrastructure and Operations: A Synthesis Report (2001)

EXHIBIT 1

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY **GAVIN NEWSOM,** *Governor*

DEPARTMENT OF WATER RESOURCES

1416 NINTH STREET, P.O. BOX 942836

SACRAMENTO, CA 94236-0001

(916) 653-5791

February 20, 2019

Osha R. Meserve
Soluri Meserve
510 8th Street
Sacramento, California 95814

Dear Ms. Meserve:

I write to give you an update regarding the Draft Environmental Impact Report (DEIR) for the Proposed Prospect Island Tidal Habitat Restoration Project (Proposed Project). In an ongoing effort to be good neighbors and transparent in the decision-making process for this Proposed Project, we want to let you and the Local Agencies of the North Delta (LAND) and Reclamation District 501 (RD 501) know that the DEIR for the Project will soon be partially recirculated. We want to highlight for you some of the issues that were previously discussed under our confidentiality agreement, some of which will be included in the Partial Recirculated DEIR. We hope that the changes described below will provide the clarity you have requested regarding the Proposed Project. You and other members of the public will have 45 days to review and comment on the changes. Separate from the DEIR, we also provide Department of Water Resources (DWR) review of the Seepage Impact Analysis prepared by ENGEO Incorporated (ENGEO Report) and submitted by LAND and RD 501 (Attachment 2).

Changes to the DEIR

Following is list of some of the changes and decisions we will make regarding the DEIR. These changes are based upon a number of factors including several new technical reports: land acquisition of a private parcel on Prospect Island; review of comments received on the previously circulated DEIR, including our confidential discussions with you, LAND and RD 501; additional technical information and preliminary construction design options being evaluated as part of natural Project progression; and further analysis of some of the impacts identified in the previously circulated DEIR.

- DWR will recirculate the following sections of the DEIR:
  - 2 *Proposed Project Description*;
  - Impacts 3.1-3, 3.1-4, 3.1-5, and 3.1-6 in 3.1 *Hydrology (Surface and Groundwater);*
  - Impacts 3.2.5 and 3.2.8 in 3.2 *Water Quality (Surface and Groundwater);*
  - Impacts 3.17-1 and 3.17-2 in 3.17 *Transportation and Traffic;*
  - Impact 3.10-1 in 3.10 *Noise;*
  - Impacts 3.7-1 and 3.7-2 in 3.7 *Air Quality;* and

- 4 *Alternatives*.

- Monitoring of groundwater and surface water levels following Proposed Project completion will be removed from the DEIR because the analysis has shown that monitoring is not necessary to support the impact determinations.

- Routine monitoring of the Miner Slough levee along Ryer Island and funding of any necessary levee repairs will be removed from the DEIR because the analysis has shown that this is not necessary to support the impact determinations. Note that levee repairs included in the Proposed Project design are shown on Figure 2.2-3 (Attachment 3).

- Access to technical reports that were completed pre and post circulation of the DEIR will be included in the Partial Recirculated DEIR. You can also visit this website for access to Project documents: https://water.ca.gov/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects. Reports relevant to this letter that have been completed subsequent to previous circulation of the DEIR are summarized in Attachment 1 of this letter and include: RMA 2016, and DWR 2018a, b. The links that are provided in the Attachment are the same as those that will be provided in the Partial Recirculated DEIR.

- Corresponding alternatives discussions have been updated as appropriate. A hydrodynamic modeling report (RMA 2016) was developed for alternative 2 of the DEIR. Although the Proposed Project remains DWR's proposed preferred alternative at this time, alternative 2 has fewer environmental impacts and may become DWR's preferred alternative after consideration of all public comments (see the Proposed Project and alternative 2 design configurations in Attachment 3).

We are confident in the EIR impact analyses and stand by our previous significance determinations. No hydrologic mitigation measures will be included in the DEIR since the analyses in the Partial Recirculated DEIR support DWR's original analyses that the hydrology impacts will be less than significant without need for mitigation. Nevertheless, DWR has or will carry out the following actions to alleviate some of your concerns.

Groundwater Seepage Concerns

You have previously expressed concerns that groundwater seepage post-construction of the Proposed Project would impact Ryer Island and associated farming activities. Following your requests from November 2017, please note that weblinks for the "multi-year groundwater and surface water study" (DWR 2014), and the "analysis of new hydrologic data collected since the completion of the above study" (DWR 2018) are

provided in Attachment 1. DWR (2014) is discussed in Impacts 3.1-3 and 3.1-6 of the Partial Recirculated DEIR, and DWR (2018) is discussed in Impact 3.1-3 of the Partial Recirculated DEIR. The analysis supports the determination that no mitigation for potential seepage impacts on Ryer Island is necessary.

If DWR decides to move forward with the Proposed Project or one of the alternatives, DWR intends to continue monitoring existing wells on Prospect and Ryer Island as part of its ongoing efforts to document hydrologic activity in the area. This monitoring is not discussed in the Partial Recirculated DEIR because the analysis has shown that such monitoring is not necessary to support the impact determination of no significant impact.

Scour Concerns

You have previously expressed concerns that breaching of the Miner Slough levee of Prospect Island may cause localized cross-currents that may result in erosion of the Ryer Island levee. Additionally, you have also expressed concern that the post-restoration conditions will result in increased channel velocities and potential erosion or scour of the channel bed and the toe of the Ryer Island levee. As described in the Project and alternatives descriptions, the Proposed Project and alternatives have been designed such that the number of breaches and location of breaches, at channel bends to align with flows and avoid cross-channel velocities, limit potential for scour (SWS and WWR 2012). As discussed in our May 2017 workshops, levee scour by cross-currents were previously assessed during restoration planning and hydraulic modeling and showed no potential for erosion by cross-currents at levee breaches. This information was and continues to be discussed in Impact 3.1-5 of the Partial Recirculated DEIR.

With regard to potential scour due to increased velocities in Miner Slough, please see Appendix K in SWS and WWR 2012, and Impact 3.1-5 of the Partial Recirculated DEIR. For the Proposed Project, modeling data show no increases in water velocities downstream of the proposed northern breach and only minor increases in velocities downstream of the southern breach location (Appendix K in SWS and WWR 2012). Similarly, for alternatives 2 and 3, only minor increases in velocity were identified in the southern end of Miner Slough, which were below thresholds for scour of the Miner Slough bed materials (RMA 2016; Appendix K in SWS and WWR 2012). Therefore, no changes to the analysis or significance determinations included in Impact 3.1-5 of the DEIR have been made.

If DWR decides to move forward with the Proposed Project or one of the alternatives, DWR intends to undertake bathymetric surveys pre- and post-construction as part of its ongoing efforts to document hydrologic activity in the area. These surveys are not discussed in the Partial Recirculated DEIR because the analysis has shown that such surveys are not necessary to support the impact determination of no significant impact.

Wind Fetch and Wind Wave Erosion Concerns

You have previously expressed concerns that potential erosion of the Prospect Island

levee would lead to increased wind fetch and wind wave erosion of the Ryer Island levee, and that wind wave erosion of the Ryer Island levee may be increased by wind fetch through levee breaches.

In addition to the construction of toe berms and intertidal benches along the interior of the Prospect Island levee of Miner Slough, DWR will plant and provide water to emergent and riparian plants for one year prior to levee breaching in the design of the Proposed Project and alternatives. As discussed during our workshop, DWR will site the northernmost breach of the Proposed Project and alternatives such that waves occurring in the predominant wind direction do not directly impinge on the Ryer Island levee. In addition, exposed levee ends at one breach will be armored, depending on the alternative selected. These actions are discussed in Impact 3.1-4 in the Partial Recirculated DEIR. The Partial Recirculated DEIR does not include any mitigation measures for potential erosion impacts because the analysis has shown that mitigation is not necessary to support the impact determination of no significant impact.

DWR believes that the Proposed Project and alternatives design and the impact analyses have benefitted from our confidential discussions. As we move into this next stage of a Partial Recirculated DEIR, we believe it is time to end the confidential nature of any discussions. We look forward to ongoing communication with you as we continue with planning for the Proposed Project. As in the past, inquiries relating to the Proposed Project should be directed to:

Dan Riordan
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Fish Restoration Program
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Dan.Riordan@water.ca.gov

Sincerely,

Michelle Morrow
Assistant Chief Counsel

Attachments

Attachment 1
Project References
Relevant Project Reports Referenced in the 2016 DEIR:

DWR 2013. Site Characterization and Groundwater Monitoring Data Collection Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum Report. North Central Region. June. Site Characterization and Groundwater Monitoring Data Collection Summary

DWR 2014. Site Characterization and Groundwater Monitoring Data Analysis Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum Report. DWR, North Central Region. January. Site Characterization and Groundwater Monitoring Data Analysis Summary

SWS and WWR (Stillwater Sciences and Wetlands & Water Resources). 2012. Prospect Island Tidal Restoration: Synthesis of Phase 1 screening-level modeling evaluation of conceptual restoration alternatives. Final Report. Prepared for California Department of Water Resources, West Sacramento by Stillwater Sciences, Davis, and Wetlands & Water Resources, Inc., San Rafael, California. Contract No. 4200009291. Phase I Modeling Results Synthesis Final Report (September 2012)
Phase I Modeling Results Synthesis Final Report Appendices A-K

WWR and SWS. 2013. Prospect Island Tidal Restoration: Supplemental Phase 1 screening-level modeling results memorandum. Prepared for California Department of Water Resources, West Sacramento, by Stillwater Sciences, Davis, and Wetlands & Water Resources, Inc., San Rafael, California, with assistance from Resource Management Associates, Fairfield, California.
http://www.water.ca.gov/environmentalservices/docs/frpa/Supplemental_Prospect_Screening_Level_Model_Results_Memo_Final.pdf

WWR and SWS. 2014. Phase 2 modeling synthesis report. Prospect Island Tidal Habitat Restoration Project. Final report, Contract No. 4200009291. Prepared by Wetlands and Water Resources, Inc., San Rafael and Stillwater Sciences, Davis, with assistance from Resource Management Associates, Fairfield, and Delta Modeling Associates, San Francisco, California for California Department of Water Resources, West Sacramento, California. Phase II Modeling Synthesis Final Report (July 2014)
Phase II Modeling Synthesis Final Report Appendices A-D

Relevant Project Reports Completed Since Circulation of the 2016 DEIR:

DWR 2018a. Prospect and Ryer Island Hydrologic Data Analysis, October 1, 2013 to April 1, 2017, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum report prepared by California Department of Water Resources, February. Prospect and Ryer Island Hydrologic Data Analysis

DWR 2018b. Review of ENGEO's Seepage Impact Analysis, Reclamation District 501, Prospect and Ryer Islands, Solano County, California, July 14, 2015, ENGEO Incorporated. Memorandum prepared by California Department of Water Resources, February.

RMA (Resource Management Associates, Inc.). 2016. Hydrodynamic Modeling Analysis for 100-year and 200-year Flood Events, Prospect Island Tidal Habitat Restoration Project. Technical Memorandum. Resource Management Associates, Davis, California.
http://www.water.ca.gov/environmentalservices/docs/frpa/Attachment_4_Prospect_100y_and_200y_Flood_Modeling_111616.pdf

Attachment 2
California Department of Water Resources Memorandum: Review of ENGEO's Seepage Impact Analysis, Reclamation District 501, Prospect and Ryer Islands, Solano County, California, July 14, 2015, ENGEO Incorporated

Attachment 3
Relevant Figures

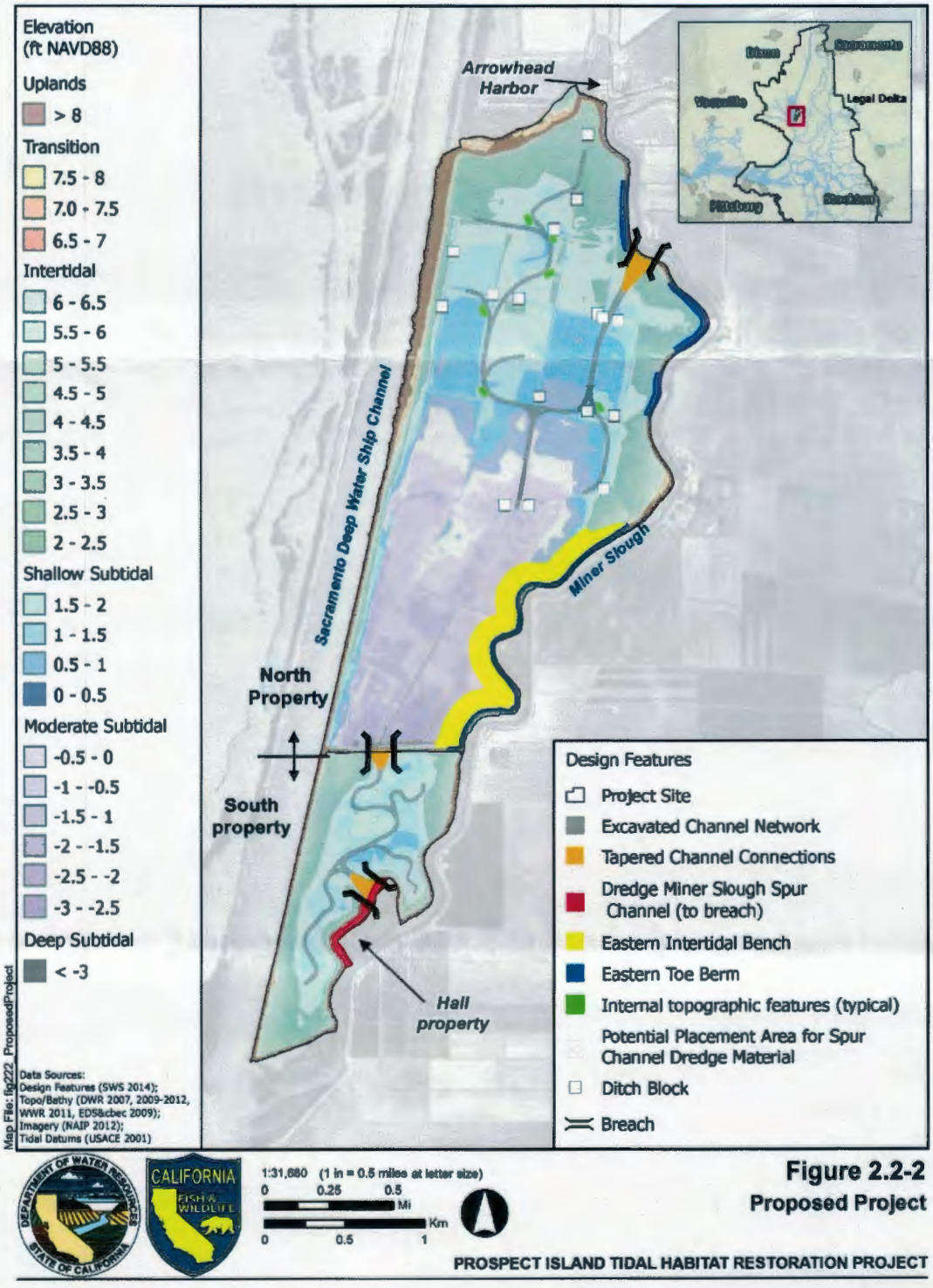

Figure 2.2-2
Proposed Project

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

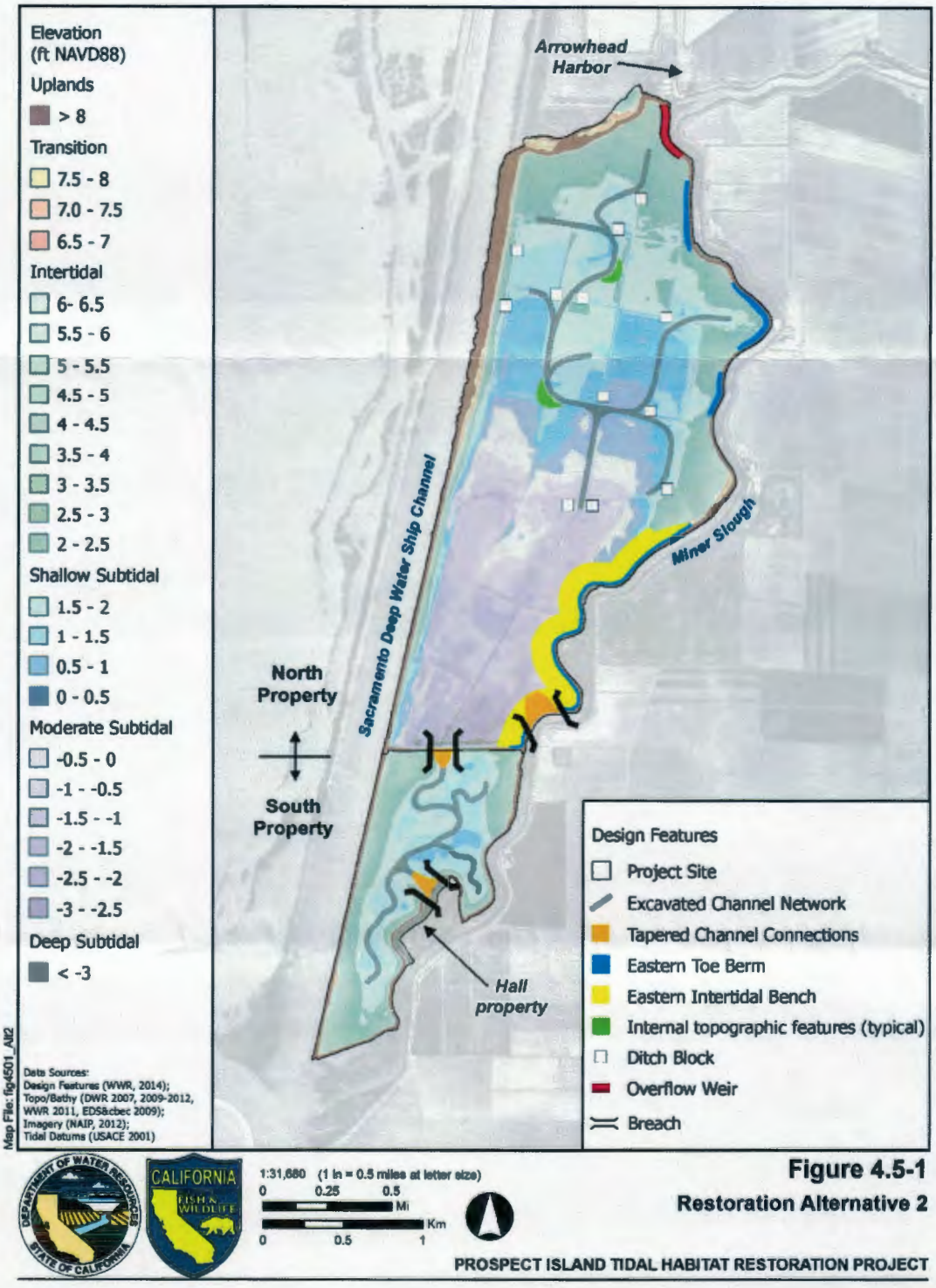

Figure 4.5-1
Restoration Alternative 2

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

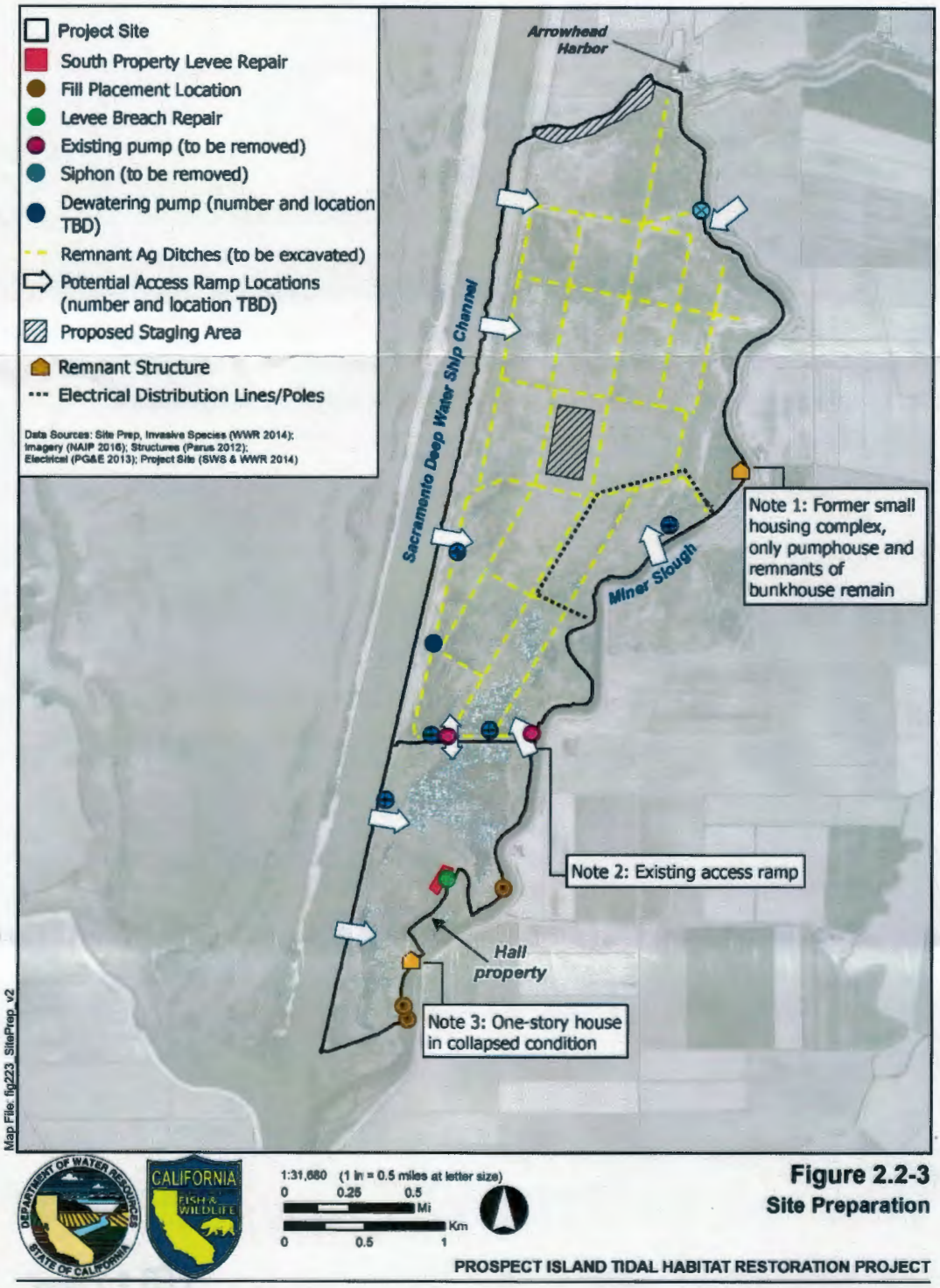

Figure 2.2-3
Site Preparation

PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

EXHIBIT 2

LOCAL AGENCIES OF THE NORTH DELTA

1010 F Street, Suite 100, Sacramento, CA 95814
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November 4, 2014

SENT VIA EMAIL (Dan.Riordan@water.ca.gov)

Dan Riordan
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

RE: Early Input on Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

These comments on the proposed Prospect Island Tidal Habitat Restoration ("project") are submitted on behalf of the Local Agencies of the North Delta ("LAND"). LAND is a coalition comprised of reclamation and water districts in the northern geographic area of the Delta.[1] As local agencies in the areas most impacted by the restoration projects such as that now proposed on Prospect Island, we are providing these comments to assist in the design and environmental analysis of a project that achieves the project goals and at the same time provides effective mitigation of project impacts to nearby flood protection facilities and agricultural operations.

We understand the Environmental Impact Report for the project is underway, and request that the issues discussed in this letter be addressed in that document. These comments do not attempt to catalog every possible issue, but rather, expand on prior discussions with staff. These comments are in addition to prior scoping comments from LAND-associated Reclamation Districts ("RDs") 501 and 999.

We also wish to thank you and other DWR staff for taking the time to discuss this project with us early in the planning process and look forward to working with DWR and its consultants to further develop a project that is both beneficial for the Delta ecosystem and also acceptable to local landowners and districts.

---

[1] LAND member agencies cover an approximately 110,000 acre area of the Delta; current LAND participants include Reclamation Districts 3, 150, 307, 317, 349, 407, 501, 551, 554, 556, 744, 755, 813, 999, 1002, 2111, 2067 and the Brannan-Andrus Levee Maintenance District. Some of these agencies provide both water delivery and drainage services, while others only provide drainage services. These districts also assist in the maintenance of the levees that provide flood protection to homes and farms.

I. PROJECT OVERVIEW

- The project intends to take what is currently vacant, retired agricultural land and convert it to tidal habitat, within some portion of the existing levee system.

- The project will remove portions of the existing levee and or reduce their height to allow Sacramento River water to enter from the Sutter, Steamboat and Miner Sloughs.

- The project will pond water for extended periods of time or be connected to "live flows" of the river.

II. COMMENTS

Habitat projects in the Delta have had a variety of outcomes, many of which are not intentional or even fully understood. LAND has actively worked with DWR and other parties to attempt to better understand the potential impacts of these habitat projects on reclamation and water districts and their agricultural operations and residents. The results of millions of dollars of restoration efforts in the Delta have been poorly documented, poorly monitored, and ecologically uncertain. For instance, despite over 40,000 acres of publically held or managed intertidal and open water habitat in the Delta primary zone, and 116,000 acres in Suisun, native fish species declines do not appear to be stabilizing. Moreover, the vast majority of publically held land in the Delta receives little or no invasive weed management, ecological monitoring, or any ecological site management.

Though past restoration successes have been limited, we believe it is possible for the proposed project to be a showcase for effective community and RD engagement in the context of habitat creation or restoration projects in the Delta. To that end, LAND proposes that the project planning consider, and implement key project features and address the underlying scientific, technical and economic questions before proceeding on the project. Our comments are organized into the following categories and discussed in detail below: Communications, Technical Premises, Operations and Maintenance, and Mitigation, Monitoring and Funding.

Issue 1 – Communications

DWR has undertaken direct communications with the local RDs and LAND, and has also provided a field visit to discuss the proposed project features. These efforts are very important for the common understanding of the physical elements of the project, as well as understanding of the potential impacts of the project and possible mitigation under CEQA. LAND appreciates these efforts and urges their expansion for this and

future projects. Early communication can significantly reduce costs and delays that occur when projects lack local community support and/or acceptance; such communications can lead to early inclusion of project features to enhance compatibility with adjacent land uses and effective mitigation from the outset, thereby avoiding unnecessary conflict. The long-term success of the project will also require the clear communication with neighboring landowners and RDs.

Issue 2 – Technical Premises

LAND has found that in some cases that the scientific basis for the habitat restoration in the Delta is thin at best and is far likelier to improve conditions for the very invasive species that currently "stress" the Delta ecosystem. It is important that the technical basis for restoration elements be clearly articulated, and where habitat creation is being used, that that premise is identified as well. Under the existing conditions (baseline) there is high riparian and wetland bird use at the site; thus, the explicit tradeoffs between current uses by species and projected benefits for other species in the future need to be identified.

Elevations

LAND has reviewed several LiDAR elevation figures for the island and it appears that there may be some discrepancies associated with the current elevations and the proposed design elevations. It would be critical for the success of the project that an independent review by a licensed surveyor of the survey, bathymetry, and LiDAR data occur to ensure that the vertical datum and the control points for these data are correct and consistent. The vertical error associated with some LiDAR data in general and the use of too widely spaced control points can lead to significant cut and fill errors that will prevent the project from meeting its design requirements.

Salinity, Nutrients and Toxins

The project design has a high possibility of altering local tidal dynamics, sediment deposition in and around Cache Slough, reducing available nitrogen, and increasing salinity. Suisun Marsh projects and their operations have a clear potential to change tidal dynamics and salinity intrusion throughout the northern Delta; when those effects are combined with this project and other DWR' barrier projects throughout the Delta, there are similar confounding effects, which must be identified and planned for effectively.

The same complexities are associated with the premise that nutrients would be exported from this site. The tradeoffs between nutrient cycling that occurs there now and the proposed conditions should be analyzed. For example, any unoxidized organic matter currently being trapped onsite would be exported, with greenhouse gas implications,

which must identified. This would also include the need for analysis of localized eutrophication and toxic cyanobacterial blooms, and conversely the depletion of local nitrogen and reduction of productivity in the Cache Slough complex.

Accordingly, the project's facilitation of invasive aquatic weeds and invasive clams, and the potential for new mussel invasions must be fully analyzed. For example, if the project intent is to export nutrients, how will the project ensure that it simply does not promote these invasives and export methylmercury (dissolved and sediment-associated) into the food chain?

Sediment

Sediment dynamics must be fully disclosed. The site sediment mechanics (assessing the local distribution of sediment) need to be fully described from a seasonal, as well as an early and late project perspective. The local-regional sediment balance should also be identified, and the implications of the long-term decline of sediment in the Sacramento River system on the project performance should be fully described. Equally importantly, the implications on sediment mechanics as a result of this project on other nearby locations should also be described.

Sediment plays a complex role in aquatic ecosystems. Too much sediment in high elevation streams can cause significant water quality problems and lead to fish declines. In the Delta however, sediment provides visual cover for some fish, such as Delta smelt, which protects them from predators. Sediment is also the building block for streambanks through over bank deposits. Sediment is critical for the maintenance of floodplains and the associated riparian habitat by creating the new locations for plants to grow and for creating and maintaining topographic complexity.

Reductions in stream sediment loads can also lead to scouring, where previously accumulated sediment is stripped and mobilized from existing floodplains. Project-associated invasive aquatic (and some terrestrial) weeds can also lead to the additional removal of sediment, exacerbating this problem.

Seepage and Erosion

The extent and impact of project-associated seepage and wave run-up at any levee breaks is unclear. The seepage modeling should be supported with a tracer study, and a 3–dimensional analysis for erosion on neighboring levees. Optimization of intake locations to minimize hydraulic effects is also essential. Inclusion of operable gates could also minimize impacts of the project on neighboring levees. Additionally, construction of cutoff walls, installation of interception wells, or other means, may be necessary to control seepage to adjacent islands. Moreover, mitigation in the form of

levee maintenance funds for the neighboring islands will likely be necessary due to hydraulic and other effects of the project.

Weed Management

Terrestrial weeds such as white top (perennial pepperweed) and Arundo, which interfere with crops and levee maintenance, and aquatic weeds, such as Hydrilla, Hyacinth and Egeria, which clog pumps and wildlife impacts, have to be carefully managed and their management fully funded for the life of the project.

Issue 3 – Mitigation, Monitoring and Funding

Mitigation, monitoring and reporting plans ("MMRP") are required by CEQA and this project will have ongoing impacts that will require follow-up and long-term funding. This project will be under considerable scrutiny to ensure it meets those requirements, especially in light of the even more extensive habitat restoration/creation contemplated by the Bay Delta Conservation Plan ("BDCP"). All impacts that require mitigation must be clearly identified in the MMRP and be adequately funded.

The funding should include adequate compensation for the expected types and extents of impacts with a contingency. Typical small claims of road and fence damage, damage to irrigation and drainage facilities, localized groundwater impacts from dewatering or restoration, weed management issues, and loss of access to property can be handled in an expeditious and fair manner by maintaining a mitigation fund for the project. For instance, funding for levee stability if erosion occurs on neighboring levees should be clearly identified. Weeds and the island's own remaining levees will require routine maintenance, as will ongoing environmental monitoring under adaptive management.

Issue 4 – Operations and Maintenance

Operations and maintenance are where these projects typically fail to meet their goals and objectives. The Delta has numerous examples of "restoration projects" that have environmental impacts that were not intended. A long-term management plan and associated funding are critical to maintain these goals and objectives and to meet the requirements under CEQA. DWR cannot expect to meet its CEQA analysis and its adaptive management requirements through a passive management approach. The current condition of the island is a direct result of the passive approach and a lack of funding.

Issue 5 – Water Rights and New Diversion

The project must identify the source and legal rights to water. Specifically the project must identify the legal water rights basis (including compliance with the no injury rule), and the point of diversion by which water will be diverted away from the Miner Slough and drained into the Sacramento Deep Water Ship Channel/Cache Slough Complex. The environmental impacts of diverting additional water from the slough must also be addressed. According to DWR data, open water and riparian vegetation consume about 67.5 acre-feet per year, which is much greater than most agricultural uses. (See Exhibit A.)[2] Additionally, the project's potential to further reduce outflow must also be considered.

Issue 6 – Good Neighbor Issues

An ongoing focus of LAND has been to minimize the local impacts from restoration projects. In general, the project should include "good neighbor policies." This includes adequate planning, monitoring and maintenance funding to ensure that impacts such as seepage, increased levee erosion, invasive weeds, and other issues are managed effectively so as not to interfere adjacent and nearby land uses. It is important that the project description and/or mitigation measures include good neighbor principles. DWR has developed a Good Neighbor Checklist as part of its Agricultural Land Stewardship Strategies effort for projects that should be consulted in the development of this project. (See Exhibit B.)

As discussed in this letter, neighboring landowner impacts from this project requiring special attention are:

- Loss of agricultural productivity/crop damage from seepage
- Damage to levees from wind fetch, increased wave action and changes in flow patterns
- Increased flood risks from levee damage and changes in flow patterns
- Impairment of water quality and reduced surface water availability
- Increased terrestrial and aquatic weeds leading to crop damage and damage to water diversions
- Endangered Species take jeopardy by listed species introduction/enhancement of habitat

[2] Department of Water Resources, Bulletin 168 (October 1978) titled, "Sacramento Valley Water Use Survey 1977," Table A-5 (showing 1976-77 Estimated Crop Evapotranspiration Values for the Delta Service Area).

- Sound, dust and traffic from construction and ongoing maintenance
- Damage to levees along the travel route to the site from heavy equipment needed for construction and ongoing maintenance

The EIR must analyze and provide adequate mitigation for these impacts.

One issue that requires special attention is the potential for increased take liability concerns for operation existing water diversions in the vicinity of the project. If the project is successful in improving conditions for listed fish (an explicit goal), listed species may become more abundant than they are currently. Though these intakes are not currently a cause of concern with respect to take of listed species,[3] that could change as a result of the project. Thus, the project should include means to extend take coverage to these intakes if needed.

Though this issue can be complex, on the project-level, there are means by which this issue could be addressed, for instance, through extension of take coverage to neighboring landowners in the C/ESA permitting processes. A low effects HCP may also be a possibility for the surrounding area. There is also the option of the project including funding for screening or other improvements to neighboring intakes to prevent the possibility of take (even though they are below the size on which the fish agencies have been most focused). The key is to create *no-harm* strategy for existing Delta water users, which will in turn prevent negative impacts on neighboring agricultural land uses. We have discussed this issue extensively with DWR staff in the context of the BDCP, and are willing to continue the dialogue in the context of this project, which should be much more straightforward in comparison.

Issue 7 – Adaptive Management

The project needs to include functional adaptive management features, specifically including an operable gate to control the connection of the slough to the restoration. The only means by which the project can minimize or mitigate its salinity intrusion and

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[3] "[S]mall agricultural Delta agricultural diversions are likely to have a minor effect on pelagic (open water) fish, such as the [D]elta smelt." (Ecosystem Restoration Program, Ecosystem Strategy for Stage 2 Implementation Sacramento San Joaquin Delta Ecological Management Zone July 21, 2010 report, p. 50, citing Nobriga, M., Z. Matica, and Z. Hymanson. 2004. Evaluating Entrainment Vulnerability to Agricultural Irrigation Diversions: A Comparison Among Open-Water Fishes. American Fisheries Society Symposium 39:281-295, available at: http://www.fws.gov/stockton/afrp/SWRCB/12.%20Nobriga%20et%20al.%202004.pdf. As a result, larger diversions (over 250 cfs), have been the focus for consideration of screening by state and federal agencies.

methylmercury production is through operable water control structures. These structures can also be used to manage aquatic and terrestrial weeds and aquatic primary production. While a passive spill system may seem ideal from an engineering standpoint, it fails to meet several significant environmental considerations. Currently, incoming water to the island is managed through a controlled gate, and to apply adaptive management in any substantive sense, gates and/or other operable structures will be necessary.

III. CONCLUSION

LAND and local communities want a positive outcome from the Prospect Island restoration. With successful collaboration, this project can be the hallmark of ecological improvements and functional restoration with minimal impacts on adjacent flood control structures and agriculture. LAND wants to see this project succeed not just on paper, but in practice. To do anything less will create yet more barriers to the completion of future restoration projects.

Very truly yours,

SOLURI MESERVE
A Law Corporation

By: 
Osha R. Meserve

Enclosure: Exhibit A - DWR Bulletin 168 (October 1978), Table A-5
Exhibit B – DWR Good Neighbor Checklist

cc: Mark Souverville, Department of Water Resources (Mark.Souverville@water.ca.gov)
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Michael Perrone, Department of Water Resources (Michael.Perrone@water.ca.gov)
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Jonathon Frame, Reclamation District 999 (jframe@rd999.org)
Bill Darsie, KSN Engineers (wdarsie@ksninc.com)

EXHIBIT A

TABLE A-5
1976-77 Estimated Crop Et Values
Delta Service Area
(in inches)

Land Use Category	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Total Oct.76-Sep.77	Oct.77	Total Nov.77-Oct.77
Sacramento-San Joaquin Delta															
Irrigated Pasture	3.2	1.5	1.0	0.7	1.5	3.6	5.4	4.8	6.9	7.7	6.4	4.7	47.4	3.4	47.6
Alfalfa	3.2	1.5	1.0	0.7	1.5	3.2	4.9	4.4	6.5	7.5	6.5	4.9	45.8	3.4	46.0
Deciduous Orchard (Fruits & Nuts)	2.6	1.5	1.0	0.7	1.5	2.7	3.8	4.0	6.1	7.4	6.1	4.3	41.7	2.6	41.7
Tomatoes	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.6	4.0	8.2	6.0	2.3	34.3	1.9	33.8
Sugar Beets	2.4	1.5	1.0	0.7	1.5	1.9	2.2	3.7	7.6	8.3	6.4	4.4	41.6	2.4	41.6
Grain Sorghum (Milo)	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.0	5.9	7.3	4.3	2.5	33.2	1.9	32.7
Field Corn	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.3	5.7	6.9	5.1	2.6	33.8	1.9	33.3
Dry Beans	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.7	5.7	6.2	2.7	2.5	30.0	1.9	29.5
Safflower	2.4	1.5	1.0	0.7	1.5	1.9	2.5	4.8	8.7	7.7	4.4	2.5	39.6	1.9	39.1
Asparagus	2.4	1.5	1.0	0.7	1.5	1.9	2,2	1.0	3.5	7.7	6.4	4.7	34.5	2.4	34.5
Potatoes	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.7	4.3	7.4	5.5	2.8	32.9	1.9	32.4
Irrigated Grain	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	1.0	1.0	1.6	26.1	1.6	24.7
Vineyard	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.8	5.3	6.5	5.3	3.4	34.5	2.4	34.5
Rice	3.2	1.5	1.0	0.7	1.5	1.9	2.8	5.6	8.8	9.8	8.1	5.5	50.4	3.4	50.6
Sudan	2.4	1.5	1.0	0.7	2.0	4.3	5.7	4.8	6.9	7.7	4.9	4.7	46.6	2.4	46.6
Misc. Truck	2.4	1.5	1.0	0.7	1.5	1.9	3.2	4.6	6.7	7.4	5.2	3.7	39.8	1.9	39.3
Misc. Field	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.4	6.1	7.4	5.0	1.9	34.0	1.9	33.5
Double Cropped with Grain															
Sugar Beets	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	4.2	5.2	5.8	37.7	3.4	38.7
Field Corn	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	4.3	6.3	6.1	39.2	2.7	39.5
Grain Sorghum (Milo)	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	2.7	6.1	5.2	36.5	1.9	36.0
Sudan	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	3.6	7.7	4.9	4.7	41.6	1.9	41.1
Dry Beans	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	3.1	7.6	3.5	1.5	36.4	1.9	35.9
Tomatoes	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	2.3	6.6	6.0	5.2	40.8	1.9	40.3
Lettuce	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	4.1	7.4	5.3	4.9	42.4	2.4	42.4
Misc. Truck	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	2.3	6.6	6.0	5.2	40.8	2.4	40.8
Misc. Field	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	4.1	7.4	5.3	4.9	42.4	3.4	43.4
Fallow Lands 1/	2.4	1.5	1.0	0.7	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	14.0	1.0	12.6
Native Vegetation 2/	2.4	1.5	1.0	0.7	1.4	3.7	3.8	2.1	2.3	2.6	2.3	2.0	25.8	1.6	25.0
Riparian Veg. & Water Surface	4.6	2.4	1.4	0.8	1.9	4.5	7.4	6.6	9.7	11.8	9.7	7.0	67.8	4.3	67.5
Urban	1.6	0.8	0.6	0.7	1.0	1.0	1.9	2.4	2.4	2.5	2.4	1.9	19.2	1.6	19.2

1/ Applies also to nonirrigated grain.
2/ Applies also to nonirrigated orchards and vineyards

Metric conversion: inches times 25.4 equals millimetres.

EXHIBIT B

Good Neighbor Checklist

The Sacramento-San Joaquin Delta (Delta) is the home of numerous habitat restoration efforts. Many Delta farmers are concerned that habitat lands could harm nearby agriculture in various ways. They would like assurance that entities that establish and manage habitat projects will consult with their neighbors and find ways to avoid impacts and resolve problems if they arise.

Restoration project managers can use the following checklist to ensure that they comprehensively consider and examine the impacts of their project on neighbors, and vice versa. The checklist is based on a discussion paper, "Agricultural and Land Stewardship Strategies" (see https://agriculturallandstewardship.water.ca.gov), which identifies a menu of mitigation measures and enhancements for the Delta. The measures described in the discussion paper, called Strategies, are referenced in the checklist.

- ☐ Have project proponents consulted with all neighboring landowners and operators about the project and its potential impacts? (See Strategy E1.1, which recommends involvement of landowners in project planning.)
- ☐ Have project proponents designated a local contact person to meet with neighboring landowners and discuss any issues of concern? (See Strategy D5.1, which suggests establishment of a public advisor position to help the public work with government agencies.)
- ☐ Will the project need access through other properties? If so, have access agreements been obtained?
- ☐ Does the management plan for the project provide for an on-site patrol or manager to deter trespass and vandalism? (See Strategy A4.3, which suggests the hiring of game wardens, sheriff's deputies, or private security guards.)
- ☐ Will the project increase the presence of vegetation susceptible to fire? (If yes, see Strategy A4.3.)
- ☐ Will the project discontinue maintenance of flood control features, involve prolonged or repeated flooding of previously dry land, or affect wind fetch across waterways? (If yes, see Strategy A1, which discusses flood protection improvements, and Strategy E1.3.2, which discusses drainage and seepage.)
- ☐ As a result of the project, are species on the project site expected to increase markedly in abundance and move from the site to neighboring lands or waterways? If yes, which species? (And see Strategy A4.2, which suggests ways to protect landowners from liability under endangered species laws.)
- ☐ Is it reasonably possible that species in the project area could damage crops or promote the growth of weeds or diseases on neighboring farms? (If yes, see Strategy A3, which suggests ways to control weeds, and Strategy A4.1, which

suggests the use of buffer zones and mechanisms for compensation for crop damages.)

- Will the project disturb utilities, roads, bridges, or other infrastructure that serve agricultural uses? (If yes, see Strategy D3, which suggests improvements to transportation infrastructure.)
- Will the project fragment or isolate farmland? (If yes, see Strategy E1.1, which encourages collaborative project planning.)
- Do domestic or feral animals or livestock occur on lands neighboring the project? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)
- Do neighboring farms use chemicals as fertilizer, or to control weeds or crop pests? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)

EXHIBIT 3

LOCAL AGENCIES OF THE NORTH DELTA

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November 7, 2016

SENT VIA EMAIL (Dan.Riordan@water.ca.gov)

Dan Riordan
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

RE: Comments from Local Agencies of the North Delta on Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

These comments on the proposed Prospect Island Tidal Habitat Restoration ("project") are submitted on behalf of the Local Agencies of the North Delta ("LAND"). LAND is a coalition comprised of reclamation and water districts in the northern geographic area of the Delta.[1] As local agencies in the areas most impacted by the restoration projects such as that now proposed on Prospect Island, we are providing these comments to assist in the design and environmental analysis of this project so that it achieves the project goals, and provides effective mitigation of project impacts to nearby flood protection facilities and agricultural operations.

Generally, we are disappointed that Department of Water Resources ("DWR") has not responded to our comments on the Notice of Preparation submitted on November 4, 2014. Upon review of the Draft Environmental Impact Report ("DEIR") for the project, there is a systematic failure to respond to our technical comments or even to our general environmental impacts comments in in any substantive way. Our comments in this letter do not attempt to catalog every possible issue, but rather, expand on specific technical environmental impacts based on our prior comments and discussions with staff. These comments are in addition to comments from other LAND-associated Reclamation Districts ("RDs"). In response to these deficiencies, we have developed an immediate process by which we feel that these impacts can be mitigated and address the local

[1] LAND member agencies cover an approximately 110,000 acre area of the Delta; current LAND participants include Reclamation Districts 3, 150, 307, 317, 349, 407, 501, 551, 554, 556, 744, 755, 813, 999, 1002, 2111, 2067 and the Brannan-Andrus Levee Maintenance District. Some of these agencies provide both water delivery and drainage services, while others only provide drainage services. These districts also assist in the maintenance of the levees that provide flood protection to homes and farms.

concerns about the impacts of the proposed project. We are again reiterating that offer to work together toward a project that is both beneficial for the Delta ecosystem and also acceptable to local landowners and districts. In particular, we would like to follow up informally on our conversation in West Sacramento last week, which discussed ways in which the concerns outlined below could be addressed in a mutually beneficial manner.

I. COMMENTS

Habitat projects in the Delta have had a variety of outcomes, many of which are not intentional or even fully understood. LAND has actively worked with DWR and other parties to attempt to better understand the potential impacts of these habitat projects on reclamation and water districts, as well as agricultural operations and residents. The results of millions of dollars of restoration efforts in the Delta have been poorly documented, poorly monitored, and ecologically uncertain. For instance, despite over 40,000 acres of publically held or managed intertidal and open water habitat in the Delta primary zone, and 116,000 acres in Suisun, native fish species declines do not appear to be stabilizing. Moreover, the vast majority of publically held land in the Delta receives little or no invasive weed management, ecological monitoring, or any ecological-oriented site management.

Though past restoration successes have been limited, we believe it is possible for the proposed project to be a showcase for effective community and RD engagement in the context of habitat creation or restoration projects in the Delta. To that end, LAND proposes that the project planning consider, and implement key project features and address the underlying scientific, technical and economic questions before proceeding on the project. Our comments are organized into the following categories and discussed in detail below: Communications, Technical Premises, Mitigation, Monitoring and Funding, Operations and Maintenance, Water Rights and New Diversion, Good Neighbor Issues, and Adaptive Management.

Issue 1 – Communications

DWR had initially undertaken direct communications with the local RDs and LAND, and has also provided a field visit to discuss the proposed project features. These efforts were very important for the common understanding of the physical elements of the project, as well as understanding of the potential impacts of the project and possible mitigation under CEQA. LAND appreciated those efforts and urges their expansion for this and future projects. We are concerned that DWR has failed to respond systematically to these comments and failed to take advantage that such communications can lead to early inclusion of project features to enhance compatibility with adjacent land

uses and effective mitigation from the outset, thereby avoiding conflict. We still believe that the long-term success of the project will require the clear communication with neighboring landowners and RDs.

Issue 2 – Technical Premises

LAND has found that in some cases that the scientific basis for the habitat restoration in the Delta is thin at best and is far likelier to improve conditions for the very invasive species that currently "stress" the Delta ecosystem. It is important that the technical basis for restoration elements be clearly articulated, and where habitat creation is being used, that that premise is identified as well. Under the existing conditions (baseline) there is high riparian and wetland bird use at the site; thus, the explicit tradeoffs between current uses by species and projected benefits for other species in the future need to be identified.

Elevations

LAND has reviewed several LiDAR elevation figures for the island and it appears that there may be some discrepancies associated with the current elevations and the proposed design elevations. It would be critical for the success of the project that an independent review by a licensed surveyor of the survey, bathymetry, and LiDAR data occur to ensure that the vertical datum and the control points for these data are correct and consistent. The vertical error associated with some LiDAR data in general and the use of too widely spaced control points can lead to significant cut and fill errors that will prevent the project from meeting its design requirements.

Salinity, Nutrients and Toxins

The project design has a high possibility of altering local tidal dynamics, sediment deposition in and around Cache Slough, reducing available nitrogen, and increasing salinity. Suisun Marsh projects and their operations have a clear potential to change tidal dynamics and salinity intrusion throughout the northern Delta; when those effects are combined with this project and other DWR' barrier projects throughout the Delta, there are similar confounding effects, which must be identified and planned for effectively.

The same complexities are associated with the premise that nutrients would be exported from this site. The tradeoffs between nutrient cycling that occurs there now and the proposed conditions should be analyzed. For example, any unoxidized organic matter currently being trapped onsite would be exported, with greenhouse gas implications, which must identified. This would also include the need for analysis of localized

eutrophication and toxic cyanobacterial blooms, and conversely the depletion of local nitrogen and reduction of productivity in the Cache Slough complex.

Accordingly, the project's facilitation of invasive aquatic weeds and invasive clams, and the potential for new mussel invasions must be fully analyzed. For example, if the project intent is to export nutrients, how will the project ensure that it simply does not promote these invasives and export methylmercury (dissolved and sediment-associated) into the food chain?

Sediment

Sediment dynamics must be fully disclosed. The site sediment mechanics (assessing the local distribution of sediment) need to be fully described from a seasonal, as well as an early and late project perspective. The local-regional sediment balance should also be identified, and the implications of the long-term decline of sediment in the Sacramento River system on the project performance should be fully described. Equally importantly, the implications on sediment mechanics as a result of this project on other nearby locations should also be described.

Sediment plays a complex role in aquatic ecosystems. Too much sediment in high elevation streams can cause significant water quality problems and lead to fish declines. In the Delta however, sediment provides visual cover for some fish, such as Delta smelt, which protects them from predators. Sediment is also the building block for streambanks through over bank deposits. Sediment is critical for the maintenance of floodplains and the associated riparian habitat by creating the new locations for plants to grow and for creating and maintaining topographic complexity.

Reductions in stream sediment loads can also lead to scouring, whereby previously accumulated sediment is stripped and mobilized from existing floodplains. Project-associated invasive aquatic (and some terrestrial) weeds can also lead to the additional removal of sediment, exacerbating this problem.

Seepage and Erosion

The extent and impact of project-associated seepage and wave run-up at any levee breaks is unclear. The seepage modeling should be supported with a tracer study, and a 3–dimensional analysis for erosion on neighboring levees. Optimization of intake locations to minimize hydraulic effects is also essential. Inclusion of operable gates could also minimize impacts of the project on neighboring levees. Additionally, construction of cutoff walls, installation of interception wells, or other means, may be

necessary to control seepage to adjacent islands. Moreover, mitigation in the form of levee maintenance funds for the neighboring islands will likely be necessary due to hydraulic and other effects of the project. Wind fetch effects could feasibly be monitored with bank pins.

Weed Management

Terrestrial weeds such as perennial pepperweed and *Arundo donax*, which interfere with crops and levee maintenance, and aquatic weeds, such as Hydrilla, Hyacinth and Egeria, which clog pumps and wildlife impacts, have to be carefully managed and their management fully funded for the life of the project. The DEIR includes no weed management beyond initial construction.

Issue 3 – Mitigation, Monitoring and Funding

Mitigation, monitoring and reporting plans ("MMRP") are required by CEQA and this project will have ongoing impacts that will require follow-up and long-term funding. This project will be under considerable scrutiny to ensure it meets these requirements, as this is just one project among about 28,000 acres of habitat creation requirements already required by the currently applicable Biological Opinions. Currently, the erroneous less-than-significant conclusions for virtually every impact of concern to local interests has led to a complete lack of mitigation.

All impacts that require mitigation must be clearly identified in the MMRP and be adequately funded. The funding should include adequate compensation for the expected types and extents of impacts with a contingency. Typical small claims of road and fence damage, damage to irrigation and drainage facilities, localized groundwater impacts from dewatering or restoration, weed management issues, and loss of access to property can be handled in an expeditious and fair manner by maintaining a mitigation fund for the project. For instance, funding for levee stability if erosion occurs on neighboring levees should be clearly identified. Weeds and the island's own remaining levees will require routine maintenance, as will ongoing environmental monitoring under adaptive management.

Issue 4 – Operations and Maintenance

Operations and maintenance are where these projects typically fail to meet their goals and objectives. The Delta has numerous examples of "restoration projects" that have environmental impacts that were not intended. A long-term management plan and associated funding are critical to maintain these goals and objectives and to meet the

requirements under CEQA. A passive management approach will not suffice. The current condition of the island is a direct result of the passive approach and a lack of funding.

Issue 5 – Water Rights and New Diversion

We believe that the project should still identify the source and legal rights to water. (*Cf*. DEIR, pp. 3-36 to 3-37.) Specifically, the project must identify the legal water rights basis (including compliance with the no injury rule), and the point of diversion by which water will be diverted away from the Miner Slough and drained into the Sacramento Deep Water Ship Channel/Cache Slough Complex. The environmental impacts of diverting additional water from the slough must also be addressed. According to DWR data, open water and riparian vegetation consume about 67.5 acre-feet per year, which is much greater than most agricultural uses. (See Exhibit A.)[2] Additionally, the project's potential to further reduce outflow must also be considered.

Issue 6 – Good Neighbor Issues

An ongoing focus of LAND has been to minimize the local impacts from restoration projects. In general, the project should include "good neighbor policies." This includes adequate planning, monitoring and maintenance funding to ensure that impacts such as seepage, increased levee erosion, invasive weeds, and other issues are managed effectively so as not to interfere with adjacent and nearby land uses. It is important that the project description and/or mitigation measures include good neighbor principles. DWR has developed a Good Neighbor Checklist as part of its Agricultural Land Stewardship Strategies effort for projects that should be consulted in the development of this project. (See Exhibit B.)

As discussed in this letter, neighboring landowner impacts from this project requiring special attention are:

- Loss of agricultural productivity/crop damage from seepage;
- Damage to levees from wind fetch, increased wave action and changes in flow patterns;
- Increased flood risks from levee damage and changes in flow patterns;

[2] Department of Water Resources, Bulletin 168 (October 1978) titled, "Sacramento Valley Water Use Survey 1977," Table A-5 (showing 1976-77 Estimated Crop Evapotranspiration Values for the Delta Service Area).

- Impairment of water quality and reduced surface water availability;
- Increased terrestrial and aquatic weeds leading to crop damage and damage to water diversions;
- Endangered Species take jeopardy by listed species introduction/enhancement of habitat;
- Sound, dust and traffic from construction and ongoing maintenance; and
- Damage to roads and levees along the travel route to the site from heavy equipment needed for construction and ongoing maintenance.

The DEIR should be revised to analyze and provide adequate mitigation for these impacts. Unfortunately, the DEIR does not mention good neighbor policies at all. We would like to work with DWR to address these issues, as discussed at our meeting last week.

One issue that still requires attention is the potential for increased take liability concerns for operation of existing water diversions in the vicinity of the project. If the project is successful in improving conditions for listed fish (an explicit goal), listed species may become more abundant than they are currently. Though local intakes are not currently a cause of concern with respect to take of listed species,[3] that could change as a result of the project. Thus, the project should include some means to extend take coverage to these intakes, or otherwise provide assurances, if needed.

Though this issue can be complex, on the project-level, there are means by which this issue could be addressed, for instance, through extension of take coverage to neighboring landowners in the C/ESA permitting processes. A low effects HCP could also be a possibility for the surrounding area. There is also the option of the project including funding for screening or other improvements to neighboring intakes in determined necessary to prevent the possibility of take (even though they are below the size on which the fish agencies have been most focused). The key is to create *no-harm*

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[3] "[S]mall agricultural Delta agricultural diversions are likely to have a minor effect on pelagic (open water) fish, such as the [D]elta smelt." (Ecosystem Restoration Program, Ecosystem Strategy for Stage 2 Implementation Sacramento San Joaquin Delta Ecological Management Zone July 21, 2010 report, p. 50, citing Nobriga, M., Z. Matica, and Z. Hymanson. 2004. Evaluating Entrainment Vulnerability to Agricultural Irrigation Diversions: A Comparison Among Open-Water Fishes. American Fisheries Society Symposium 39:281-295, available at: http://www.fws.gov/stockton/afrp/SWRCB/12.%20Nobriga%20et%20al.%202004.pdf. As a result, larger diversions (over 250 cfs), have been the focus for consideration of screening by state and federal agencies.

strategy for existing Delta water users, which will in turn prevent negative impacts on neighboring agricultural land uses. We discussed this issue extensively with DWR staff in the context of the now abandoned BDCP, and are willing to continue the dialogue in the context of this project, which should be much more straightforward in comparison.

Issue 7 – Adaptive Management

The project needs to include functional adaptive management features, specifically including an operable gate to control the connection of the slough to the restoration. The only means by which the project can minimize or mitigate its salinity intrusion and methylmercury production is through operable water control structures. These structures can also be used to manage aquatic and terrestrial weeds and aquatic primary production. While a passive spill system may seem ideal from an engineering standpoint, it fails to meet several significant environmental considerations. Currently, incoming water to the island is managed through a controlled gate, and to apply adaptive management in any substantive sense, gates and/or other operable structures will be necessary. We understand an adaptive management plan is being prepared, and would like to have input into the final plan.

II. CONCLUSION

LAND and local communities continue to desire a positive outcome from the Prospect Island restoration. With successful collaboration, this project *could be* the hallmark of ecological improvements and functional restoration with minimal impacts on adjacent flood control structures and agriculture. Alternatively, this project could become the hallmark of irresponsible reclamation that is not sensitive to existing adjacent land uses and users. LAND would like to see this project succeed not just on paper, but in practice. To do anything less will create yet more barriers to the completion of future restoration projects.

Very truly yours,

SOLURI MESERVE
A Law Corporation

By: 
Osha R. Meserve

ORM/mre

Enclosures: Exhibit A - DWR Bulletin 168 (October 1978), Table A-5
Exhibit B – DWR Good Neighbor Checklist

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EXHIBIT A

TABLE A-5
1976-77 Estimated Crop Et Values
Delta Service Area
(in inches)

Land Use Category	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Total Oct.76-Sep.77	Oct.77	Total Nov.77-Oct.77
Sacramento-San Joaquin Delta															
Irrigated Pasture	3.2	1.5	1.0	0.7	1.5	3.6	5.4	4.8	6.9	7.7	6.4	4.7	47.4	3.4	47.6
Alfalfa	3.2	1.5	1.0	0.7	1.5	3.2	4.9	4.4	6.5	7.5	6.5	4.9	45.8	3.4	46.0
Deciduous Orchard (Fruits & Nuts)	2.6	1.5	1.0	0.7	1.5	2.7	3.8	4.0	6.1	7.4	6.1	4.3	41.7	2.6	41.7
Tomatoes	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.6	4.0	8.2	6.0	2.3	34.3	1.9	33.8
Sugar Beets	2.4	1.5	1.0	0.7	1.5	1.9	2.2	3.7	7.6	8.3	6.4	4.4	41.6	2.4	41.6
Grain Sorghum (Milo)	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.0	5.9	7.3	4.3	2.5	33.2	1.9	32.7
Field Corn	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.3	5.7	6.9	5.1	2.6	33.8	1.9	33.3
Dry Beans	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.7	5.7	6.2	2.7	2.5	30.0	1.9	29.5
Safflower	2.4	1.5	1.0	0.7	1.5	1.9	2.5	4.8	8.7	7.7	4.4	2.5	39.6	1.9	39.1
Asparagus	2.4	1.5	1.0	0.7	1.5	1.9	2,2	1.0	3.5	7.7	6.4	4.7	34.5	2.4	34.5
Potatoes	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.7	4.3	7.4	5.5	2.8	32.9	1.9	32.4
Irrigated Grain	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	1.0	1.0	1.6	26.1	1.6	24.7
Vineyard	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.8	5.3	6.5	5.3	3.4	34.5	2.4	34.5
Rice	3.2	1.5	1.0	0.7	1.5	1.9	2.8	5.6	8.8	9.8	8.1	5.5	50.4	3.4	50.6
Sudan	2.4	1.5	1.0	0.7	2.0	4.3	5.7	4.8	6.9	7.7	4.9	4.7	46.6	2.4	46.6
Misc. Truck	2.4	1.5	1.0	0.7	1.5	1.9	3.2	4.6	6.7	7.4	5.2	3.7	39.8	1.9	39.3
Misc. Field	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.4	6.1	7.4	5.0	1.9	34.0	1.9	33.5
Double Cropped with Grain															
Sugar Beets	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	4.2	5.2	5.8	37.7	3.4	38.7
Field Corn	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	4.3	6.3	6.1	39.2	2.7	39.5
Grain Sorghum (Milo)	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	2.7	6.1	5.2	36.5	1.9	36.0
Sudan	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	3.6	7.7	4.9	4.7	41.6	1.9	41.1
Dry Beans	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	3.1	7.6	3.5	1.5	36.4	1.9	35.9
Tomatoes	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	2.3	6.6	6.0	5.2	40.8	1.9	40.3
Lettuce	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	4.1	7.4	5.3	4.9	42.4	2.4	42.4
Misc. Truck	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	2.3	6.6	6.0	5.2	40.8	2.4	40.8
Misc. Field	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	4.1	7.4	5.3	4.9	42.4	3.4	43.4
Fallow Lands 1/	2.4	1.5	1.0	0.7	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	14.0	1.0	12.6
Native Vegetation 2/	2.4	1.5	1.0	0.7	1.4	3.7	3.8	2.1	2.3	2.6	2.3	2.0	25.8	1.6	25.0
Riparian Veg. & Water Surface	4.6	2.4	1.4	0.8	1.9	4.5	7.4	6.6	9.7	11.8	9.7	7.0	67.8	4.3	67.5
Urban	1.6	0.8	0.6	0.7	1.0	1.0	1.9	2.4	2.4	2.5	2.4	1.9	19.2	1.6	19.2

1/ Applies also to nonirrigated grain.
2/ Applies also to nonirrigated orchards and vineyards

Metric conversion: inches times 25.4 equals millimetres.

EXHIBIT B

Good Neighbor Checklist

The Sacramento-San Joaquin Delta (Delta) is the home of numerous habitat restoration efforts. Many Delta farmers are concerned that habitat lands could harm nearby agriculture in various ways. They would like assurance that entities that establish and manage habitat projects will consult with their neighbors and find ways to avoid impacts and resolve problems if they arise.

Restoration project managers can use the following checklist to ensure that they comprehensively consider and examine the impacts of their project on neighbors, and vice versa. The checklist is based on a discussion paper, "Agricultural and Land Stewardship Strategies" (see https://agriculturallandstewardship.water.ca.gov), which identifies a menu of mitigation measures and enhancements for the Delta. The measures described in the discussion paper, called Strategies, are referenced in the checklist.

- ☐ Have project proponents consulted with all neighboring landowners and operators about the project and its potential impacts? (See Strategy E1.1, which recommends involvement of landowners in project planning.)
- ☐ Have project proponents designated a local contact person to meet with neighboring landowners and discuss any issues of concern? (See Strategy D5.1, which suggests establishment of a public advisor position to help the public work with government agencies.)
- ☐ Will the project need access through other properties? If so, have access agreements been obtained?
- ☐ Does the management plan for the project provide for an on-site patrol or manager to deter trespass and vandalism? (See Strategy A4.3, which suggests the hiring of game wardens, sheriff's deputies, or private security guards.)
- ☐ Will the project increase the presence of vegetation susceptible to fire? (If yes, see Strategy A4.3.)
- ☐ Will the project discontinue maintenance of flood control features, involve prolonged or repeated flooding of previously dry land, or affect wind fetch across waterways? (If yes, see Strategy A1, which discusses flood protection improvements, and Strategy E1.3.2, which discusses drainage and seepage.)
- ☐ As a result of the project, are species on the project site expected to increase markedly in abundance and move from the site to neighboring lands or waterways? If yes, which species? (And see Strategy A4.2, which suggests ways to protect landowners from liability under endangered species laws.)
- ☐ Is it reasonably possible that species in the project area could damage crops or promote the growth of weeds or diseases on neighboring farms? (If yes, see Strategy A3, which suggests ways to control weeds, and Strategy A4.1, which

suggests the use of buffer zones and mechanisms for compensation for crop damages.)

- Will the project disturb utilities, roads, bridges, or other infrastructure that serve agricultural uses? (If yes, see Strategy D3, which suggests improvements to transportation infrastructure.)
- Will the project fragment or isolate farmland? (If yes, see Strategy E1.1, which encourages collaborative project planning.)
- Do domestic or feral animals or livestock occur on lands neighboring the project? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)
- Do neighboring farms use chemicals as fertilizer, or to control weeds or crop pests? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)

EXHIBIT 4

LOCAL AGENCIES OF THE NORTH DELTA

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February 15, 2017

SENT VIA EMAIL (dennis.mcewan@water.ca.gov)

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RE: Collaborative Mitigation and Monitoring Proposal for Prospect Island Tidal Habitat Restoration Project

Dear Mr. McEwan:

Thank you for meeting with us to discuss our concept for developing a collaborative mitigation and monitoring approach for the Prospect Island Tidal Habitat Restoration ("project"). As you know, Local Agencies of the North Delta ("LAND") is a coalition comprised of reclamation and water districts in the northern geographic area of the Delta.[1] Many of these districts are located in the areas impacted by restoration projects, such as what is now proposed for Prospect Island.

Local agencies support efforts to effectively restore Delta ecosystems consistent with surrounding land uses. To further this shared goal, we are proposing a means by which the Department of Water Resources ("DWR") can demonstrate its commitment to the safety and security of the Delta's levees, the implementation of good neighbor policies, and promotion of effective communication with neighboring landowners. This demonstration is critical to the success of restoration efforts in the Delta, where most such projects will be adjacent or near working agricultural landscapes. In addition to LAND member Reclamation Districts ("RDs"), we are also discussing these concepts with landowners and representatives in the most affected area (Ryer Island/RD 501).

[1] LAND member agencies cover an approximately 118,000 acre area of the Delta; current LAND participants include Reclamation Districts 3, 150, 307, 317, 349, 407, 501, 551, 554, 556, 744, 755, 813, 999, 1002, 2111, 2067, Maintenance Area 9 South, and the Brannan-Andrus Levee Maintenance District. Some of these agencies provide both water delivery and drainage services, while others only provide drainage services. These districts also assist in the maintenance of the levees that provide flood protection to homes and farms.

LAND's earlier preliminary comments (dated November 4, 2014) and comments on the Draft Environmental Impact Report ("DEIR") (dated November 7, 2016), explained that LAND wishes to assist in the design of mitigation and monitoring practices for this project so that it achieves the project goals while also providing effective mitigation impacts to nearby flood protection facilities and ongoing agricultural operations. We are again reiterating our offer to work together toward a project that is both beneficial for the Delta ecosystem and also acceptable to local landowners and districts.

Good Neighbor Issues

As discussed in both of our prior comment letters, the LAND wishes to work with DWR and other agencies to minimize negative local impacts from restoration projects. In general, these types of project should explicitly incorporate "good neighbor policies." Such policies generally include adequate pre- and post-project planning, monitoring and maintenance and associated funding to ensure that impacts such as seepage, increased levee erosion, invasive weeds, and other issues are managed effectively so as not to interfere with adjacent and nearby land uses. Despite our submitting DWR's Good Neighbor Checklist from the Agricultural Land Stewardship Strategies effort to our 2014 comments, these policies are not reflected in the DEIR.

As discussed and documented in LAND and other public comments, impacts to neighboring landowners and reclamation districts from this project requiring special attention include:

- Construction Impacts: Sound, dust, and traffic from construction; damage to roads and levees along the travel route to the site from heavy equipment needed for construction.

- Operations Impacts: Loss of agricultural productivity/crop damage from seepage; Damage to levees from wind fetch, increased wave action and changes in flow patterns; increased flood risks from levee damage and changes in flow patterns; impairment of water quality and reduced surface water availability; increased terrestrial and aquatic weeds leading to crop damage and interference with water diversions.

Specific Issues for Prospect Restoration

The project has environmental implications offsite from several impacts. Onsite Impacts generated on-site with offsite repercussions include:

- Invasive terrestrial and aquatic weeds density standards need to be established.
- Invasive clams and mussels need monitoring and a response plan.
- Harmful algal bloom ("HABs") production needs to be minimized.
- Salinity intrusion from local evaporation on the island, as well as flow changes should be minimized.
- Methylmercury production-trapping must be monitored.

Offsite impacts of concern that are generated outside of the restoration footprint by the project activity include:

- Monitoring sediment stripping from levees.
- Seepage monitoring on RD 501/Ryer and RD 999/Netherlands.
- Good neighbor program and sufficient funding to manage mitigation and operations.

In general, implementation and success monitoring, and sufficient adaptive management funding will be necessary to effectively address these issues. Mitigation, monitoring and reporting plans ("MMRP") are required by CEQA and this project will have ongoing impacts that will require follow-up and long-term funding. (See CEQA Guidelines, § 15097.)

I. PROPOSED APPROACH

Though past restoration successes in the Delta have been limited, we believe Prospect has the potential to be a showcase for effective community and RD engagement in the context of habitat creation/restoration projects in the Delta. To that end, LAND proposes that the project planners consider, and implement key project features and address the underlying scientific, technical and economic questions before proceeding on the project. Each project activity must have a clear and consistent approach, documentation, reporting, and transparency. Even if the DEIR finds certain impacts less than significant, effects on neighboring landowners and RDs need to be completely described, as well as the necessary response fully funded. Proposed tasks to address these issues are included below. These ideas are intended to be the beginnings of a conversation in which a mutually agreeable set of conditions is reached in order to address public concerns.

Communications with Affected Stakeholders

DWR had initially undertaken direct communications with the local RDs and LAND, and has also provided field visits to discuss the proposed project features. LAND appreciated those efforts and urges their expansion for this and future projects. We are concerned, however, that DWR has failed to respond systematically to comments from affected stakeholders and failed to address the content of the communications.[2] Information from such communications can lead to early inclusion of project features to enhance compatibility with adjacent land uses and effective mitigation from the outset, thereby avoiding conflict. We still believe that the long-term success of the project will require clear communication with neighboring landowners and RDs.

LAND is concerned that inquiries from the public regarding current conditions on Prospect Island are not being effectively addressed. For instance, when Ms. Nicky Suard contacted Mr. Dan Riordan regarding flooding concerns in January 2017, it took over five days to receive a response. (See Exhibit A.) The response from the DWR legal office failed to address the concern at all, simply denying any problem. The response also stated that DWR "does not monitor Ryer Island" apparently overlooking the fact that DWR does have a Division of Flood Management,[3] with broad responsibility for flood control. In addition, the email advises Ms. Suard that she is to communicate only with the legal office even though she is a neighbor who operates a resort. Open and timely communications with DWR staff that actually manage the project is essential to good neighbor relations and early resolution of problems. A neighbor's good faith attempts to communicate with DWR staff about local concerns should not be quashed, it should be encouraged.

Good communication will be needed going forward as construction activity increases and the potential for disturbance to neighbors increases. Real world impacts from construction include dust, traffic and levee/road damage. An effective and efficient approach to monitoring for and resolving these issues is needed both during and post-construction. The success of the project relies on clear communication with neighboring land owners and districts, which also minimizes project costs. Prolonged disputes, if they occur, will take time and resources away from successful project implementation and erode community support.

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[2] It is also not clear to what extent the Communications and Engagement Plan has been carried out, or whether it has been effective at all. (See http://www.water.ca.gov/environmentalservices/docs/frpa/Prospect%20Island%20Communications%20%20Engagement%20Plan_final%20for%20printing.pdf.)

[3] See http://www.water.ca.gov/floodmgmt/.

Task I: *Implement a monthly coordination meeting with LAND, landowners and, and local RD representatives to track the implementation of the proposed approach and resolution of technical questions. This could possibly become an annual and then a semi-annual meeting, as the project progresses. Reports from the tasks described below would be discussed and addressed at the coordination meetings. Small claims procedures will be developed to address impacts documented by project monitoring/included in the project as described below.*

Adaptive Management/Passive Design Concerns

Under the project, water would enter and leave the interior flooded area through passive openings that cannot be managed. (See DEIR, Figure 2.2-2.) This is concerning because adaptive management of water inflows and outflows cannot occur. As this winter illustrates aptly, depending on hydrologic conditions, such management may be critical to allow the project to meet its restoration objectives while minimizing offsite impacts.

The project needs operable gates or other water control structures that can be used to actively and adaptively manage the connection between the outer slough and the restoration area within the island. This is the only means by which the project can minimize or mitigate its salinity intrusion and methylmercury production. These structures can also be used to manage aquatic and terrestrial weeds and aquatic primary production through flooding and drying. While a passive spill system may seem ideal from an engineering standpoint, it fails to meet several significant environmental considerations. Currently, incoming water to the island is managed through a controlled structure, and to apply adaptive management in any substantive manner, gates and/or other operable structures will be necessary.

Having operable gates would allow for instance, drying and wetting to control weeds. Also they could be critical to controlling mercury production and HABs as well. Without such controls no management is possible.

More generally, adaptive management is meaningless without a clear plan of approach, routine monitoring for the areas of concern and adequate funding. We understand an adaptive management plan is being prepared, and would like to have input into the final plan. The following sections discuss some of those factors as they relate to this project.

Task II: *Develop a revised design that includes operable gates to ensure that adaptive management in response to dynamic conditions is possible.*

Salinity, Nutrients and Toxins

The project design has a high possibility of altering local tidal dynamics, sediment deposition in and around Cache Slough, reducing available nitrogen, and increasing salinity and methylmercury. This would also include the need for detection and tracking of localized eutrophication and toxic cyanobacterial blooms. Accordingly, the project's facilitation of invasive clams, and the potential for new mussel invasions must be fully assessed, both by themselves, as well as for their potential bioaccumulation of these toxins. For example, if the project intent is to export nutrients, the project must ensure that it simply does not promote cyanobacteria blooms and invasive plant and clams, and export methylmercury (dissolved and sediment-associated), into the food chain.

The Department itself has expressed similar concerns regarding changes to salinity gradients from implementation of other restoration projects. (See, e.g., Exhibit B, July 15, 2014 DWR Comment Letter, p. 3.) In this context, DWR requested that these water quality impacts be clearly identified and mitigation provided, including collaboration with DWR. The following tasks would begin to address water quality and related concerns.

Task III: *Implement an annual invasive clam survey at 8 permanently flooded fixed control points. Perform a species identification, count, density and biomass assessment for each plot and the aggregate. Complete 2 individual and 2 composite samples for mercury accumulation.*

Task IV: *Install a two continuous water monitors and associated telemetry for public viewing on the DWR or USGS website—one monitor at the primary discharge point and one in the interior. Provide calibrated monitors for temperature corrected EC, DO, pH, temperature, turbidity, chlorophyll-a and microcystins. See http://ca.water.usgs.gov/projects/baydelta/methods.html.*

Task V: *Collect monthly grab samples for N/P/THg/MeHg at outflows, and during first flush, pre- and post-project.*

Note: For maximum effectiveness, each of the permanent monitoring locations should be established as full photopoints and located by high accuracy GPS.

Weed Management

Terrestrial weeds such as *Lepidium* (perennial pepperweed) and *Arundo donax*, which interfere with crops and levee maintenance, and aquatic weeds, such as *Eichhornia* (Hyacinth), *Hydrilla* (water weed), and *Egeria* (Brazilian water weed), which clog pumps and impacts wildlife, must be carefully managed and their management fully funded for the life of the project. Descriptions of weed management in the DEIR are overly vague and do not commit to any particular outcome. (See DEIR, pp. 2-31 to 2-35.)

Task VI: *Prepare and implement a detailed weed monitoring program using methods described by the California Invasive Plant Society (http://cal-ipc.org/) for classifying and mapping terrestrial and aquatic weeds at 10 mutually agreed upon locations on Prospect Island and its margin.*

Seepage and Erosion

Seepage and erosion are a large concern of neighboring landowners and RDs. A very similar project, the Delta Wetlands Project, proposed flooding of two islands in the South Delta for water storage purposes, as well as restoration on two other islands. The Delta Wetlands Settlement Agreement, which involved San Joaquin County, Central Delta Water Agency ("CDWA"), East Bay Municipal Utility District, which is provided as an illustration, provides comprehensive details of how to address long term seepage, erosion and other impacts from flooding and/or restoration of Delta islands. (See, e.g., Exhibit C, Delta Wetlands Settlement Agreement, Attachment A, pp. 6-15 [Central Delta Water Agreement at pdf pp. 26-35], Attachment B [Geotechnical Terms and Conditions], and Attachment C [Delta Wetlands Seepage Control Plan].) The agreement also contemplates the formation of a Design Review Board and a Monitoring and Action Board to help guide the design and operation of the project according to agreed parameters to avoid/reduce impacts to neighboring islands. (See Exhibit C, pp. B-1 to B-5.)

Seepage

The extent and impact of project-associated seepage and wave run-up at any levee breaks is unclear. The seepage modeling should be supported with a tracer study, and a 3–dimensional analysis for erosion on neighboring levees. Optimization of intake locations to minimize hydraulic effects is also essential, along with gate operability discussed above. Inclusion of operable gates would help minimize impacts of the project on neighboring levees. Additionally, construction of cutoff walls, installation of interception wells, or other means, may be necessary to control seepage to adjacent

islands. Moreover, mitigation in the form of levee maintenance funds for the neighboring islands will likely be necessary due to hydraulic, seepage and other effects of the project. (See, e.g., Exhibit C, pp. B-5 to B-8.)

Task VII: *Install 5 shallow groundwater monitoring wells at mutually agreeable locations on Ryer Island and one on Prospect Island, install piezometers, and track river stage, Ryer and Prospect Island water surface elevations. Report annually. Provide a correlation analysis.*

Erosion

Increased erosion of neighboring levees as a result of changes to hydrodynamics in the vicinity of the project remains a serious concern. DWR itself has publicly voiced concerns when other restoration projects involving breaching certain existing levees would potentially impact nearby DWR-maintained levees. For instance, DWR's 2014 comments on a restoration project in the west Delta requested that the restoration proponent identify that improvements to DWR-maintained levees be committed to as part of the project to avoid increased levee risks. (See Exhibit B, p. 2.) DWR requested that the project identify:

i. impacts to existing levees from Project implementation;
ii. appropriate levee improvements to mitigate the impacts of the Project including impacts to wetlands;
iii. who will carry-out the required levee improvements and permitting for the improvements;
iv. the source and quality of the required levee fill material;
v. a timeline to accomplish the levee improvements that protects all interests;
vi. who will perform maintenance on this section of levee; and
vii. who will offset the costs associated with the aforementioned issues.

(See Exhibit B, p. 2.) Later, DWR still had concerns after the applicant offered to install vinyl sheetpile walls along the embankment in question to prevent levee failures as a result of the hydrodynamic changes. (See Exhibit D, DWR Comment Letter dated July 12, 2016.)

Here, the degree of impact on neighboring levees can be reduced through proper project design and operation. In order to monitor the effectiveness of such measures, erosion and wind fetch effects can easily be monitored with bank pins. Such data can help the project implementers understand and respond to as appropriate project impacts

(if any) on neighboring levees. Data also allows for a fact based, rather than opinion-based discussion and has a greater potential to lead to the solving of problems.

Task VIII: *Install 5 ranks of bank pins to asses for levee erosion at 5 locations on Ryer Island facing the project and 100 m downstream, with a series of pins located vertically every 2 feet, oriented in rows from the LLWL to the HHWL. These pins would be located with DGPS. Every 2 years following spring flows the pins would be located and the change in exposed length identified and reported.*[4] [5] [6] *Alternately, the entire bank surface could be mapped every 2 years with high resolution lidar to track changes to the surface.*

Traffic and Road Damage during Construction

Delta roads typically have low traffic, and are typically located on the levee tops. Yolo County has legal requirements for traffic studies,[7] and while Caltrans is largely silent on road impacts many other areas have complete planning systems for establishing impacts. These roads often lack suitable geotechnical support for high loads associated with construction. There can be severe impacts to roads from heavy vehicle travel, such as that associated with moving equipment and fill.[8] [9] [10] Correction of road damage was provided in the Delta Wetlands Settlement Agreement and should be included here as well. (See, e.g., Exhibit C, p. 11 of 18 [San Joaquin County Agreement].)

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[4] https://www.researchgate.net/figure/229496394_fig1_Figure-2-Measurement-of-erosion-pin-in-the-bank-face

[5] http://www.safca.org/protection/NR_Documents/2007_Symposium_Sherman_Presentation.pdf

[6] http://labs.bio.unc.edu/Peet/pubs/GSA2009.pdf

[7] http://www.yolocounty.org/home/showdocument?id=11513

[8] Distress Identification manual for the Long-Term Pavement Performance Project. National Research Council. NRC, SHRP-P-338. Washington, D.C.: Strategic Highway Research Program, 1993

[9] Mrad, N., M. El-Gindy, and W. Kenis. Effects of Wheel-Load Spatial Repeatability on Road Damage: A Literature Review. Federal Highway Administration, 1998.

[10] https://www.lrrb.org/PDF/201432.pdf

Task IX: *Work with Yolo County and Caltrans to develop protocols to minimize road impacts and a monitoring program to track success and address concerns and damage. Provision of an impact fee to help fund maintenance of and/or improvements to affected roads may be appropriate.*

Operations and Maintenance

Operations and maintenance are where these types of projects often fail to meet their goals and objectives. The Delta has numerous examples of "restoration projects" that have unintended environmental impacts. A comprehensive long-term management plan and associated funding are critical to maintain these goals and objectives. The current condition of Prospect Island is a direct result of the passive approach and a lack of funding, which will not suffice going forward.

Task X: *Establish funding to address offsite impacts for duration of project.*

As described in LAND's previous comments, the funding should include adequate compensation for the expected types and extents of impacts with a contingency. Typical small claims may arise from road and fence damage, damage to irrigation and drainage facilities, localized groundwater impacts from dewatering or flooding, weed management issues, and loss of access to property. These claims can be handled in an expeditious and fair manner by maintaining a mitigation fund for the project. For instance, funding for levee stability if erosion occurs on neighboring levees should be clearly identified. Weeds and the island's own remaining levees will require routine maintenance, as will ongoing environmental monitoring under adaptive management.

This Fish Restoration Program Agreement project must include sufficient budget to identify impacts on neighboring properties and infrastructure, as well as respond to them. Some of the same measures that will protect neighbors will also ensure the success of the restoration (e.g., adequate weed control). A feasible mechanism for providing assurances of adequate future funding for these purposes can be developed in further conversation. As an example, the settlement agreement between Delta Wetlands, LLC and various water agencies included provision of a $1 million fund to implement remedial actions. (See, e.g., Exhibit C, p. B-7, ¶ 21.)

II. CONCLUSION

LAND and local communities would like to see a positive outcome from the Prospect Island restoration. With successful collaboration, this project *could be* the hallmark of ecological improvements and functional restoration with minimal impacts on

adjacent flood control structures and agriculture. Alternatively, this project could become the icon for irresponsible restoration that is not sensitive to existing adjacent land uses and users. LAND would like to see this project succeed not just on paper, but also in practice, and therefore is proposing the above approach.

Very truly yours,

SOLURI MESERVE
A Law Corporation

By: 
Osha R. Meserve

ORM/mre

Attachments: Exhibit A – Nicky Suard Email Chain (January 12, 2017)
Exhibit B – DWR Comment Letter (July 15, 2014)
Exhibit C – Delta Wetlands Settlement Agreement
Exhibit D – DWR Comment Letter (July 12, 2016)

cc: Dan Riordan, Department of Water Resources (Dan.Riordan@water.ca.gov)
Michelle Morrow, Department of Water Resources (Michelle.Morrow@water.ca.gov)
Mark Souverville, Department of Water Resources (Mark.Souverville@water.ca.gov)
Tim Smith, Department of Water Resources (Tim.Smith@water.ca.gov)
Michael Perrone, Department of Water Resources (Michael.Perrone@water.ca.gov)
Catherine Hallinan, Department of Water Resources (Catherine.Hallinan@water.ca.gov)
Katy Spanos, Department of Water Resources (Katherine.Spanos@water.ca.gov)
Tom Hester, Reclamation District 501 (islandsfarmer@hotmail.com)
Stacy Boyd, Reclamation District 501(rd501@riverdeltawireless.com)
Jonathon Frame, Reclamation District 999 (jframe@rd999.org)
Bill Darsie, KSN Engineers (wdarsie@ksninc.com)
Michael Van Zandt, Hanson Bridgett LLP (mvanzandt@hansonbridgett.com)
Mia S. Brown, Attorney at Law (mbrown@miabrownlaw.com)
Melinda Terry, Central Valley Flood Control Association (melinda@floodassociation.net)

EXHIBIT A

From: sunshine@snugharbor.net
Sent: Wednesday, January 18, 2017 4:29 AM
To: islands farmer
Cc: Osha Meserve; Barbara; Anna Swenson
Subject: [FWD: FW: flooding of Prospect Island and standing water on Ryer Island]

Importance: High

Below is the response from DWR about my concern that the just-flooded Prospect Island is already impacting Ryer Island. There is more standing water in the island than I recall seeing over the last 25 years. I wanted DWR to be aware of this. Yet they say they don't monitor the island for impacts from their actions. So who does?

Nicky Suard

-------- Original Message --------
Subject: FW: flooding of Prospect Island and standing water on Ryer Island
From: "Cavanaugh, Catherine@DWR" <Catherine.Cavanaugh@water.ca.gov>
Date: Tue, January 17, 2017 5:26 pm
To: "sunshine@snugharbor.net" <sunshine@snugharbor.net>
Cc: "Riordan, Dan@DWR" <Dan.Riordan@water.ca.gov>

Dear Ms. Suard,

Program has forwarded the email below to the legal office.

Since you are an attorney, we would ask that you communicate directly with the legal office in future. I have included my telephone and email information below for your convenience.

We have noted your concerns, however DWR does not believe there is any connection between water levels on Prospect and standing water which is or may be present on Ryer Island.

Further, with regard to your health and safety concerns, please be advised that DWR does not monitor Ryer Island.

Thank you.

Cathy Cavanaugh

Catherine F. Cavanaugh
Staff Counsel III

Office of the Chief Counsel
1416 Ninth Street, Room 1104

Sacramento, CA 95814
Office: (916) 654-9822
Cell: (916) 709-0168
Fax: (916) 654-095
catherine.cavanaugh@water.ca.gov

From: sunshine@snugharbor.net [mailto:sunshine@snugharbor.net]
Sent: Thursday, January 12, 2017 6:40 AM
To: Riordan, Dan@DWR
Cc: Melinda Terry; Anna Swenson; islands farmer; Barbara
Subject: flooding of Prospect Island and standing water on Ryer Island

Hello Mr. Riordan,

You are listed as the lead person for DWR for the Prospect Island "restoration" project. I have been taking aerial photos and video of Prospect Island for several years. Yesterday, from Ryer Island on SR 84, I saw that it appears that Prospect Island has been substantially flooded or has much more water there than before. I am also seeing more standing water on Ryer Island than I recall seeing in the past. I am sure the levees are being watched as we have high flows on Steamboat, Miners and Sutter Sloughs, but I wanted to express my concern of impacts from filling of Prospect Island. **The EIR/EIS for Prospect Island restoration said we would not be impacted over on Ryer Island from Prospect Island actions, so hopefully DWR/F&G are correct.**

If you think there is going to be a problem on Ryer Island that could result in a levee breach or flooding from a boil, will you please let me know? We have people who live onsite at Snug Harbor who would be stranded if Ryer Island is flooded. In addition, there are residential homes along the Snug Harbor peninsula, and residential homes scattered around Ryer Island, where people live. I know of several elderly and ill couples that would not be able to evacuate easily. At the resort property, most of our leaseholders have left until the water level lowers, but we do have people staying onsite who would need to be notified if there is an issue with Ryer Island levee. All this to say, if you anticipate a problem, please contact me directly.

Nicky Suard, Esq. Snug Harbor Resorts, LLC (707) 287-1003

EXHIBIT B

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

Via U.S. Mail and email

July 15, 2014

Reclamation District 2130
Dr. Terry Huffman
Huffman-Broadway Group, Inc.
828 Mission Avenue
San Rafael, CA 94901

RE: COMMENTS ON INITIAL STUDY/MITIGATED NEGATIVE DECLARATION FOR THE MALLARD FARMS CONSERVATION BANK

Dear Dr. Huffman:
The California Department of Water Resources (DWR) appreciates the opportunity to provide comments on the Initial Study/Mitigated Negative Declaration (IS/MND) for the proposed Mallard Farms Conservation Bank (hereafter, "Project"). These comments are prepared in response to the State Clearinghouse Filing Number 2013042006. As currently proposed, DWR cannot support the Project.

These comments serve to memorialize the issues raised over the past year during our cooperative efforts to further analyze the impacts of the Project and the corresponding information/actions that DWR would like to see included in your IS/MND. DWR is concerned with the adequacy of your environmental analysis review and corroborating environmental documentation in your IS/MND in several areas. However, we hope to continue working collaboratively with you to achieve your Project goals while avoiding impacts to DWR facilities and operations and important Suisun Marsh habitats.

I. THE IS/MND FAILS TO ACCURATELY IDENTIFY ENVIRONMENTAL IMPACTS TO PUBLIC SERVICES, RECREATION AND WATER QUALITY AND NECESSARY MITIGATION MEASURES TO REDUCE THESE IMPACTS TO LESS THAN SIGNIFICANT.

A. PUBLIC SERVICES

The Project site shares approximately 10,000 feet of an existing interior levee with DWR's Roaring River Distribution System (RRDS); this section of levee will become an external levee (exposed to full tidal action) if the Project is carried out. This particular section of the RRDS levee was designed by DWR as an interior levee and is currently exposed to muted tidal action (due to a natural breach in the one of the Project proponent's exterior levees).

This particular section of the RRDS levee was designed by DWR as an interior levee, and DWR's current obligations are to maintain this levee as an internal levee between the minimum elevation of 6.7 feet (NAVD88) and 7.7 feet. This standard does not provide adequate which no flood protection for levees exposed to full tidal action (Stage Frequency Curve Sacramento River at Collinsville, Corps of Engineers, 1992). Under the current muted tidal conditions on the Project site, tidal stage against the RRDS levee can be within a few inches of the top of the RRDS levee. With Project implementation, the probability of levee overtopping, breaching, and flooding would be significantly increased.

The IS/MND indicates that DWR's 2013 Roaring River Levee Rehabilitation Project will be sufficient to reduce the Project's impact on flooding to less than significant (IS/MND page 43). However, this Project has not been fully designed, funded, or a timeline developed for implementation. This would be a multi-million dollar rehabilitation Project reliant on state and Federal funding. Given the current fiscal conditions at the state and national level, as well as, historical fiscal unpredictability, there are no guarantees that funding will come available in the foreseeable future. Relying on a hypothetical Project for flood protection for the Project is not an appropriate future condition baseline under CEQA, and is not acceptable to DWR.

To provide adequate flood protection to the RRDS and neighboring properties, including California Department of Fish and Wildlife's (DFW) Grizzly Island Wildlife Area, the RRDS levee along the Project site needs to be improved to HMP (Hazard Mitigation Plan) external levee standards. For this location, those standards include an elevation of approximately 10.2 feet (NAVD88) with an appropriate width to allow legal vehicle access, and bank-stabilization (to protect the levee from tidal/wind damage).

DWR requests that at a minimum the IS/MND be revised to acknowledge Project impacts to the existing levees (as the appropriate baseline for CEQA review) and identify appropriate mitigation to ensure that necessary improvements to the RRDS levee are committed to as part of the Project. DWR requests the Project proponents specifically identify: (i) impacts to existing levees from Project implementation; (ii) appropriate levee improvements to mitigate the impacts of the Project including impacts to wetlands, (iii) who will carry-out the required levee improvements and permitting for the improvements, (iv) the source and quality of the required levee fill material, (v) a timeline to accomplish the levee improvements that protects all interests, (vi) who will perform maintenance on this section of levee, (vii) and who will offset the costs associated with the aforementioned issues.

Additionally, the Project's IS/MND does not address seven (7) unused water control structures (culverts) that historically provided water to the Project site and are owned by the property owners of their respective locations. These unused culverts will impair the structural integrity of the levee if they are exposed to full-tidal action. Several of the culverts are currently leaking water and represent an operational hazard to the RRDS. DWR requests that the Project proponents address these culverts including identifying the responsible party for removing them.

The Project will impact the RRDS levee maintenance/flood protection and could jeopardize DWR's regulatory compliances with the Suisun Marsh Preservation Agreement (SMPA), the State Water Resources Control Board Water Right Decision 1641 (D-1641), the Suisun Marsh Preservation Act, the Suisun Marsh Protection Plan, and the Plan of Protection for the Suisun Marsh. These impacts are not analyzed or discussed in the IS/MND. Discussion needs to be

provided with appropriate mitigation measures including coordination with DWR during construction and post-construction phases to ensure impacts are reduced to less than significant.

The Project proponents and DWR's Division of Environmental Services have engaged in discussions over the past year with respect to the aforementioned levee improvements and the unused culvert issues; however, as of the date of this comment letter, no formal agreements have been reached.

B. RECREATION

The IS/MND fails to identify potential significant adverse impacts to recreation as a result of the Project. As stated above, the Project presents a significant risk of levee failure. Should the RRDS levee fail, Grizzly Island Wildlife Area, a public recreation area owned and operated by DFW, is at great risk of significant adverse impacts. Currently this area is utilized by recreational hunters and is open to the public. Should levees fail at a time where public hunters are present there is a risk of significant injury, and even potential loss of human life.

C. HYDROLOGY AND WATER QUALITY

The IS/MND does not address any water quality impacts of the Project beyond construction-related water quality issues. The IS/MND needs to provide thorough documentation related to the water quality impacts (i.e., construction and non-construction related) of the Project, including the results of any reports, expert opinions, and hydrodynamic model analyses.

The Project will expose approximately 700 acres of former managed wetlands (currently under a muted-tidal regime) in the Suisun Marsh to a full-tidal regime. Based upon the geography and hydrodynamics in the vicinity of the Project site, there is the potential for the Project to alter current salinity gradients throughout the Suisun Marsh and potentially change salinities at Delta and Suisun Marsh D-1641 monitoring and compliance stations. Altering the current salinity regime in the Delta and Suisun Marsh could force operational changes at State Water Project (SWP) and Central Valley Water Project (CVP) facilities and/or require additional upstream water releases. Altering salinity gradients in Suisun Marsh could force operational changes of the Suisun Marsh Salinity Control Gates (SMSCG) and could jeopardize DWR's regulatory compliances with several Biological Opinions, the RSMPA, and D-1641.

The Project proponent's IS/MND does not address long term water quality impacts of the Project including potentially cumulative impacts from other currently planned Projects in the Suisun Marsh and within the vicinity of the Project.

DWR believes there are potentially significant impacts related to water quality associated with the Project. We request that these impacts be clearly identified within the IS/MND, that references be provided supporting your determinations and appropriate mitigation measures including collaboration with DWR be included, to reduce the impacts to less than significant.

II. THE CURRENT IS/MND DOES NOT MEET THE REQUIREMENTS OF CEQA REVIEW

A. Substantial Evidence Exists That The Project May Have A Significant Impact On The Environment And As Such An EIR Should Be Prepared

CEQA Guidelines § 15064 states that "If there is substantial evidence, in light of the whole record before a lead agency, that a Project ***may*** have a significant effect on the environment, the agency ***shall*** prepare a draft EIR" (emphasis added). Further, a mitigated negative declaration cannot be used where there is evidence that its mitigation is inadequate or deferred. As stated above, the IS/MND fails to identify several significant impacts of the Project. Additionally, without further analysis and commitment by the Project proponents it is unlikely that these impacts could be mitigated to a less than significant level.

In addition, there are two CEQA mandatory findings of significance that are applicable to the Project. First, where the Project has possible environmental effects that are cumulatively considerable and second, where the environmental effects of a Project will cause substantial adverse effects on human beings, either directly or indirectly. Although the IS/MND does not presently include the results of the limited modeling work performed on behalf of the Project proponents by RMA, the modeling that has been shared with DWR indicates an adverse impact to salinity as a result of the Project. In light of the planned and potential Projects in this vicinity the cumulative contribution of this Project may be significant. The Project also presents the possibility of substantial adverse effects on human beings as presently proposed due to the increased risk of levee failure and the adjacent properties including several privately owned duck clubs and the Grizzly Island Wildlife Area which is open the public.

B. Notwithstanding The Necessity Of Preparing An EIR, Should The Lead Agency Choose To Proceed With An MND, The Changes Would Require Recirculation

Because of the deficiencies identified above, the Draft IS/MND will need to be re-circulated prior to certifying it under CEQA, and approving the Project. Specifically, State CEQA Guidelines section 15073.5 requires that a negative declaration be re-circulated when "the document must be substantially revised after public notice of its availability has previously been given pursuant to Section 15072, but prior to its adoption." Substantial revision includes:

(1) A new, avoidable significant impact is identified and mitigation measures or Project revisions must be added in order to reduce the effect to insignificance, or

(2) The lead agency determines that the proposed mitigation measures or Project revisions will not reduce potential effects to less than significance and new measures or revisions must be required.

DWR looks forward to your responsiveness and continued coordination. As stated above and in our prior meetings we wish to continue to collaborate with you to ensure these efforts are successful and avoid adverse impacts to interested stakeholders such as DWR. If the lead agency has any questions, please do not hesitate to Erik Loboschefsky, Water Resources Engineer, at (916) 376-9751; or Cliff Feldheim, Suisun Marsh Environmental Planning and Information Branch Chief, at (916) 376-9693 with any questions. We look forward to continuing to work with you to resolve these issues.

Sincerely,



Cliff Feldheim,
Branch Chief,
Suisun Marsh Environmental Planning and Information

EXHIBIT C

A-13-276

PROTEST DISMISSAL AND SETTLEMENT AGREEMENT BETWEEN DELTA WETLANDS PROPERTIES, SAN JOAQUIN COUNTY AND SAN JOAQUIN COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

This Protest Dismissal and Settlement Agreement ("Agreement") is entered into and effective this 13th day of AUGUST, 2013 ("Execution Date"), by and between San Joaquin County ("County"), a political subdivision of the State of California, San Joaquin County Flood Control and Water Conservation District ("District"), a political subdivision of the State of California, and Delta Wetlands Properties, an Illinois General Partnership ("Delta Wetlands"). San Joaquin County and San Joaquin County Flood Control and Water Conservation District are collectively referred to as "County". Hereinafter, the term "Delta Wetlands" shall include Delta Wetlands Properties, its successors and assigns.

RECITALS

A. WHEREAS, Delta Wetlands is proposing to develop the Delta Wetlands Project ("Project") on Bacon Island, Bouldin Island, Webb Tract and Holland Tract;

B. WHEREAS, the Project involves water storage reservoirs for diversion and storage of water on and discharge of water from Bacon Island and Webb Tract (the "Reservoir Islands") and seasonal diversion and use of water on Bouldin Island and Holland Tract (the "Habitat Islands") for farming and wildlife habitat;

C. WHEREAS, Delta Wetlands and the Semitropic Water Storage District ("Semitropic") state that they are presently jointly responsible for the permitting, development, construction and operation of the Project;

D. WHEREAS, the Project is described in the 1995 Draft Environmental Impact Report/Statement for the Delta Wetlands Project, the 2000 Revised Draft Environmental Impact Report/Environmental Impact Statement, the 2001 Final Environmental Impact Report, the 2001 Final Environmental Impact Statement, the 2010 Delta Wetlands Project Place of Use Draft Environmental Impact Report and the Delta Wetlands Project Place of Use Final Environmental Impact Report ("2011 FEIR");

E. WHEREAS, Semitropic served as the lead agency for purposes of compliance with the California Environmental Quality Act and certification of the 2011 FEIR for the Project;

F. WHEREAS, the Project is located within the Sacramento – San Joaquin River Delta ("Delta");

G. WHEREAS, Bacon Island and Bouldin Island are located in San Joaquin County and Holland Tract and Webb Tract are located in Contra Costa County;

H. WHEREAS, Bacon Island consists of approximately 5,263 acres of Important Farmland, which includes approximately 5,151 acres designated as Prime Farmland; however,

only 4,807 acres are presently in active agricultural production (USDA, FSA-578 Report of Acreage for 2012), and the remainder of the land is not currently farmable due to roads, levees, drains, and wet soil conditions;

I. WHEREAS, agricultural production on Bacon Island will cease during the life of the Project, eliminating the agricultural production capabilities on the island and resulting in a 4,807-acre reduction in agricultural production during that time;

J. WHEREAS, Bacon Island will be seasonally inundated but the agricultural soils will not be permanently lost or converted to non-agricultural use, and the island will be restored to commercially farmable condition following its use as a water storage reservoir;

K. WHEREAS, Delta Wetlands will conduct wildlife-friendly farming on Bouldin Island as part of the Project's Habitat Management Plan ("HMP"), which also calls for the creation of wetlands and other wildlife habitat under a California Fish and Wildlife Easement;

L. WHEREAS, County, Central Delta Water Agency ("CDWA"), Reclamation District No. 2038, Reclamation District No. 2072, and RC Farms, Inc., jointly filed a lawsuit challenging Semitropic's certification of the 2011 FEIR and approval of the Project in the case, *Central Delta Water Agency, et al. v. Semitropic Water Storage District, et al.*, San Francisco County Superior Court Case No. CPF-11-511753 (hereinafter referred to as "Lawsuit");

M. WHEREAS, the San Francisco County Superior Court denied the County's and other parties' claims in the Lawsuit and entered Judgment in favor of Semitropic and Delta Wetlands on October 29, 2012;

N. WHEREAS, Semitropic and Delta Wetlands filed a memorandum of costs in the Lawsuit on November 2, 2012;

O. WHEREAS, County and other parties have jointly filed an appeal of the San Francisco County Superior Court decision and Judgment in the Lawsuit, which is pending before the First District Court of Appeal as Case No. A137300;

P. WHEREAS, Delta Wetlands has applied for appropriative water right permits from the State Water Resources Control Board for the Project and the active Applications and Petitions to Change Applications (hereinafter collectively the "Applications") for the Project have been assigned the following numbers by the State Water Resources Control Board: Nos. 29062 and 30268 (Webb Tract), and Nos. 29066 and 30270 (Bacon Island);

Q. WHEREAS, County has filed protests against some or all of the Applications (hereinafter collectively referred to as "Protests");

R. WHEREAS, County is concerned about possible seepage and levee stability issues in connection with Project activities on Bacon Island and Bouldin Island, and also on Webb Tract and Holland Tract, which while located in Contra Costa County, are close enough to the County that they could cause seepage and levee stability problems for landowners and Reclamation Districts within San Joaquin County;

S. WHEREAS, County does not wish to duplicate the Protest Dismissal and Settlement agreement that Delta Wetlands and CDWA have entered into, but remains concerned with the seepage and levee stability issues;

T. WHEREAS, the County has enacted San Joaquin County Code Section 9-115.582 and Table 9-605.2, a zoning ordinance that requires a conditional use permit ("CUP") to construct water storage facilities of 500 acre-feet or greater;

U. WHEREAS, the County has enacted San Joaquin County Code Section 9-1080 *et seq.*, an agricultural land conversion ordinance that requires conservation of other agricultural land at a 1:1 ratio or payment of an in lieu fee for projects involving a zoning change that results in conversion of agricultural land to non-agricultural purposes;

V. WHEREAS, Delta Wetlands and County dispute whether a CUP and additional agricultural land mitigation will be required for the Project;

W. WHEREAS, although the Parties are in disagreement as to appropriate agricultural land conservation measures, the Parties desire to settle the litigation and disputes between them, thus avoiding continued expense and attention, and the Parties have therefore agreed that Delta Wetlands will acquire easements on 5,500 acres of Prime Farmland in accordance with the terms of this Agreement;

X. WHEREAS, the Parties intend and agree that easements satisfying mitigation land obligations of the Agreement be held by the Central Valley Farmland Trust ("CVFT") or another third party mutually agreed upon by the County and Delta Wetlands; and

Y. WHEREAS, the Parties desire to address the County's concerns regarding the construction and operation of the Project, its impacts to agricultural production, and its other impacts by entering into this settlement of all existing legal claims and disputes between the County, Delta Wetlands and Semitropic regarding the 2011 FEIR and the Project's construction, operation, approvals, and water rights.

AGREEMENT

NOW, THEREFORE, the Parties hereby agree as follows:

1. **Purpose of Agreement.**

The purpose of this Agreement is to provide a mechanism for the terms herein and to settle litigation and permitting disputes between the Parties.

2. **Definitions**.

2.1.1. **"CDWA Settlement Agreement"**. The Protest Dismissal and Settlement Agreement between Delta Wetlands, CDWA, and other parties, dated _____, 2013, as

may be amended, restated or supplemented from time to time. The _____, 2013 Protest Dismissal and Settlement Agreement is attached hereto as Exhibit A.

2.1.2. **"Commercial Agricultural Production"**. The production of crops for sale including, but not limited to, livestock production and grazing, on land and includes the capability to alter, from time to time, practices and crops produced to attain the most economically advantageous production given the climate and soil of the land. Nothing in this definition is intended to exclude agricultural lands used for seasonal wildlife hunting and recreation, such as the common practice of intentional flooding of Delta agricultural lands in the fall and winter.

2.1.3. **"County"**. County shall refer to the County of San Joaquin, the Board of Supervisors of the County of San Joaquin, San Joaquin County Flood Control & Water Conservation District, and all departments and agencies of the County of San Joaquin.

2.1.4. **"Easement(s)"**. Agricultural conservation easements acquired pursuant to Section 3 of this Agreement.

2.1.5. **"Easement Agreement"**. The legal document encumbering a specific property with an easement that substantially conforms to the Easement Form and that is tailored to the specific features of the property by Easement Holder.

2.1.6. **"Easement Form"**. The form of easement attached hereto as Exhibit B. Each Easement Agreement entered into between Easement Grantor and Easement Holder shall substantially conform to the Easement Form.

2.1.7. **"Easement Grantor"**. The owner of land granting an Easement.

2.1.8. **"Easement Holder"**. The organization selected by the Parties in accordance with Section 3.3 to administer the Easements acquired pursuant to the this Agreement.

2.1.9. **"Easement Holder-Delta Wetlands Agreement"**. The agreement entered into between Easement Holder and Delta Wetlands to carry out easement provisions of this Agreement.

2.1.10. **"Project" or "Delta Wetlands Project"**. The Delta Wetlands Project, including all governmental and non-governmental regulatory, real property and other permits, clearances and approvals necessary for the construction and operation of the Project, as defined in the 2011 Delta Wetlands Project Place of Use Environmental Impact Report.

3. Agricultural Conservation Easements

Delta Wetlands, its agent, or one or more Easement Holders shall acquire perpetual agricultural easements from willing sellers on 5,500 acres in accordance with the following terms.

3.1. **Land Eligible for Easements**. The land eligible for easements shall meet the following terms:

3.1.1. Land must be Prime Farmland that has been used for Commercial Agricultural Production within three of the last five years and is free of restrictions limiting agricultural use subject to Section 3.1.4. "Prime Farmland" means land designated as such by the California Department of Conservation at the time the easement is acquired.

3.1.2. Land shall be located anywhere within San Joaquin County; however, Delta Wetlands may request County approval, in accordance with Section 3.2.3, for land located outside of San Joaquin County but within the area defined as the "Sacramento-San Joaquin Delta" (hereinafter, "legal Delta") in Water Code section 12200 if Delta Wetlands is not able to acquire all 5,500 acres of easements within San Joaquin County at a reasonable cost.

3.1.3. Land must have a permanent water supply that is adequate to support customary local commercial agricultural production on the land. This term shall be fulfilled by providing either a statement of the easement grantor that the property has an adequate water supply or other documentary evidence of a water right or other entitlement to use water on the property subject to review and approval by County, which approval shall not be unreasonably denied. This term does not require submission of further proof or evidence to establish the validity of water rights unless reasonably requested by County in the case of a particular Easement.

3.1.4. Land may have existing or future Williamson Act, flood, flowage or other easements that do not impair agricultural productive capacity of the property, provided that such other easements are not conservation easements that already restrict use of the property to agricultural uses or which restrict the use of the property for wildlife habitat conservation purposes. Any other existing easement, restriction or encumbrance on land shall be subject to review and approval by County, which approval shall not be unreasonably denied.

3.2. **Verification that Easements Lands Meet Section 3.1 Criteria.**

3.2.1. Easement Holder Verification. Easement Holder shall exercise due diligence to verify that the easement lands meet the criteria in Section 3.1. Easement Holder shall provide a written statement to County Counsel that the easement meets the Section 3.1 criteria.

3.2.2. County Review and Approval of Verification. County Counsel shall have thirty days to review and approve or deny the proposed easement and verification submitted by Easement Holder for compliance with this Agreement. If County Counsel does not approve or deny the proposed easement within thirty days it shall be deemed approved. If County Counsel denies the proposed easement it shall provide Easement Holder and Delta Wetlands with specific reasons in writing why the proposed easement does not comply with this Agreement.

3.2.3. Procedure for Approval of Lands outside San Joaquin County. In the event that Delta Wetlands proposes easements outside of the County in accordance with Section 3.1.2, the following procedures shall govern.

3.2.3.1. Delta Wetlands shall submit to the County a request to satisfy easement obligations with easements located on lands outside San Joaquin County but within the legal Delta, as provided in 3.1.2. The request shall be supported with Delta Wetlands'

explanation of its efforts to acquire easements within San Joaquin County, and an explanation of the impediments and obstacles to obtaining easements at reasonable cost on land comparable to those impacted on Bacon Island (e.g., Delta lowlands properties) within San Joaquin County. The request shall also include the quantity of acres Delta Wetlands expects to acquire outside San Joaquin County, and a legal and physical description of the land within the legal Delta that Delta Wetlands proposes for easements. The County Board of Supervisors shall respond to Delta Wetlands' request within 45 days. County Board of Supervisors shall respond in writing by approving or disapproving Delta Wetlands' request, or the County may seek additional information supporting the request. Where County Board of Supervisors seeks additional information regarding the request, then upon a response from Delta Wetlands, County Board of Supervisors shall respond to Delta Wetlands' request within 45 days. County Board of Supervisors shall not unreasonably deny Delta Wetlands' request. .

3.3. **Easement Holder**. The parties shall mutually agree to the organization that shall hold and administer the easement(s). The easement holder shall be an organization whose purposes include agricultural land preservation and be a "qualified organization" under Section 170(h) of the United States Internal Revenue Code and meet the requirements of Section 815.3(a) of the California Civil Code.

3.3.1. The parties propose that CVFT shall be the holder of the easement(s). County agrees that CVFT shall serve as easement holder if CVFT and Delta Wetlands execute an Easement Holder-Delta Wetlands Agreement whereby CVFT agrees to administer the easements in accordance with this Agreement and Delta Wetlands agrees to provide the Easement administration and enforcement costs. The Parties agree that CVFT meets the requirements of Section 3.3 of this Agreement.

3.3.2. The parties may mutually select a different easement holder to hold and administer all or a portion of the Easements.

3.4. **Required Elements for Easement Holder-Delta Wetlands Agreement**. The Easement Holder-Delta Wetlands Agreement shall provide the following:

3.4.1. Verification of Easements Lands. Easement Holder shall exercise due diligence to verify that the Easement lands meet the Section 3.1 criteria in accordance with the Section 3.2.1 procedure.

3.4.2. Verification of Easement Agreements. Easement Holder shall verify that the Easement Agreements conform to the Easement Form and other applicable obligations set forth in the Agreement.

3.4.3. Monitoring. Easement Holder shall monitor the property(ies) encumbered by the Easements for compliance with the terms of the each specific property's Easement Agreement.

3.4.4. Enforcement. Easement Holder shall establish procedures for enforcement where Easement Grantor or subsequent landowner does not comply with the terms of the Easement Agreement. The Easement Holder-Delta Wetlands Agreement shall state that both Easement Holder and County have the authority to enforce the terms of the Easement

Agreements and to take any enforcement action authorized by the Easement Holder-Delta Wetlands Agreement.

3.4.5. Annual Report. The Easement Holder shall provide to County's Board of Supervisors by March 1 an annual report that summarizes the monitoring and enforcement activities as to each Easement for the prior year.

3.4.6. Delta Wetlands Payments. The Easement Holder-Delta Wetlands Agreement shall provide that Delta Wetlands shall make the payments described in Section 3.6.

3.5. **Easement Agreements.**

3.5.1. The Easement Agreements entered into between Easement Grantors and Easement Holder shall substantially conform to the Easement Form attached hereto as Exhibit B.

3.5.2. The terms of the Easement Agreements shall provide that the grantor of any easement shall not substantially impair or diminish the agricultural productive capacity of the encumbered property.

3.5.3. The easement(s) shall not limit or prevent any activities of a reclamation district or any measures to construct, operate and maintain flood control, drainage, reclamation, seepage control, or irrigation facilities. The foregoing list does not allow for inundation for a reservoir or water storage facility or other facilities or uses of any kind that impair the commercial agricultural production capacity of the encumbered property.

3.5.4. Closing of each Easement Agreement shall be by a national title insurance company with an office in San Joaquin County and at closing, County and Easement Holder shall be issued a policy of title insurance insuring that the Easement is not subordinate to any lender interest, encumbrance or restriction capable of foreclosing the property and extinguishing the easement. All title costs and the cost of the required policy of title insurance shall be borne by Delta Wetlands.

3.6. **Delta Wetlands Easement Administration Payments.** Delta Wetlands shall be responsible for the following payments to Easement Holder. The amounts of the payments shall be negotiated between Easement Holder and Delta Wetlands and included in the Easement Holder-Delta Wetlands Agreement.

3.6.1. An initial payment to Easement Holder for the costs of the establishment, administration, and initial stewardship of the Easement(s).

3.6.2. Annual payments to Easement Holder for stewardship of the easement(s), including, but not limited to, ongoing monitoring, yearly reporting, and enforcement of the easement(s). The annual payment shall be secured by an encumbrance on Delta Wetland's Bacon Island and Bouldin Island. It is understood by County that the encumbrance will be subordinate to a prior and superior Fish and Wildlife Habitat easement. In the alternative to annual payments, Delta Wetlands may place in trust funds which will yield annually the amount required for the purposes specified in this subparagraph, as determined by CVFT or a one-time payment agreed upon by Easement Holder and Delta Wetlands may be made.

3.7. **Timing for and Conditions Precedent to Acquisition of Easements.** Delta Wetlands' obligation to acquire Easements pursuant to this Agreement shall not be effective until Delta Wetlands has received all necessary governmental and nongovernmental regulatory, real property and other permits, clearances and approvals to locate, construct and operate the Project, including but not limited to any all approvals required by County. If Delta Wetlands' obligation to acquire Easements takes effect, Easements shall be acquired prior to Delta Wetlands' commencement of construction of facilities for diversion of water to storage on Bacon Island in accordance with any water right permits issued for applications 29066 and 30270.

4. Delta Wetlands Protest Dismissal and Settlement Agreement with CDWA

4.1. **County as Third Party Beneficiary.** The CDWA Settlement Agreement shall provide that County shall be authorized and shall have the power to enforce the terms of that agreement as they relate to seepage (Section 2), levee integrity (Section 3), road integrity (Section 3) and future reclamation for agricultural use of Bacon Island (Section 4) with respect to the portion of the Project within the San Joaquin County or any effects from the Project to lands within San Joaquin County, in accordance with the same terms and conditions applicable to CDWA under the CDWA Settlement Agreement; provided, however, County expressly agrees to be bound by the CDWA Agreement as if it were a party signatory thereto including to be bound to the enforcement and arbitrations provisions (Sections 5 and 6) and any other procedural or substantive requirements and remedies of the CDWA Settlement Agreement that pertain to seepage (Section 2), levee integrity (Section 3), road integrity (Section 3) and future reclamation for agricultural use of Bacon Island (Section 4). County acknowledges that the CDWA Settlement Agreement provides the exclusive remedies regarding construction and operation of the Project, including those relating to Project seepage, levee integrity, road integrity and reclamation available to the County. The CDWA Settlement Agreement shall include the following language as a subsection in Section 6:

> This Agreement confers rights and remedies upon the County of San Joaquin as a third-party beneficiary of this Agreement. The County of San Joaquin may enforce the provisions of this Agreement pertaining to seepage (Section 2), levee integrity (Section 3), road integrity (Section 3) and future reclamation for agricultural use of Bacon Island (Section 4) as to the portion of the Project within the San Joaquin County or any effects from the Project to lands within San Joaquin County in the same manner and subject to the same limitations as provided for herein applicable to the CDWA. The Parties expressly intend to confer these rights and remedies upon the County of San Joaquin and may not materially amend this Section 6.24 or Section 9.1 of this Agreement or terminate this Agreement without the prior written consent of the County of San Joaquin, which consent shall not be unreasonably withheld.

4.2. **County Rights of Entry.** Section 9.1 of the CDWA Settlement Agreement shall confer to the County a right of entry to Bacon Island and Bouldin Island in accordance with and subject to the same terms, conditions and limitations applicable to CDWA defined in Section 9, including the obligation to indemnify Delta Wetlands in accordance with Section 9.4.

4.3. **Satisfactory Form of Agreement.** County acknowledges that it has received the CDWA Settlement Agreement dated _____, 2013 (Exhibit A). County acknowledges that the language of Sections 6.24 and 9.1 of the attached CDWA Settlement Agreement satisfy the terms of Sections 4.1 and 4.2 above.

4.4. **Waiver.** To the extent that the foregoing provisions of this Section 4 are releases by County to which Section 1542 of the California Civil Code or similar provisions of other applicable law applies, it is the intention of the parties that the foregoing releases shall be effective as a bar to any and all actions, fees, damages, losses, claims, liabilities and demands of whatsoever character, nature and kind, known or unknown, suspected or unsuspected specified herein of County as to Delta Wetlands. In furtherance of this intention, County expressly waives any and all rights and benefits conferred upon them by the provisions of Section 1542 of the California Civil Code, or similar provisions of applicable law, which states:

> **"A general release does not extend to claims which the creditor does not know or suspect to exist in his or her favor at the time of executing the release, which if known by him or her must have materially affected his or her settlement with the debtor."**

The Parties acknowledge that the foregoing waiver of the provisions of Section 1542 of the California Civil Code was bargained for separately. Notwithstanding the provisions of Section 1542, and for the purpose of implementing a full and complete settlement, County expressly acknowledges that this waiver is intended to include in its effect without limitation all of the claims, causes of action and liabilities which County do not know or suspect to exist in its favor at the time of execution of this Agreement, and this Agreement, contemplates extinguishment of all such claims, causes of action and liabilities as provided herein.

5. Bacon Island Restoration

Delta Wetlands agrees to prepare and implement a reclamation plan to restore Bacon Island to a commercially farmable condition at the conclusion of water storage operations. This paragraph is satisfied by Delta Wetlands compliance with the CDWA Settlement Agreement's provisions for a Reclamation Plan (Section 4), including provisions in that the CDWA Settlement Agreement provide for funding for the Reclamation Plan (Section 8).

6. County Permits and Approvals

6.1. **County Permits and Approvals Required for Project.** The Parties agree that the County permit and approval provisions of this Section shall apply to the construction and operation of the Project.

6.2. **Project Construction and Operations.** The County plans, permits and approvals identified herein shall be the exclusive means by which the County shall apply its regulatory authority to permit, condition or otherwise control Project construction and operation associated with the conversion of Bacon Island into a water storage reservoir, including construction of new water diversion and discharge facilities, major land grading and other construction that will be undertaken to convert Bacon Island into a water storage reservoir, and Project construction and operation associated with development of the HMP on Bouldin Island.

The requirements of this Section are not intended to apply to activities not associated with the Project, including any ongoing agricultural activities and levee maintenance and repair, and maintenance, repair and construction of electrical, natural gas, and other utilities not owned and operated by Delta Wetlands.

6.3. **Ministerial County Permits and Approvals.** Notwithstanding any claim that such permits and approvals may be preempted under Government Code section 53091, Delta Wetlands shall do the following prior to or during (if applicable) construction of Project:

6.3.1. Prepare a traffic control plan for the Project's construction and operation;

6.3.2. Obtain any encroachment or other County permits necessary for traffic associated with Project construction activities;

6.3.3. Comply with San Joaquin County Code agricultural excavation noise standards (San Joaquin County Code, Development Title 9, Section 9-1410.3) during Project's construction activities;

6.3.4. For new recreation facilities on Bouldin Island, obtain San Joaquin County building permits and permits required for septic systems and disposal of solid waste;

6.3.5. Prepare an integrated pest management plan prior to construction and coordinate plan implementation with the San Joaquin County Mosquito Vector and Control District; and

6.3.6. Obtain well permits for all monitoring wells or other wells of any kind that it installs as part of the Project in San Joaquin County.

6.4. **Conditional Use Permit**

6.4.1. Government Code Section 53091. The parties are in agreement that pursuant to Government Code section 53091, subdivision (e), zoning ordinances of the County shall not apply to the location or construction of facilities for the production, generation, storage, treatment, or transmission of water by a Local Agency as defined in Government Code 53090.

6.4.2. No Local Agency Ownership of Bacon Island. The parties do not agree on the application of County building ordinances and zoning ordinances to the location, construction and operation of a water storage facility on Bacon Island if a local agency does not own Bacon Island but such local agency has an interest in construction or operation of the Project. To attempt to resolve such a dispute and any dispute as to the meaning of Local Agency, the parties agree that Delta Wetlands will apply for and pursue, in good faith, County approval of a conditional use permit for the Project pursuant to San Joaquin County Code Section 9-115.582 and Table 9-605.2, as may be amended or renumbered ("CUP") in accordance with the following terms:

6.4.2.1. A water storage facility shall not be constructed on Bacon Island unless one of four events has occurred: County has issued a CUP authorizing such construction and Delta Wetlands elects to proceed under the terms of the CUP; Delta Wetlands

after final decision on a CUP asserts it is not bound by the requirement of a CUP as provided by Section 6.4.2.2, below; the CUP is preempted by State or Federal law; or one or more Local Agencies have acquired Bacon Island for value such that a CUP is not required.

6.4.2.2. Delta Wetlands reserves the right to proceed without compliance with the County's zoning ordinances (a) after application and good faith participation in the process for a CUP if dissatisfied with the outcome of the CUP process necessary to obtain a CUP after a final decision by the Planning Commission or the final decision by the Board of Supervisors if appealed (final decision), or (b) if the CUP is preempted by State or Federal law. Asserting that a CUP is not required as a matter of law and proceeding with the Project without compliance with the terms of a CUP shall not be deemed a breach of this Agreement by Delta Wetlands or its successor and County, in such event, may pursue litigation or undertake other proceedings to enforce the requirement of a CUP.

6.4.3. Local Agency Ownership of Bacon Island. The parties agree that if one or more Local Agencies acquire Bacon Island for value and construct a water storage facility on Bacon Island, County zoning ordinances including but not limited to San Joaquin County Code Section 9-115.582 and Table 9-605.2, shall not apply to the location, construction and operation of Bacon Island as a water storage facility and no conditional use permit or other County zoning approval shall be required for such a facility.

6.4.4. Regardless of whether Delta Wetlands has submitted an application for a CUP, or has obtained a CUP, neither the CUP application nor any CUP shall be binding on a public agency that is exempt from compliance with the requirement for a CUP.

6.5. **No Additional Agricultural Land Mitigation.** In no event, including in connection with the CUP application or any other permit or approval sought under the Agreement, shall the County insist or require that Delta Wetlands provide any agricultural land mitigation in excess of the amount or form of agricultural conservation easements specified in the Agreement, or insist or require that the standards for agricultural easements differ from those provided in this Agreement.

6.6. **County Approvals.** County shall not unreasonably withhold any permits or approvals associated with the items listed in this Section.

6.7. **Terms Continue.** Whether a CUP is required or is pursued by Delta Wetlands or is not pursued due to a Local Agency being exempt from the CUP requirement, all of the other terms of this Agreement shall remain binding on the parties and on any successor to Delta Wetlands whether a Local Agency or other entity.

7. County Road Restoration

Delta Wetlands shall repair or replace to their pre-construction condition Bacon Island Road and any other roads within the County that are damaged due to impacts associated with construction or operation of the Project, including, but not limited to damage caused by hauling or other work in San Joaquin County for the portions of the Project in Contra Costa County.

8. **County Dismissal of Lawsuits, Withdrawal of Protests and Agreement Not to Oppose the Project**

8.1. **Withdrawal of Protests.** County shall withdraw any Protests filed on behalf of itself against the Project and the Applications. To effect the withdrawal, within five (5) working days of execution of this Agreement by both Parties, County shall file with the State Water Resources Control Board, Division of Water Rights, a letter or other instrument withdrawing and requesting dismissal, with prejudice, of the Protests filed on behalf of itself, landowners and water right holders against the Project and the Applications. County shall diligently and in good faith pursue having the State Water Board enter the withdrawal of Protests, dismiss the Protests, or otherwise acknowledge the withdrawal of Protests, as expeditiously as possible. None of Delta Wetlands' obligations under this Agreement shall take effect unless and until the State Water Resources Control Board has entered the withdrawal or dismissal of all Protests on behalf of County with regard to the Project.

8.2. **Dismissal of Appeal of Judgment.**

8.2.1. County shall dismiss with prejudice the County's appeal of the Judgment entered in San Francisco County Superior Court Case No. CPF-11-511753. To effect these dismissals, within five (5) working days of execution of this Agreement by both Parties, County shall file with the First District Court of Appeal a request for dismissal, with prejudice, of the County's appeal of the Judgment, First District Court of Appeal Case No. A137300, and any other outstanding claims in the Lawsuit, against all respondents and real parties in interest, including parties not known to County. County shall diligently and in good faith pursue having each dismissal entered as expeditiously as possible. Within five (5) working days of entry of dismissal, County shall serve on all Parties notice of entry of that dismissal. None of Delta Wetlands' obligations under this Agreement shall take effect unless and until the First District Court of Appeal has entered dismissal of Case No. A137300 by County as to all respondents and real parties in interest in the Lawsuit.

8.2.2. If other parties to the Lawsuit, including CDWA, Reclamation District No. 2038, Reclamation District No. 2072, RC Farms, Inc., and any party who may intervene in the Lawsuit including the Attorney General's Office of the State of California, pursue claims, causes of action and requests for relief, County shall not indemnify, fund, or otherwise assist such parties to the Lawsuit.

8.3. **Agreement to Not Oppose Project.** So long as Delta Wetlands is in compliance with the terms of this Agreement and the conditions of all permits pertaining to the Project, and there has not been material change in the Project, County shall not protest or otherwise object to the permitting, location, construction or operation of the Delta Wetlands Project in any forum or encourage others to do the same, including, but not limited to, the following:

8.3.1. County shall seek no further relief, including appeals, with regard to the Protests and the Lawsuit, including any award of costs or attorneys' fees incurred in connection with the Protests, Lawsuit or previous administrative proceedings.

8.3.2. County shall not file, take, support in any way (financially or otherwise),

any administrative or legal action, protest or objection of any kind, in any forum, that opposes, challenges or seeks to delay, hinder or modify any or all existing or future approvals or actions by any private entity or federal, state or local public agency implementing the Project or implementing any future non-material modification to the Project, including but not limited to any permits, clearances, approvals or actions by Semitropic, the State Water Resources Control Board, the United States Army Corps of Engineers, the National Oceanic and Atmospheric Administration, the United States Fish and Wildlife Service, the California Department of Fish and Wildlife, the California Department of Water Resources, the Delta Protection Commission, the Delta Stewardship Council, the State Lands Commission, the Central Valley Flood Protection Board, Reclamation District Nos. 756, 2025, 2026 and 2028, California Department of Transportation, State Historic Preservation Office, Semitropic Water Storage District, Metropolitan Water District of Southern California, San Bernardino Valley Municipal Water District, Western Municipal Water District of Riverside of County, Kern County Water Agency, the United States Bureau of Reclamation, the United States Environmental Protection Agency, the applicable Regional Water Quality Control Board, the applicable Air Quality Control Board, San Joaquin County, Contra Costa County, and any other third party governmental or nongovernmental entity. County also shall not oppose or submit any written or oral comments on any National Environmental Policy Act or California Environmental Quality Act document prepared for the Project, including approvals by responsible and cooperating agencies, or prepared for any non-material modification to the Project. It is understood that County has taken, and expects in the future to take and pursue, positions in opposition to alterations in Delta channels and flows, the reconfiguration of the movement of water from the Sacramento River to the Tracy area pumps, increases in the quantity and flow rate of Delta exports, and related positions. County shall not be precluded from taking the foregoing positions or other positions on Delta issues by this Section 8.3.2 or this Agreement. If in the future the Project should become an integral component of a larger Delta project that alters Delta channels and flows, or reconfigures the movement of water from the Sacramento River to the Tracy area pumps, or increases the quantity and flow rate of Delta exports, County shall not be precluded from opposing the larger Delta project but County shall not oppose the Project.

8.3.3. For purposes of this Agreement, the following non-exhaustive list of Project modifications shall be deemed non-material: (a) a change in Project footprint or operations that decreases the average water storage quantity or residence time or reduces the maximum permitted water storage capacity of the Reservoir Island(s); (b) a change in Project operations or infrastructure that decreases the maximum permitted daily, monthly, and combined rates of diversion; (c) a change in Project operations or infrastructure that reduces maximum permitted discharges from the Reservoir Islands to the central Delta; (d) a change in the authorized place of use of the Project's water rights; or (e) a change in ownership of the Project.

8.3.4. Notwithstanding the foregoing obligations and restrictions in this Section 8, County may elect to seek judicial enforcement of its CUP requirements in the event that Delta Wetlands withdraws its CUP application pursuant to Section 6.5.2, a local agency does not own Bacon Island, and Delta Wetlands proceeds with construction of water storage facilities on Bacon Island. The filing and/or processing of a CUP application by Delta Wetlands shall not constitute an admission by Delta Wetlands that a CUP is required.

8.3.5. If there is a material change in the Project, County shall not be bound by this section 8.3 with respect to the material change, unless County has approved the material change in writing.

9. Each Party to Bear its Own Costs and Attorney's Fees; Delta Wetlands Withdrawal of Claim for Costs of Suit

9.1. **Costs and Fees.** Each party shall bear its own attorney's fees and costs in the Lawsuit. Neither party shall be entitled to recover any attorney's fees or costs from another party associated with the Lawsuit under any theory.

9.2. **Withdrawal of Claim for Costs of Suit.** Within five (5) working days of notice of entry of dismissal by County, Delta Wetlands shall withdraw or dismiss with prejudice its memorandum of costs filed under the Lawsuit with the San Francisco County Superior Court.

10. Arbitration of Disputes Regarding Section 3

All questions and disputes with respect to rights and obligations of the parties arising under Section 3 of this Agreement shall be resolved exclusively by arbitration.

10.1. **Demand for Arbitration.** Either party has 60 days from the date of notice of a claim to demand arbitration.

10.2. **Appointment of Arbitrators.** The parties may agree on one arbitrator. If they cannot agree on one arbitrator, there shall be three: one named in writing by each of the parties within five days after demand for arbitration is given, and a third chosen by the two appointed. Should either party refuse or neglect to join in the appointment of the arbitrator(s) or to furnish the arbitrator(s) with any papers or information demanded, the arbitrator(s) may proceed ex parte.

10.3. **Hearing.** The arbitration hearing shall be set by the arbitrator(s) to begin within 120 days from the date of a demand for arbitration, and the decision of the arbitrator(s) shall be issued within 180 days from the date of a demand for arbitration. The hearing on the matter to be arbitrated shall take place before the arbitrator(s) in Stockton, California, the time and place to be selected by the arbitrator(s). At the hearing, any relevant evidence may be presented by either party, and the formal rules of evidence applicable to judicial proceedings shall not govern. Evidence may be admitted or excluded in the sole discretion of the arbitrator(s). The arbitrator(s) shall hear and determine the matter and shall execute and acknowledge the award in writing and cause a copy of the writing to be delivered to each of the parties.

10.4. **Award.** If there is only one arbitrator, his or her decision shall be binding and conclusive on the parties, and if there are three arbitrators, the decision of any two shall be binding and conclusive. Except as otherwise expressly stated in this Section 10, the Commercial Arbitration Rules of the American Arbitration Association shall apply to the arbitration, and judgment on the award rendered by the arbitrator(s) may be entered in any court having jurisdiction.

10.5. **New Arbitrators.** If three arbitrators are selected, but no two of the three are able to reach a consensus regarding the determination of the dispute, then the matter shall be decided by three new arbitrators who shall be appointed and shall proceed in the same manner, and the process shall be repeated until a decision is agreed on by two of the three arbitrators selected.

10.6. **Cost of Arbitration.** Each party shall bear their own respective costs of arbitration and the cost of the arbitrator or arbitrators shall be shared equally.

11. Partners, Successors and Assigns

11.1. **Partners and Successors.** This Agreement shall inure to the benefit of and shall be binding upon the assigns, partners, successors in interest, personal representatives, estates, heirs, and legatees of each of the Parties hereto. Any successor or assignee of Delta Wetlands shall be bound to the terms of this Agreement in the same manner and to the extent as Delta Wetlands.

12. Miscellaneous Provisions

12.1. **Other Documents.** The Parties hereto agree to execute any and all additional documents reasonably necessary to carry out the purpose and intent of this Agreement.

12.2. **Entire Agreement.** Except for the documents incorporated by reference herein, this Agreement contains the entire understanding among the Parties and supersedes any prior written or oral agreements between them respecting the subject matter contained herein. There are no representations, agreements, arrangements, or understandings, oral or written, between and among the Parties relating to the subject matter of this Agreement that are not fully expressed herein.

12.3. **Amendments.** The provisions of this Agreement may be amended only by written agreement executed by the Parties hereto and recorded as required herein for this Agreement.

12.4. **Attorneys' Fees.** If any action at law or in equity, including an action for declaratory or injunctive relief, is brought to enforce or interpret the provisions of this Agreement, the prevailing party shall be entitled to reasonable attorneys' fees.

12.5. **Governing Law.** All questions with respect to the construction of this Agreement and the rights and liabilities of the Parties hereto shall be governed by the laws of the State of California.

12.6. **Severability.** If any non-material provision of this Agreement is declared by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions shall continue in full force and effect.

12.7. **Counterparts.** This Agreement may be executed in several counterparts and all counterparts so executed shall constitute one agreement which shall be binding on all of the

Parties hereto, notwithstanding that all of the Parties are not signatory to the original or the same counterpart.

12.8. **Headings**. The headings preceding the paragraphs of this Agreement are for convenience of reference only, are not a part of this Agreement, and shall be disregarded in the interpretation of any portion of this Agreement.

12.9. **Agents**. All rights and obligations agreed to herein by any Party may be exercised and fulfilled by the Party's authorized agent.

12.10. **Notices**. Any notice, demand, request or communication that the Parties desire or are required to give in writing pursuant to this Agreement shall be deemed to have been duly given if delivered by hand or mailed, postage prepaid, certified or registered mail, return receipt requested and addressed to the appropriate Party as set forth below with copies to all of the other Parties to this Agreement. Notice of change of address shall be effective only when given in accordance with this Paragraph. All notices, demands and other communications made in compliance with this paragraph shall be deemed to have been received on the earlier to occur of the date of delivery or on the third business day after mailing.

To DWP:

Delta Wetlands Properties
c/o Rick Stephens
Stephens Real Estate Partners, LLC
1330 Arnold Drive, Suite 142
Martinez, CA 94553-6538
Phone: (925) 932-0251
Fax: (925) 932-0277
stephens@zks.com

With copies to:

George Childs
Zurich Alternative Asset Management
165 Broadway - One Liberty Plaza
New York, NY 10006
Phone: (212) 871-1578
Fax: (866) 457-7296
george.childs@zurich.com

Peter J. Kiel
Ellison, Schneider & Harris L.L.P.
2600 Capitol Avenue, Suite 400
Sacramento, CA 95816
Phone: (916) 447-2166
Fax: (916) 447-3512
pjk@eslawfirm.com

To COUNTY:

County of San Joaquin
Office of the County Counsel
David E. Wooten
44 N. San Joaquin Street
Sixth Floor, Suite 679
Stockton, CA 95202
Phone: (209) 468-2980
Fax: (209) 468-0315

With copies to:

Neumiller & Beardslee
c/o Thomas J. Shephard, Sr.
P.O. Box 20
Stockton, CA 95201-3020
Phone: (209) 948-8200
Fax: (209) 948-4910
tshephard@neumiller.com

12.11. **Effective Date.** Except as otherwise stated in this Agreement, the effective date of this Agreement shall be the date it has been executed by all parties.

12.12. **Termination Date.** This Agreement shall terminate upon the later of the termination or abandonment of all water right permits for Project water diversion and storage on Bacon Island or the restoration of Bacon Island to a farmable condition pursuant to the Reclamation Plan.

12.13. **No Admission of Liability.** Execution of this Agreement and compliance with its terms do not constitute an admission of liability or wrongdoing by any Party.

DELTA WETLANDS PROPERTIES
An Illinois general partnership

By KLMLP 2, LLC
A Delaware limited liability company,
Managing General Partner of Delta
Wetlands Properties

By KLMLP, L.P.
A Delaware limited partnership,
Managing Member of KLMLP 2, LLC

By Zurich American Corporation (fka
Kemper Corporation)
A Delaware corporation,
Managing General Partner of
KLMLP, L.P.

By _____

Date: 7/2/2013

ACKNOWLEDGMENT

State of New York)
) ss
County of New York)

On JULY 2nd, 2013, before me, RONALD RAMDEO, Notary Public, personally appeared ELIZABETH LAND, who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of New York that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____(SEAL)

RONALD RAMDEO
Notary Public, State of New York
No.: 01RA6182165
Qualified in New York County
Commission Expires March 10, 2016

COUNTY OF SAN JOAQUIN,
a political subdivision of the State of California

By _____
KEN VOGEL, Chairman
Board of Supervisors
County of San Joaquin

Date: 8/13/2013

SAN JOAQUIN COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT

By _____
KEN VOGEL, Chairman
Board of Supervisors
San Joaquin County Flood Control
and Water Conservation District

Date: 8/13/2013

ATTEST:
MIMI DUZENSKI
Clerk of the Board of Supervisors, County of San Joaquin, State of California

By _____
MIMI DUZENSKI
Clerk of the Board of Supervisors

Date: 8/13/2013

ATTEST:
Clerk of the Board of Supervisors of the San Joaquin County Flood Control and Water Conservation District

By _____
MIMI DUZENSKI
Clerk of the Board of Supervisors

Date: 8/13/2013

APPROVED AS TO FORM:
DAVID WOOTEN
County Counsel

By _____
J. MARK MYLES
Assistant County Counsel

Date: 7/23/13

Exhibit A

Agreement between Central Delta Water Agency and Delta Wetlands Properties

RECORDING REQUESTED BY AND WHEN RECORDED, RETURN TO:	THIS SPACE RESERVED FOR RECORDER ONLY (Govt. Code § 27361.6)

PROTEST DISMISSAL AND SETTLEMENT AGREEMENT

This Protest Dismissal and Settlement Agreement is entered into by and between Central Delta Water Agency, a public agency ("CDWA"), RC Farms, Inc, a California corporation, Reclamation District No. 2038 (Lower Jones Tract), a public agency, Reclamation District No. 2072 (Woodward Island), a public agency, Reclamation District No. 2030 (McDonald Island) Reclamation District No. 2027 (Mandeville Island), a public agency, Tuscany Research Institute, a Nevada corporation, CCRC Farms, LLC, a California limited liability company, Delta Wetlands Properties, an Illinois general partnership ("Delta Wetlands"), Reclamation District No. 756 (Bouldin Island), a public agency, Reclamation District No. 2025 (Holland Tract), a public agency, Reclamation District No. 2026 (Webb Tract), a public agency, Reclamation District No. 2028 (Bacon Island), a public agency, and Semitropic Water Storage District, a public agency ("Semitropic"). Hereinafter, CDWA, RC Farms, Inc, Reclamation District No. 2038 (Lower Jones Tract), Reclamation District No. 2072 (Woodward Island), Reclamation District No. 2030 (McDonald Island), Reclamation District No. 2027 (Mandeville Island), Tuscany Research Institute, and CCRC Farms, LLC shall collectively be referred to as the "CDWA Parties". Hereinafter the term "Delta Wetlands" shall include Delta Wetlands Properties, its successors and assigns. Hereinafter, Reclamation District No. 756 (Bouldin Island), Reclamation District No. 2025 (Holland Tract), Reclamation District No. 2026 (Webb Tract), and Reclamation District No. 2028 (Bacon Island) shall collectively be referred to as the "Project Island Reclamation Districts." The aforementioned parties may be referred to individually as "Party" and collectively as "Parties."

RECITALS

A. WHEREAS. Delta Wetlands is proposing to develop a project (the "Delta Wetlands Project" or "Project") on Bacon Island, Bouldin Island, Webb Tract and a portion of Holland Tract (individually, "Project Island, and collectively, the "Project Islands") that involves water storage reservoirs for diversion and storage of water on and discharge of water from Bacon Island and Webb Tract (the "Reservoir Islands") and seasonal diversion and use of water on Bouldin Island and Holland Tract (the "Habitat Islands") for farming and wildlife habitat;

B. WHEREAS, Delta Wetlands owns all of Bacon Island, Bouldin Island and Webb Tract and the portion of Holland Tract to be used for the Project;

C. WHEREAS, Delta Wetlands has entered into an agreement with Semitropic whereby Delta Wetlands and Semitropic will be jointly responsible for the permitting, development, construction and operation of the Project;

D. WHEREAS, Reclamation District No 2026 (Webb Tract) and Reclamation District No 2028 (Bacon Island) are reclamation districts encompassing the Reservoir Islands;

E. WHEREAS, Reclamation District No. 756 (Bouldin Island) and Reclamation District No 2025 (Holland Tract) are reclamation districts encompassing the Habitat Islands:

F. WHEREAS, the Project is described in the 1995 Draft Environmental Impact Report/Statement for the Delta Wetlands Project, the 2000 Revised Draft Environmental Impact Report/Environmental Impact Statement, the 2001 Final Environmental Impact Report, the 2001 Final Environmental Impact Statement, the 2010 Delta Wetlands Project Place of Use Draft Environmental Impact Report and the Delta Wetlands Project Place of Use Final Environmental Impact Report ("2011 FEIR");

G. WHEREAS, Semitropic served as the lead agency for purposes of compliance with the California Environmental Quality Act and certification of the 2011 FEIR for the Project;

H. WHEREAS. CDWA, Reclamation District No. 2038. Reclamation District No. 2072, and RC Farms. Inc., San Joaquin County, and San Joaquin County Flood Control and Water Conservation District have jointly filed a lawsuit challenging Semitropic's certification of the 2011 FEIR and approval of the Project in the case, Central Delta Water Agency, et al. v. Semitropic Water Storage District. et al., San Francisco County Superior Court Case No. CPF-11-511753 (Judgment entered October 29, 2012) and First District Court of Appeal Case No. A137300 (Notice of Appeal filed December 10, 2012) (hereinafter referred to as "Lawsuit");

I. WHEREAS, the Project is located within the Sacramento – San Joaquin River Delta ("Delta"). Bacon and Bouldin Islands are located in San Joaquin County and Holland and Webb Tract are located in Contra Costa County:

J. WHEREAS, Delta Wetlands has applied for appropriative water rights permits from the State Water Resources Control Board ("SWRCB") for the Project and the active Applications and Petitions to Change Applications for the Project have been assigned the following numbers by the SWRCB: Nos. 29062 and 30268 (Webb Tract), and Nos. 29066 and 30270 (Bacon Island) (hereinafter collectively the "Applications");

K. WHEREAS, CDWA has filed protests against some or all of the Applications on behalf of itself and landowners and water right holders within CDWA (hereinafter collectively referred to as "Protests");

L. WHEREAS, CDWA is concerned

(1) That increased seepage caused by the proposed Reservoir Islands may adversely affect the levee integrity of neighboring islands and the farmability of the lands thereon;

(2) That erosion of the interior levee slopes of the Reservoir Islands or other actions could result in levee failures or reduction of the Reservoir Island levee widths to the extent that proper installation and maintenance of roadways, seepage and interceptor well fields, seepage cutoff walls and other remedial actions cannot be easily accomplished;

(3) That loss of economically productive farming activities on such Reservoir Islands and Habitat Islands may result in lack of revenue to sustain adequate levee maintenance and drainage:

(4) That the Project could be abandoned due to financial difficulty or other causes and there will be a need to restore the levees, drainage systems and farmland on the Reservoir Islands and Habitat Islands so that farming could be recommenced and sustained to generate income to fund ongoing levee maintenance, operation and maintenance of the drainage systems and carryout other functions necessary to sustain reclamation of the lands for farming purposes; and

(5) That the Habitat Islands (Bouldin Island and Holland Tract) be maintained with productive farming and wildlife friendly agriculture and not be allowed to become permanently flooded or the levees opened to provide tidal wetlands.

M. WHEREAS, when CDWA filed its first Protests, Delta Wetlands' preferred alternative was the four-island water storage alternative with flooding only in the winter and early spring and farming of waterfowl food crops in the spring and fall. Since that time, Delta Wetlands' proposed alternative has been revised to the Project described above which involves two Reservoir Islands and two Habitat Islands, and the Project as revised also includes an improved levee protection system, a maximum water storage elevation of +4 feet mean sea level ("MSL") (NGVD 1929 Datum), and a seepage monitoring and control system that will be installed prior to Project operation;

N. WHEREAS, Delta Wetlands has entered into a Protest Dismissal Agreement with East Bay Municipal Utility District ("EBMUD") dated September 13, 2000 ("EBMUD PDA," attached hereto as Exhibit A) whereby Delta Wetlands has agreed to implement a program to ensure that seepage from Delta Wetlands' water storage operations does not damage neighboring islands;

O. WHEREAS, the EBMUD PDA requires Delta Wetlands to implement a "Seepage Control Plan" (EBMUD PDA, Att. C) that requires extensive groundwater monitoring of the islands in the vicinity of the Reservoir Islands, a seepage control system, identification of groundwater "reference envelopes" for the purpose of assessing Project water storage impacts on groundwater elevations and criteria that require Delta Wetlands to suspend diversions to storage and to lower storage when certain groundwater elevations are reached;

P. WHEREAS, the Seepage Control Plan includes requirements for the vertical filling of the Reservoir Islands in 25% volume increments, holding the water level at each stage while operating interceptor wells and other measures as appropriate to verify that no net seepage impacts are occurring on neighboring islands ("Initial Stage Filling") (EBMUD PDA, Att. C, Art. 1 § E);

Q. WHEREAS, CDWA is concerned that filling be stopped at any time that monitoring reflects that seepage into neighboring levees or lands is being caused by the filling and that reservoir water levels be lowered if such seepage is not promptly eliminated;

R. WHEREAS, the EBMUD PDA requires Delta Wetlands to establish and fund a Design Review Board ("DRB") (EBMUD PDA, Att. B) of engineers to review plans and specifications for the Reservoir Island levees and diversion and discharge facilities including but not limited to: levee factors of safety, wave wash protection for levees, levee slopes widths and heights, seepage control, interceptor well system and monitoring programs;

S. WHEREAS, the EBMUD PDA requires Delta Wetlands to establish and fund a three-member Monitoring & Action Board ("MAB") (EBMUD PDA, Att. B) of engineers to review groundwater monitoring data submitted by Delta Wetlands, to review Project compliance with groundwater performance criteria, to review and recommend changes to the groundwater performance criteria, to serve as a neutral technical engineering advisory panel to hear and investigate complaints associated with Project operations through the EBMUD PDA Dispute Resolution Procedure, and to recommend remedial actions;

T. WHEREAS, the EBMUD PDA provides that the SWRCB shall appoint one member to the MAB, Delta Wetlands shall appoint one member to the MAB, and the two appointed members shall appoint the third member and two alternates (EBMUD PDA, Att. B, § 4);

U. WHEREAS, the EBMUD PDA includes a Dispute Resolution Procedure to identify and remedy levee, seepage and related problems that may be caused by Project Reservoir Island operations (EBMUD PDA, Att. B, §§ 8-17);

V. WHEREAS, the EBMUD PDA requires Delta Wetlands to provide certain "Financial Assurances" including the obligation to initially fund and maintain a "Seepage and Monitoring Fund" (EBMUD PDA, Att. B. § 19), a "Drawdown Fund" (EBMUD PDA, Att. B. § 20), a "Remedial Actions" fund (EBMUD PDA. Att. B. § 21), and "Insurance" (EBMUD PDA, Att. B, § 22);

W. WHEREAS, the purpose of the Seepage Control Plan and Financial Assurances is to prevent or mitigate impacts on or to the lands and levees on neighboring properties, including without limitation, seepage into the lands and levees on adjacent islands, failure of Reservoir Island levees giving rise to increased erosive forces on adjacent islands from wave action, increased velocity of water flows by water diversion and discharge operations, and other impacts to neighboring properties attributable to the Project:

X. WHEREAS, Semitropic has incorporated the EBMUD PDA into the Project Description as a Project environmental commitment in the 2011 FEIR;

Y. WHEREAS, CDWA is concerned that there is no timely mechanism to ensure Delta Wetlands will comply with the EBMUD PDA, that the EBMUD PDA may not prevent the Project from causing increased seepage into neighboring lands and/or levees and there may be no funding source adequate to cover damages from the Project and no adequate funding to recover the Reservoir Islands in the event of levee failure or abandonment;

Z. WHEREAS, Delta Wetlands and Semitropic are confident that increased seepage into neighboring lands and/or levees caused by Reservoir Island operations can be prevented by way of the proposed interceptor well system to be installed on the Reservoir Island levees and other measures confined to the Reservoir Islands;

AA. WHEREAS, Delta Wetlands, Semitropic, and Project Island Reclamation Districts fully understand and agree if increased seepage into neighboring lands and levees caused by the Project is not prevented by such Reservoir Island measures, that reservoir water levels will be limited to such levels as will avoid such increased seepage and if necessary: Reservoir Island operations and other operations causing such seepage will be permanently precluded. Similarly, if changes are made to Habitat Island operations or lands such that seepage into neighboring lands or levees is increased then it is agreed that such seepage must be promptly corrected and that adjustments be made to operations and actions such that there will be no reoccurrence of such increased seepage;

BB. WHEREAS, the Parties wish to resolve CDWA's Protests to the Applications and legal challenges to the Project through this Agreement by providing a legal mechanism for timely enforcement of the terms herein and adequate funding for the remedies provided herein: and

CC. WHEREAS, the Parties wish to establish an effective and expeditious mechanism for resolving future problems and disputes that will be available in addition to the EBMUD PDA.

AGREEMENT

NOW, THEREFORE, the parties hereby agree as follows:

1. **Purpose of Agreement.** The purpose of this Agreement is to provide a mechanism for timely legal enforcement of the terms herein and adequate funding for the remedies provided herein.

2. **Seepage Control and Other Measures**

2.1 As modified by the more restrictive provisions herein the provisions of the EBMUD PDA Seepage Control Plan (Attachment C) are enforceable pursuant to this Agreement by CDWA, the County of San Joaquin and neighboring Reclamation Districts and owners and operators of lands within ten thousand (10,000) feet of any Project island.

2.3 (a) Delta Wetlands will request and use its reasonable best efforts to ensure that the SWRCB includes the Seepage Control Plan (including the groundwater monitoring program) as a term and condition to any permit and license issued pursuant to the Applications.

(b) Delta Wetlands shall implement the Seepage Control Plan (including groundwater monitoring program) and the more restrictive provisions herein whether or not such are included as a term and condition to any permit issued pursuant to the Applications.

2.4 Delta Wetlands will keep all excavations (other than customary farm ditch excavations) at least one thousand (1,000) feet from the landside toe of the Reservoir Island levees, however excavations necessary for Project water diversion and discharge structure facilities may occur within 1,000 feet of the landside of any Reservoir Island levee.

2.5 Delta Wetlands will in accordance with the provisions herein expeditiously implement all measures to stop Reservoir Island operations causing seepage into neighboring lands and levees including without limitation, lowering reservoir water levels sufficiently to stop such seepage.

2.6 Water levels within the Reservoir Islands shall at no time exceed + 4 feet MSL (NGVD 1929 Datum).

2.7 Delta Wetlands agrees that it will not cause damage on or to the lands and levees on neighboring islands including without limitation damage due to: a) seepage into the lands and levees; b) failure of Reservoir Island or Habitat Island levees giving rise to increased erosive forces on neighboring islands from wave action; and c) increased velocity of water flows and increased erosive forces on neighboring islands caused by water diversion and discharge operations. The Parties agree that there may be other damage caused by the Delta Wetlands Project which could result on or to neighboring islands and that the above listing is not intended to be exhaustive.

2.8 On or before one year prior to the start of filling of any reservoir Delta Wetlands shall advance to CDWA the sum of two hundred thousand dollars ($200,000.00) to fund CDWA review of and participation in the initial filling, monitoring and adjustment process. Any funds not used for such purpose shall be repaid to Delta Wetlands within twelve (12) months after completion of the initial filling of the Reservoirs to the maximum water levels and resolution of the initial filling related adjustments to the Operational Criteria Limit as provided herein.

2.9 Delta Wetlands shall not raise water levels or store water on the Reservoir Islands unless all of the following are met: 1) there are at least three operating background groundwater monitoring wells ("piezometers"); 2) there are at least three operating piezometers fronting the Reservoir Islands on each of the segments of neighboring island levees located within two thousand (2,000) feet from the Reservoir Islands; 3) there is continuous groundwater elevation data collected and promptly made available to the CDWA Parties; 4) that the data include a calculation of the daily mean and seven day running averages of the daily mean for each such piezometer for at least the preceding twelve months; and 5) provision is made for collection of such data continuously thereafter. In the event permission for installation of such piezometers on any neighboring island levee segment cannot be obtained then the obligation for installation and monitoring of such piezometers shall be excused and the next three closest piezometers shall be used as substitutes. The actual readings together with the daily mean and seven day running average of daily means for each piezometer shall be posted at least weekly to a website accessible to neighboring island landowners, neighboring island Reclamation Districts and CDWA. The posting shall include the data through the end of the prior week. At least one piezometer on each of such neighboring island levee segments and at least three background piezometers shall be equipped and operated to provide real-time data via telephone or the internet to neighboring landowners, reclamation districts and CDWA. It is recognized that maintenance and service interruptions may on occasion interrupt the production of such data however Delta Wetlands agrees to include more than the minimum number of piezometers and other redundancy to minimize the interruptions in producing such data.

2.10 Delta Wetlands shall operate and maintain piezometers in accordance with the Seepage Control Plan and also install, operate and maintain piezometers in accordance with the terms of this Agreement at all times that the Reservoir Islands are permitted to be used for water storage operations. In the event that the groundwater monitoring wells (piezometers) fail or do not produce the data necessary to make required groundwater and seepage determinations under the Seepage Control Plan and as required herein, Delta Wetlands shall not store water in or raise the water level of any portion of any Reservoir Island until the groundwater monitoring system is restored. In such event the discharge of stored water from the Reservoir Island shall take place as soon as practicable.

2.11 **Operational Criteria Limit.**

(a) If on an island neighboring a Reservoir Island or Habitat Island where the Project is raising water levels or allowing water levels to rise any three (3) piezometers which are contiguous to each other and fronting on the Reservoir Island or Habitat Island ("fronting piezometers") show an average "net increase in head" of .75 feet or more in the average of the

seven day running average of such three fronting piezometers daily mean water levels, it shall be presumed that seepage into the levee and or land of the neighboring island is caused by the Project. The seepage presumed to be caused as a result of a net increase in head of .75 feet shall not be presumed to cause actual, physical or monetary property, levee, or crop damage or entitle any person to recover economic or other damages for said increase in head. The proof of damage caused by such seepage shall be based on a preponderance of the evidence.

The "net increase in head" will be determined as follows:

The average of the seven day running average of the daily mean water levels for the three (3) "fronting piezometers" for any day will be compared to the pre-Delta Wetland Project operation average of the seven day running average of the daily mean water elevations for the same three (3) piezometers for the same calendar day in the baseline year. This initial comparison will be used to establish the "gross change in head." A similar calculation for the same calendar day will be made on the nearest three (3) "background piezometers" that are at least 10,000 feet from any active Project operation. If the "gross change in head" of the "fronting piezometers" is .75 feet or more higher than the "gross change in head" of the "background piezometers" then there is a "net increase in head" of .75 feet or more in the "fronting piezometers" and therefore seepage into the levee and/or land of the neighboring island is presumed to be caused by the Project. The seepage presumed to be caused as a result of a net increase in head of .75 feet shall not be presumed to cause actual, physical or monetary property, levee, or crop damage or entitle any person to recover economic or other damages for said increase in head. The proof of damage caused by such seepage shall be based on a preponderance of the evidence.

The net increase in head of .75 feet is defined to be the "Operational Criteria Limit" or "OCL." The OCL shall be subject to change as experience is gained during the initial water storage filling of the Project Reservoir Islands and thereafter during water storage operations of the Reservoir Islands. The OCL shall be used to control operation of the Project in accordance with this Agreement.

Continuous daily measurements will be used to determine the daily means. The calculations and measurements must be performed under the supervision of and certified by a civil engineer registered with the State of California. Piezometers shall be installed and screened to reflect head conditions in the sand/gravel strata below the neighboring levees which extend beneath the Reservoir Island. Piezometers shall be open standpipe design and the boring logged to verify soil conditions. If a piezometer is destroyed, damaged or otherwise fails to operate properly, a replacement piezometer shall be deemed to be the same piezometer provided it is installed within twenty (20) feet of the original piezometer and screened at the same depth subject to reasonable construction tolerances

(b) If readings from three piezometers closest to the Reservoir Island are not available, then the readings from the nearest piezometers which are available shall be used. If comparative readings are available from only one piezometer, then it shall be used. Any uncertainty relating to insufficient piezometer readings shall be resolved by lowering the

reservoir water level and monitoring the available piezometers (if none are available, then new piezometers shall be installed at Delta Wetlands' expense). No water storage shall be allowed unless at least three piezometers usable for such determinations are installed and operating on each of the neighboring island levee segments fronting on and located within two thousand (2,000) feet of the subject Reservoir Island. If uncertainty in readings arises due to excavation in the adjoining channels or other causes, then the uncertainty shall be resolved by lowering the reservoir water level while monitoring piezometers on the neighboring island to determine the reservoir impact on seepage in accordance with Section 2.12 and 2.14.

2.12 **Initial Stage Filling Seepage Detection and Management Criteria.** Delta Wetlands shall utilize the Initial Stage Filling process of the Seepage Control Plan (Att. C, § E) in conjunction with the CDWA Monitoring Procedure and OCL, subject to the following terms. Delta Wetlands shall fill the Reservoir Islands in no more than 25% volume increments, holding the water level at each stage while operating interceptor wells and other measures as appropriate to verify that no net seepage impacts are occurring on neighboring islands. If seepage into neighboring lands or levees is detected before the 25% increment is reached, then the filling shall stop and if necessary lowered to stop such seepage. Delta Wetlands shall use the criteria and process described in this section to refine the groundwater monitoring program and seepage control measures.

The OCL shall be used as the Project operating criteria until the relationship between Reservoir Island water storage operations and seepage is better understood. The parties shall confer on changes to the OCL and make such changes as per the procedure herein.

(a) If during the initial stage of filling there has been no exceedance of the OCL Delta Wetlands may fill the reservoir to the next 25% volume stage.

(b) If there is an exceedance of the OCL caused by the Project Delta Wetlands shall stop filling the Reservoir and if necessary lower the water level to stop the seepage in accordance with the following:

(i) If Delta Wetlands determines that the exceedance of the OCL is a false positive exceedance not caused by the Project, Delta Wetlands shall within five (5) days of occurrence submit the determination to the MAB for review in accordance with the EBMUD Dispute Resolution Process in Section 5.2(a). Either party may refer the MAB determination to the CDWA Dispute Resolution Process within ten (10) days of the MAB determination. Notwithstanding the above CDWA may submit the Delta Wetlands determination that the OCL exceedance is a false positive exceedance to the CDWA Dispute Resolution Process if the MAB has not rendered its own determination within fifteen (15) days of the exceedance.

(ii) If the seepage control measures are implemented but are ineffective in reducing groundwater levels below the applicable OCL within fifteen (15) days of the exceedance, the exceedance may be referred to the CDWA Dispute Resolution Process in Section 6.

(iii) Delta Wetlands shall release stored water to levels where the Project is no longer causing an exceedance of the OCL if directed by a final MAB determination or CDWA Dispute Resolution arbitrator decision.

(c) If seepage control measures are effective in returning groundwater levels below the OCL, or if the exceedance was not caused by the Project, then Delta Wetlands may fill the reservoir to the next stage.

(d) The Initial Stage Filling process shall be complete for each Reservoir Island once the reservoir has been filled to the maximum permitted elevation with no further exceedance of the OCL at the maximum elevation. After the Initial Stage Filling process is complete, the reservoir shall be subject to the Normal Operations Criteria in Section 2.14.

2.13 The parties shall, during the initial filling and draining of the Reservoir Islands or sooner if conclusive evidence exists, evaluate piezometer data to determine the effectiveness of the OCL in predicting actual seepage caused by the Project. If the data indicate that the OCL does not reflect seepage caused by the Project or gives false indications that seepage is caused by the Project, the parties agree to negotiate in good faith to reach agreement on a modification of the OCL. If the matter is not resolved by agreement, the matter may be submitted to the CDWA Dispute Resolution Process in Section 6 as provided herein. Pending resolution, the criteria shall remain in effect.

2.14 **Normal Operations Seepage Detection and Management Criteria.** After the Initial Stage Filling process has been completed for a reservoir, the following provisions for normal operations shall apply:

(a) The CDWA Monitoring Procedure and OCL, as may be amended, shall be used to control normal Project operations. If there is an exceedance of the OCL, it shall be presumed that seepage into the levee or land of the neighboring island is caused by the Project and Delta Wetlands shall take immediate action to reduce the seepage and, if necessary, stop filling and reduce the level of water within the reservoir to stop the seepage. An exceedance of the OCL shall not be presumed to cause actual, physical or monetary property, levee, or crop damage or entitle any person to recover economic or other damages for said exceedance. The proof of damage caused by such seepage shall be based on a preponderance of the evidence.

(b) If there is a dispute as to an exceedance of the OCL, it shall be addressed first through the EBMUD Dispute Resolution Process in Section 5.2(b). If an exceedance of the OCL is not resolved in the EBMUD Dispute Resolution Process within fifteen (15) days of the exceedance, or if CDWA does not agree to the resolution, then the matter may be submitted to the CDWA Dispute Resolution Procedure in Section 6.

2.15 Project Island Reclamation Districts each agree that they will, upon the approval of a permit issued by the SWRCB for the Delta Wetlands Project, grant the rights of entry as provided in Section 10 herein. Project Island Reclamation Districts hereby further authorize and approve the corrective actions directed by the Arbitrator as provided in Section 6 herein provided

that the district encompassing the subject Delta Wetlands Project area is first given the opportunity to perform the corrective work with funds to be provided from the CDWA Security Fund. All such corrective work performed by any party shall be directed by a California Registered Civil Engineer with at least ten years of experience working on levees in the Lowlands portion of the Delta as such Lowlands are shown on page 4 of the 1993 Sacramento-San Joaquin Delta Atlas prepared by the California Department of Water Resources.

2.16 Any aggrieved party as per paragraph 6.13 and any Party to this Agreement may at its own expense elect to install and monitor additional piezometers. In such event and upon the request of such party, Delta Wetlands agrees to have the same contractors and consultants performing the installation, monitoring and data reporting of the Project piezometers install, monitor and report the data for such additional piezometers. In such case, the party requesting the same shall on a monthly basis advance to Delta Wetlands the funds necessary to pay the costs for such services.

2.17 The parties recognize that raising water levels in the Project Islands may enlarge or open seepage paths into neighboring levees and lands resulting in increased seepage even from sources other than the Project. In such event remedies in addition to reduced maximum water levels on the Project Islands shall be required. The priorities for such additional remedial action shall first be increased operation and/or improvements of the on Reservoir Island interceptor well system, and shall second include the installation and operation of interceptor wells and/or other physical measures on the impacted areas. In all cases compensation for damages shall apply. Disputes regarding the above may be submitted for resolution through the CDWA Dispute Resolution Procedure.

3. **Levee Integrity and Other Measures**

3.1 As modified by the more restrictive terms herein the EBMUD PDA Geotechnical terms and Conditions (Attachment B) are enforceable pursuant to this Agreement.

3.2 **Reservoir Island Levee Standards.** Prior to allowing or causing the water surface elevation at any point within any Reservoir Island to rise four (4) feet above the preexisting land elevation, Delta Wetlands shall complete all levee and other improvements on the Reservoir Islands necessary to meet as a minimum standard either (1) the recommendations contained in the Preliminary Design Report, Reservoir Island Levees, Delta Wetlands Project, Sacramento-San Joaquin River Delta, Project No.101.20, dated March 11,2003, Prepared by Hultgren–Tillis Engineers and for Reservoir Islands and Habitat Islands or (2) the United States Army Corps of Engineers ("USACE") PL 84-99 Agricultural Delta Levee Standards, whichever provides the greatest protection against failure, in accordance with the practice described in Section 3.5. Where County roads are located on the levees the minimum levee crown width shall be sufficient to provide for a twenty-two (22) foot roadway with two (2) foot shoulders on each side and shall provide a subgrade with at least six inches of properly graded and compacted aggregate base with an oil dust cap.

3.3 **Habitat Island Levee Standards.** Delta Wetlands shall not allow or cause the water surface elevation at any point within any Habitat Island to rise four (4) feet above the preexisting land elevation. Delta Wetlands shall maintain all Habitat Island levees and other improvements as necessary to meet as a minimum the USACE PL 84-99 Delta agricultural levee requirements in accordance with the practice described in Section 3.5.

3.4 Until such time as the Project is abandoned or discontinued and the Islands restored to a good and farmable condition Delta Wetlands shall assure that the levees are maintained to the minimum conditions specified in Sections 3.2 and 3.3 adjusted from time to time to account for increases in the 100 year flood elevation due to sea level increase and climate changes.

3.5 The Parties recognize that some levee subsidence and erosion occurs gradually and non-uniformly and unless the subsidence or erosion has reached the point where the levee integrity is jeopardized, the common practice in the Delta is to repair the areas of gradually occurring subsidence and erosion every few years through projects extending over considerable distances. Consistent with the above practice, the levees shall be repaired, rehabilitated and improved to meet all requirements. Conditions presenting an immediate threat shall be addressed immediately.

3.6 **Levee Emergencies.** If a Party reasonably believes that a Delta Wetlands Project levee is at risk of imminent failure the Party may notify Delta Wetlands and the reclamation district where the levee is located. If repairs have not been commenced or a plan for expeditiously completing repairs acceptable to the complaining party have not been prepared within 72 hours of the notification, a Party may invoke Section 6.15 of the CDWA Dispute Resolution Procedure herein.

4. Reclamation Plan

4.1 Within six (6) months from the date of execution of this Agreement Delta Wetlands shall submit to CDWA a Draft Reclamation Plan to restore each Reservoir and Habitat Island to a farmable or shallow marsh habitat condition together with the estimated cost thereof. Such plan shall delineate the areas to be excavated during the life of the project and shall set forth the required actions necessary to restore the various fields to a farmable or shallow marsh habitat condition at the conclusion of the Project. The areas to be excavated shall not exceed fifteen (15) percent of the gross acreage within the Reservoir Islands and Habitat Islands and shall otherwise be planned to reasonably minimize the impact on potential restoration of the land to a farmable condition. No excavation shall take place on any Reservoir Island or Habitat Island except in conformance with such Reclamation Plan. No excavation for levee fill material or water storage shall take place within one thousand (1,000) feet of the landside toe of any Reservoir Island levee; however, excavation necessary for water diversion and discharge structure facilities may occur within 1,000 feet of the landside toe of any Reservoir Island levee. The Reclamation Plan may include planned use of portions of the farmable land for upland and/or shallow marsh habitat purposes, provided however, the land to be farmed on the Reservoir Islands shall not be less than 60% of the current farmable acreage within the levees and the land to be farmed on the Habitat Islands shall not be less than that provided in the Incidental Take Permit (ITP Number

2081-2000-061-2). The Reclamation Plan must identify the source of funding for the habitat land share of the cost of maintaining the levees and keeping the island drained. The Final Reclamation Plan shall be prepared after construction plans and specifications for the Project levee sections and diversion facilities are complete. The requirements of the Reclamation Plan shall not be deemed fulfilled unless at the time of restoration there is a written guarantee from a financially responsible party that the habitat land portion of the future cost of such levee maintenance and drainage will be paid.

4.2 Compliance with the above Reclamation Plan provisions shall be enforceable directly through the CDWA Dispute Resolution Procedure in Section 6.

5. EBMUD PDA Dispute Resolution Procedure

5.1 Sections 8-17 of Attachment B of the EBMUD PDA establish a Dispute Resolution Procedure for interested parties to identify, for the MAB to investigate, and for Delta Wetlands to remedy, levee, seepage and related problems.

5.2 If the EBMUD PDA is modified 1) to require the approval by CDWA of one of the two appointed MAB members and his/her alternate and 2) to include the seepage determination procedures set forth in Sections 2.12 and 2.13 herein, Delta Wetlands and CDWA shall, subject to the following, utilize the EBMUD PDA Dispute Resolution Procedure to identify and remedy levee, seepage, or related problems that may be caused by Reservoir Island water storage operations.

(a) **Review of Exceedances per Section 2.12.** An exceedance of the OCL during the Initial Stage Filling process shall be subject to the EBMUD Dispute Resolution Procedure in accordance with the process and criteria of Section 2.12. If Delta Wetlands' determination in Section 2.12(c) was that the exceedance of the OCL was not caused by the Project, the MAB shall review Delta Wetlands' determination and render its own determination within seven (7) days of Delta Wetlands' determination. The MAB determination shall be supported by findings and recommendations. Either party may submit the MAB determination to the CDWA Dispute Resolution Process. The MAB determination shall be final and binding on all parties if neither party has referred the MAB determination to the CDWA Dispute Resolution Process within fifteen (15) days. CDWA may refer the Delta Wetlands' determination to the CDWA Dispute Resolution Process if the MAB has not rendered its own determination within fifteen (15) days of the exceedance.

(b) **Review of Exceedances per Section 2.14.** After the Initial Stage Filling process is complete for a reservoir and the Project is subject to the normal operations criteria of Section 2.14, an exceedance of the OCL shall be deemed a complaint to the MAB subject to the EBMUD Dispute Resolution Procedure and the following provisions. In the event the Seepage Control Plan and EBMUD PDA Dispute Resolution Procedure does not result in stopping an exceedance of the OCL within fifteen (15) days from the start of the subject exceedance, then CDWA may refer the exceedance to the CDWA Dispute Resolution Procedure.

(c) **Review of Any Other Complaint.** Notwithstanding any other deadline provided in this Agreement, in the event the EBMUD PDA Dispute Resolution Procedure does not result in a complete and satisfactory remedy for any other complaint or dispute brought by an authorized complaining party regarding whether the construction or operation of the Project has caused actual seepage and related damage within 180 days from the date the complaint of the damage was submitted to the EBMUD PDA Dispute Resolution Procedure, then the authorized complaining party may refer the complaint to the CDWA Dispute Resolution Procedure no later than four (4) years of the date of occurrence. An authorized complaining party is defined as: CDWA, the County of San Joaquin, and any Reclamation District or owner or operator of land within 10,000 feet of a Reservoir Island or Habitat Island.

(d) Once a determination or complaint pursuant to Sections 5.2(a)-(c) has been referred to the CDWA Dispute Resolution Procedure, the EBMUD PDA Dispute Resolution Procedure shall not apply to, and the MAB shall no longer have jurisdiction over. the determination or complaint.

5.3 If the EBMUD PDA is not modified as per the above, then the CDWA Dispute Resolution Procedure shall be applicable to the Parties as if the EBMUD PDA Dispute Resolution Procedure did not exist.

6. CDWA Dispute Resolution Procedure

6.1. **Complaints Subject to CDWA Dispute Resolution Procedure.** Complaints brought to the EBMUD PDA Dispute Resolution Procedure pursuant to Sections 5.2(a), (b) and (c) that have not been resolved within the time frames specified therein are subject to the CDWA Dispute Resolution Procedure of this section. Complaints that a Project levee does not meet the standards specified in Sections 3.2 and 3.3 are subject to the provisions of this section. Complaints brought pursuant to Section 3.5 that a levee is at risk of imminent failure or other emergency are subject to the provisions of Section 6.13. Complaints that the OCL has been exceeded, complaints that seepage from the Project has caused damage and complaints that the project has caused damage other than from seepage are also subject to the provisions of this section.

6.2 **Procedure for Submitting Complaint to Arbitration.** To submit a complaint to the CDWA Alternative Dispute Resolution Procedure in accordance with Sections 3.2, 3.3, 3.5, 5.2(a), 5.2(b) or 5.2(c), a Party to this Agreement (hereinafter sometimes referred to as "submitting party"), may serve upon the other parties (hereinafter referred to as "responding party") a certification documenting the complaint issued by a Reclamation District Engineer or a California Registered Civil Engineer within the time limits applicable to Sections 3.2, 3.3, 3.5, 5.2(a), 5.2(b) or 5.2(c). The time limit for complaints regarding damage caused by the Project must in any event be submitted within four (4) years of the date of occurrence.

6.3 **Certification.** The certification shall include the following:

(a) A description of the problem, including, but not limited to, a description of: (i) for levee issues, the levee section(s) not in compliance with the criteria in Sections 3.2 or 3.3 or the sections constituting the levee emergency under Sections 3.5; (ii) for OCL exceedances, the determination regarding the OCL exceedance per Sections 5.2(a) or 5.2(b); (iii) for claims that the construction or operation of the Project has caused levee, seepage and related problems pursuant to Section 5.2(c), a description of the problem;

(b) Delta Wetlands' and MAB's determinations regarding exceedance of the OCL, if any (applicable to Sections 5.2(a) or (b));

(c) A copy of the complaint submitted to MAB, Delta Wetlands' response to the complaint, MAB's response to the complaint and determination, and Delta Wetlands' response to the MAB determination, if any (applicable to Section 5.2(c));

(d) Documentation that the certification has been timely brought within the time frames of this Agreement;

(e) The relief or remedy sought by submitting party in arbitration;

(f) The specific allegations supporting the requested relief; and

(g) Documentation supporting the submitting party's allegations and requested relief, including a certification issued by a Reclamation District Engineer or a California Registered Civil Engineer, which certification shall be accompanied by a declaration under engineer's seal that the certification was prepared by the engineer.

6.4 **Response to Certification.** Responding party shall have ten (10) days after the date of delivery of the certification described in Section 6.3 in which to deliver to the submitting party a California registered Civil Engineer's certification that: 1) the determinations of the engineer of the submitting party are not correct using the methods set forth in the CDWA Monitoring Procedure, Seepage Control Plan, or other criteria provided herein (whichever is applicable); 2) the violation or threatened violation or other inadequacy is cured; or 3) the violation or threatened violation or other inadequacy cannot reasonably be cured within ten (10) days but corrective action is underway and will be complete by a reasonable date certain. In the event that the response from responding party is that the determinations of the submitting party's engineer are not correct using the methods set forth herein or there is some disagreement regarding the proper cure for a violation, or threatened violation or other inadequacy and the Parties cannot resolve the dispute, the matter may be submitted to an Arbitrator as set forth below.

6.5 **List of Arbitrators.** The Parties agree that each individual listed on Exhibit B hereto is qualified to arbitrate any dispute involving this Agreement between the Parties. The Parties shall periodically update this list of Arbitrators. No Arbitrator can be added to or deleted from the list unless CDWA and Delta Wetlands agree in writing to amend this Agreement to that effect. In the event there are no Arbitrators listed who are willing to serve and the Parties cannot agree upon additional Arbitrators to be listed, then the Presiding Judge of the Superior Court of the County of San Joaquin shall designate the Arbitrators who shall be added to the list.

6.6 **Selection of Arbitrator.** In order to submit a matter to arbitration, the submitting party shall notify responding party in writing of the description of the matter and the names of any two

Arbitrators from those listed in Exhibit B. Responding party shall, within five (5) working days of delivery of such notification, designate by written notice addressed to the submitting party which one of the two Arbitrators shall serve as the single Arbitrator for the matter. It shall then be the submitting party's responsibility to contact the Arbitrator(s) to begin the arbitration process. In the event responding party fails to respond within five (5) days of delivery, the submitting party may choose either Arbitrator proposed in the notice to responding party. If the selected Arbitrator cannot serve, then the other Arbitrator shall be asked to serve. If neither of the submitted arbitrators can serve, then selection shall follow the order of names as listed.

6.7 **Arbitration Rules.** Arbitration will be conducted independently by the Parties in accordance with the rules of the American Arbitration Association ("AAA") for arbitration of commercial disputes then existing except where such rules conflict with the terms of Section 6 of this Agreement.

6.8 **Communication with Arbitrators.** The Parties may submit any written information to the Arbitrator regarding the matter in dispute as long as a copy of all such information is provided to each of the other Parties involved in the dispute. The Parties may also speak directly to the Arbitrator as long as representatives of each of the other Parties to the dispute are present either in person or by telephone. The Arbitrator may also make site visits with all Parties to the dispute in attendance. The Parties agree to provide any information reasonably requested by the Arbitrator within five (5) days.

6.9 **Failure to Respond to Certification.** In the event responding party does not within the time specified above deliver to the submitting party its engineer's determination that the determinations of the engineer for the submitting party are incorrect, the determinations of the submitting party shall be deemed to be correct and binding upon the disputing Parties. In that event, damages and/or corrective actions must still be determined by the Arbitrator and the submitting party must present the matter of damages and corrective actions to arbitration as provided herein.

6.10 **Written Decision of Arbitrator.** Except as to emergencies under 6.15 below and unless a different time period is agreed to by the disputing Parties, the Arbitrator shall within thirty (30) days of being contacted by the submitting party, issue a written decision on the matter in dispute. The Arbitrator's written decision must be faxed, emailed or mailed to thePparties to the dispute on or before the thirtieth (30th) day. In crafting a decision the Arbitrator may seek the advice of the MAB or other independent experts on technical and engineering matters. The Arbitrator shall include in that decision 1) the actions, if any, to be undertaken by Delta Wetlands and /or the encompassing Reclamation District; 2) the time period within which such actions are to be completed; 3) the corrective actions allowed to be taken by the submitting party in the event Delta Wetlands and/or the encompassing Project Island Reclamation District do not timely perform; and 4) the amount and timing of payments to be made from the CDWA Security Fund for corrective work and or damages. Damages, if any, to be paid by Delta Wetlands to the submitting party, designation of a prevailing party and determination of costs and fees may be the subject of a subsequent arbitration decision following further proceedings.

6.11 **Arbitration Remedies.** The Parties hereby specifically agree that the Arbitrator may order specific performance or injunctive relief if deemed necessary and appropriate. The Parties recognize that the Arbitrator's decision and actions necessary to implement the decision may be subject to compliance with applicable regulatory requirements. The acting party shall be responsible for regulatory compliance as to its actions. Unless determined by the Arbitrator to be futile, authorization of the submitting party to perform corrective actions and work on the Reservoir Islands or Habitat Islands shall follow a reasonable opportunity for Delta Wetlands and/or the encompassing Reclamation District to complete the corrective actions.

6.12 **Authorization to Submitting Party to Complete Corrective Actions.** The Arbitrator's decision authorizing the submitting party to enter upon the subject Reservoir Island or Habitat Island to carry out corrective measures in the event of default of Delta Wetlands or the Reclamation District to complete the corrective actions may without limitation, include performing levee work and lowering the water level on the Reservoir Island or Habitat Island. In such event, the Arbitrator shall order payments from the CDWA Security Fund to pay the reasonable costs for such corrective measures as invoices are received. The Arbitrator may order payment for advances to the submitting party to complete the corrective work. All such costs shall be supported with appropriate invoices and other documentation submitted to the Arbitrator and Delta Wetlands. If Delta Wetlands disputes any such costs, it shall notify the submitting party within twenty (20) days of receipt of the invoice or other documentation. If not resolved between the parties, the dispute shall be submitted to arbitration for final determination in accordance with the CDWA Dispute Resolution Procedure provided herein. No refilling or storage of water shall be allowed until all corrective measures have been completed. In the event corrective measures do not result in stopping seepage caused by the Project from entering into neighboring lands or levees, then storage of water shall be permanently prohibited and the reservoirs restored to a farmable condition as per the Reclamation Plan. In carrying out corrective work the submitting party shall have the right to utilize all facilities of the Project and those of the Reclamation District encompassing the Project.

6.13 **Damages Caused by Submitting Party.** Any damage to the Reservoir or Habitat Islands or facilities resulting from grossly negligent activities of the submitting party shall be the responsibility of the submitting party. The Arbitration process set forth herein shall be used by the Parties in the event that a dispute arises regarding such damage.

6.14 **Finality and Effect of Arbitrator Decision.** The decision of the Arbitrator shall be final and binding upon the Parties to the arbitration.

6.15 **Emergency Procedure.** Notwithstanding the procedures in Section 6.2 through 6.10 above, the submitting party may, in the event the submitting party believes an emergency exists, invoke the following emergency procedure: Submitting party shall (by telephone, fax, mail or any other means) notify any two (2) Arbitrators on the list and Delta Wetlands of the time and place for an inspection of the conditions constituting the alleged emergency. If after inspection the two (2) Arbitrators jointly determine that emergency corrective action is necessary, then they may immediately authorize or order Delta Wetlands and/or the encompassing Reclamation District to conduct emergency corrective work or actions. If Delta Wetlands and/or the

encompassing Reclamation District fail to diligently commence and complete said emergency corrective work, the Arbitrators may authorize the submitting party to carry out such work, with the cost to be advanced or reimbursed from the CDWA Security Fund. The joint determination of the two (2) Arbitrators shall be final and binding upon the parties. If the Arbitrators determine that no emergency work is necessary, the Parties shall proceed pursuant to the non-emergency procedure set forth herein with only one of the two Arbitrators continuing to act on the matters. The continuing Arbitrator shall be determined by flip of a coin. An emergency or emergency situation shall exist whenever there is 1) an imminent threat of levee failure on a Reservoir Island or Habitat Island, or 2) an imminent threat of levee failure on any neighboring island where such threat is caused by or emanates from the Project Islands or operations including through seepage or under seepage affecting levee stability, or a sudden or rapid increase in fronting piezometer elevation readings that a licensed civil engineer determines to be of sufficient magnitude to be considered an emergency.

6.16. **Criteria for Levee Emergency Certifications and Arbitration Decisions.** It is recognized that some levee subsidence and erosion occurs gradually and non-uniformly and that unless the subsidence or erosion has reached the point where the levee integrity is jeopardized, the common practice in the Delta is to repair the areas of gradually occurring subsidence and erosion every few years in projects extending over considerable distances. It is agreed that any subsidence or erosion areas which do not meet the FEMA Hazard Mitigation Plan requirements adjusted to incorporate any changes to the 100 year flood elevations due to sea level rise and climate change and any other areas thought to be in a state of imminent failure must be repaired immediately. Certifying engineers and/or the Arbitrator should be guided by the above. Delta Wetlands shall provide to CDWA and neighboring landowners and Reclamation District levee profiles with readings on one hundred (100) foot intervals and cross-sections on five hundred (500) foot intervals at least every three years.

6.17. **Decision Regarding Initial Stage Filling.** An Arbitrator's decision regarding an exceedance of the OCL standard during Initial Stage Filling (Section 2.12) shall apply and address the following:

(a) An exceedance of the OCL shall constitute a presumption that seepage into the levees where the fronting piezometers are located is being caused by the Project. In such case Delta Wetlands shall have the burden of proving with the preponderance of evidence that seepage is not caused by the Project.

(b) The decision shall determine whether the exceedance of the OCL is caused by the Project. If the exceedance is not caused by the Project, the complaint shall be dismissed.

(c) If the exceedance is caused by the Project or the cause of the exceedance is undetermined, the decision shall order Delta Wetlands to improve or change operation of existing interceptor wells, to install and operate additional interceptor wells, conduct appropriate measures from the Seepage Control Plan, and to release stored water as rapidly as reasonably possible to the elevation at which the Project is no longer causing an exceedance or to an empty condition so as to allow the Arbitrator to make a decision as per Section 6.18(d) below.

(d) The Arbitrator shall retain jurisdiction to review Delta Wetlands compliance with the decision. If the exceedance is not reduced even after draining the Reservoir and a waiting period for at least thirty (30) days, the Arbitrator may conclude that the exceedance was not caused by the Project.

(e) Delta Wetlands may commence refilling of water storage only after approval by the Arbitrator of a certification from a California Registered Civil Engineer that all actions required by the decision have been completed. The refilling shall be subject to the exceedance criteria.

6.18. **Decision Regarding Normal Operations.** An Arbitrators' decision regarding a potential exceedance of the OCL during normal Project operations (Section 2.13) shall apply and address the following:

(a) An exceedance of the OCL shall constitute a presumption that seepage into the levees where the fronting piezometers are located is being caused by the Project. In such case Delta Wetlands shall have the burden of proving with the preponderance of evidence that seepage is not caused by the Project.

(b) The decision shall determine whether the exceedance of the OCL is caused by the Project. If the exceedance is not caused by the Project, the complaint shall be dismissed.

(c) If the exceedance is caused by the Project, the decision shall order Delta Wetlands to improve or change operation of existing interceptor wells. to install and operate additional interceptor wells, conduct appropriate measures from the Seepage Control Plan, to release stored water as rapidly as reasonably possible to the elevation at which the Project is no longer causing an exceedance, impose any other mitigation that may be mutually agreeable between Delta Wetlands and the affected party and if necessary require that the storage of water be terminated.

(d) The Arbitrator shall retain jurisdiction to review Delta Wetlands compliance with the decision. If the exceedance is not reduced even after draining the reservoir and a waiting period of at least thirty (30) days. the Arbitrator may conclude that the exceedance was not caused by the Project.

(e) Delta Wetlands may commence refilling of water storage only after approval by the arbitrator of a certification from a California Registered Civil Engineer that all actions required by the decision have been completed.

(f) The above steps shall be repeated as necessary to address the problems arising from time to time.

6.19 **Decision Regarding Termination of Project Water Storage.** If it is determined by the Arbitrator that (1) Delta Wetlands has implemented all feasible seepage control measures including without limitation increased operation and/or improvement of the on Reservoir Island

interceptor well system and reduced maximum water levels on the Project Islands and (2) one of the following is found, (A) that a Reservoir Island cannot be operated without causing significant seepage that poses a significant increased risk of failure of neighboring island levees, or (B) if damages resulting from said seepage awarded in a final Arbitration decision have not been fully paid within one year of the date of the decision, or (C) that the amount of unpaid claims plus unresolved pending claims plus probable future claims is determined by the Arbitrator to leave an insufficient amount in the CDWA Security Fund to assure restoration of the Reservoir Islands, then the Arbitrator shall order that the operation or operations causing the same shall be permanently terminated and the Reservoir Island restored as per the Reclamation Plan. The insufficiency in the CDWA Security Fund as set forth in (C) above may be remedied with an agreement by Delta Wetlands to increase and maintain the CDWA Security Fund in an amount in excess of the $35,000,000.00 which additional amount shall be determined by the Arbitrator to be reasonably necessary to secure the future performance of this Agreement. The determination of the Arbitrator as to significant increased risk of levee failure must be supported by a preponderance of the evidence including the opinion of at least two independent California Registered Civil Engineers with at least ten years of experience working on levees in the lowlands portion of the Delta.

6.20. **Decision Regarding Levee Standards.** An Arbitrator's decision regarding Reservoir Island or Habitat Island levee standards (Sections 3.2-3.3) shall address the following:

(a) The decision shall determine whether a Reservoir Island or Habitat Island levee section does not meet the requirements or criteria of Sections 3 and 6.2. If the levee section meets the requirements or criteria of this Agreement, the complaint shall be dismissed.

(b) If the Reservoir Island or Habitat Island levee section does not meet the requirements or criteria herein, the decision shall direct Delta Wetlands to expeditiously reconstruct the levee section to meet the same. If Delta Wetlands or the encompassing reclamation district does not expeditiously reconstruct the levee to meet the same, then the Reservoir Island shall be dewatered to the elevation four (4) feet below the lowest elevation of the levee section which does not meet or exceed the required minimum criteria or 0.0 ft (NGVD 1929 Datum), whichever is lowest and the complaining party shall be provided the option of reconstructing the levee with funds from the CDWA Security Fund.

6.21 **Advancement of Fees and Costs.** Upon the request of any submitting party claiming damage from Reservoir Island operations, the Arbitrator shall, if he preliminarily finds that the claim does not appear frivolous, order advance payments from the CDWA Security Fund to pay the reasonable attorneys' fees and consultant fees of the submitting party. Delta Wetlands shall be given the option to directly provide such funds. If upon final decision of the Arbitrator such submitting party does not prevail, then the Arbitrator shall order that the advances be repaid with interest at the rate earned by the cash portion of the CDWA Security Fund. Repayment shall be made to the source from which the advance was made.

6.22 **Assorted Provisions Regarding Decisions and Remedies.** The Arbitrator shall not be permitted to award punitive or exemplary damages. All arbitration hearings shall be conducted

in Stockton, California. The costs and fees of the Arbitrator shall initially be paid one-half by Delta Wetlands and one-half by the submitting parties. The Arbitrator may award fees and costs to the prevailing party. Legal process may be served upon the Parties in the manner provided by law or in any other manner agreed to by the parties or allowed by the Arbitrator. Decisions of the Arbitrator shall be in writing. Where damages are claimed, the Arbitrator may allow limited discovery specifically related to such damages. Judgment on the award of the arbitrator(s) may be entered in any state court in the State of California and parties to such arbitration irrevocably consent to the jurisdiction of such courts for such purpose. Any party submitting a matter to arbitration as provided herein and the Parties hereto acknowledge and agree that they are waiving all rights to a trial by court or jury as a means of resolving any disputes arising out of or relating to a matter subjected to arbitration as per the terms of this Agreement. Monetary awards shall be first paid out of the CDWA Security Fund in accordance with Section 8.10.

6.23 Any aggrieved party who is not signatory to this Agreement, but is a reclamation district or owner or operator of land within ten thousand (10,000) feet of a Project Reservoir Island or Habitat Island may elect to seek a remedy for the above causes through the regular legal process or by way of the CDWA Dispute Resolution Procedure provided herein in the same manner as provided for the CDWA Parties. If such an aggrieved party elects to utilize the CDWA Dispute Resolution Procedure, then the decision of the Arbitrator shall be final and binding upon the parties to the arbitration.

6.24 This Agreement confers rights and remedies upon the County of San Joaquin as a third-party beneficiary of this Agreement. The County of San Joaquin may enforce the provisions of this Agreement pertaining to seepage (Section 2), levee integrity (Section 3), road integrity (Section 3) and future reclamation for agricultural use of Bacon Island (Section 4) as to the portion of the Project within the San Joaquin County or any effects from the Project to lands within San Joaquin County in the same manner and subject to the same limitations as provided for herein applicable to the CDWA Parties. The Parties expressly intend to confer these rights and remedies upon the County of San Joaquin and may not materially amend this Section 6.24 or Section 9.1 of this Agreement or terminate this Agreement without the prior written consent of the County of San Joaquin, which consent shall not be unreasonably withheld.

7. Financial Assurances

7.1 **Seepage and Monitoring Fund.** Delta Wetlands shall provide and maintain the Seepage and Monitoring Fund ($500,000) described in § 19 of Attachment B of the EBMUD PDA.

7.2 **Drawdown Fund.** Delta Wetlands shall provide and maintain the Drawdown Fund ($1 million) described in § 20 of Attachment B of the EBMUD PDA.

7.3 **Remedial Action Fund.** Delta Wetlands shall provide and maintain the Remedial Action Fund ($1 million) described in § 21 of Attachment B of the EBMUD PDA.

7.4 **Insurance.** Delta Wetlands shall provide and maintain the Insurance described in § 22 of Attachment B of the EBMUD PDA.

7.5 **CDWA Security Fund.** Delta Wetlands shall establish and maintain the CDWA Security Fund as set forth below. The failure of Delta Wetlands to so establish and maintain the CDWA Security Fund shall constitute a material breach of this agreement to be remedied by injunctive relief against Delta Wetlands moving forward with any aspect of the Project and if the Project is already in place the injunction shall accomplish the following: 1) preclude the storage of water; 2) require the expeditious release of any stored water; and 3) order such other actions as necessary to avoid harm to neighboring levees, lands and the owners and operators thereon. Notwithstanding anything in this agreement to the contrary, CDWA, EBMUD and the neighboring Reclamation Districts and owners and operators of land within ten thousand (10,000) feet of any portion of the Project may commence an action seeking such relief in the Superior Court of San Joaquin County without the necessity of proceeding with arbitration or other processes provided in this agreement. In such action the prevailing party shall be awarded costs and reasonable attorneys' fees.

8. CDWA Security Fund

8.1 **Purposes.** The CDWA Security Fund may be used for the following purposes: 1) to draw down water on the Reservoir Islands; 2) to repair damaged levees on the Reservoir Islands and Habitat Islands; 3) to repair other damage to the Reservoir Islands, Habitat Islands or neighboring islands caused by the Project; 4) to restore the Reservoir Islands in accordance with the Reclamation Plan following termination of Project water storage operations; 5) to pay claims for damages caused by the Project; and 6) to pay for costs and attorneys' fees related to the above.

8.2 **Components of CDWA Security Fund.** Prior to allowing or causing the water surface elevation at any point within any Reservoir Island or Habitat Island to rise above four (4) ft above the existing land elevation, or conducting any excavation below the existing median land elevation for the purpose of providing fill for Project construction purposes or increasing capacity for water storage, Delta Wetlands shall establish and thereafter maintain, subject to the provisions of this Agreement, financial security in the continuous combined amount of thirty-five million dollars ($35,000,000.00) consisting of a combination of the following: (i) cash in the minimum amount of ten million dollars ($10,000,000.00), and (ii) a "Letter of Credit" in the amount of twenty-five million dollars ($25,000,000.00). Collectively, these amounts comprise the "CDWA Security Fund." Delta Wetlands can increase the cash contribution (dollar for dollar) as a substitute for all or a portion of the Letter of Credit.

8.3 **Draws.** Draws on the CDWA Security Fund shall be available upon presentation of a "Qualified Draw Request" and in the amount specified in the "Qualified Draw Request." "Qualified Draw Request" means (i) a notarized written instrument signed by the authorized representatives of both CDWA and Delta Wetlands, (ii) a certified final order of the Arbitrator authorizing a draw on the CDWA Security Fund pursuant to the CDWA Dispute Resolution Procedure described herein, or (iii) an interim or final order of the Arbitrator carrying out the emergency procedures as provided under Section 6.15. The request shall specify the amount of the draw to be made on the CDWA Security Fund, and specify the person or entity to whom the

draw is to be payable. All draws on the CDWA Security Fund shall be paid, at Delta Wetlands' election, from the cash portion thereof or from any Letter of Credit that is part of the security fund, or from any combination of the cash portion and Letter of Credit. In any event Delta Wetlands shall within fifteen (15) days restore the CDWA Security Fund to the required $35,000,000.00 amount and shall continuously maintain said fund at that level until termination or abandonment of the Project in compliance with Sections 8.7 and 8.8 below.

8.4 **Appointment of Independent Trustee.**

(a) CDWA shall serve as representative for the CDWA Parties with respect to Section 8 of this Agreement. CDWA may appoint a different representative for the CDWA Parties by providing a written notice to Delta Wetlands.

(b) CDWA and Delta Wetlands shall designate a financial institution trust department licensed to do business in the State of California, which will act as an independent Trustee with authority to draw on the Letter of Credit in accordance with this Agreement. The identity of the initial trustee and the duties and powers of said Trustee, any specific guidelines and limitations on the investment of funds held in the CDWA Security Fund and rules for appointing a successor trustee shall be set forth in Exhibit C, attached hereto and by this reference incorporated herein. As provided above, Delta Wetlands can, upon 30 days prior written notice from Delta Wetlands to CDWA, substitute cash for all or a portion of the Letter of Credit without the consent of the parties or the trustee.

8.5 **Terms of Letter of Credit.** As used herein, the term "Letter of Credit" means a letter of credit issued by a credit provider ("L-C Bank") that is headquartered in the United States, that resides in the United States, or is a United States corporation in good standing, and that has an investment grade credit rating from and meeting at least two (2) of the following: Moody's "A2", S & P "A", or Fitch "A" or higher. If the Moody's, S & P or Fitch credit rating criteria or methodologies materially change during the terms of this Agreement, the Parties shall meet and confer to update the credit provider credit rating criteria of this section to the new ratings that are comparable to Moody's "A2", S & P "A", or Fitch "A" as they are defined on the date of execution of this Agreement. The L-C Bank shall agree and set forth in the Letter of Credit the following: 1) that the Letter of Credit shall be exclusively governed by, construed and enforced in accordance with the laws of the State of California without regard to conflict of laws; 2) that exclusive jurisdiction for disputes arising out of or related to the Letter of Credit shall be in the Superior, Appellate and Supreme Courts of the State of California; and 3) that the Letter of Credit shall designate an agent located in the State of California for service of process. Delta Wetlands shall pay all expenses, points, fees or other charges relating to obtaining, managing or extending the Letter of Credit. The Letter of Credit shall allow partial and multiple draws up to the face amount thereof. The Letter of Credit shall be irrevocable by L-C Bank during its effective term, shall expire not less than one (1) year from the date issued, and shall automatically renew for successive one (1) year terms unless the L-C Bank provides notice of non-renewal no less than 90-days prior to expiration of its term. The Letter of Credit shall be written so as to conform to the example attached hereto as Exhibit D.

(a) If the L-C Bank at any time ceases to meet the standards specified in Section 8.5, then Delta Wetlands shall have 55 days from notice that the L-C Bank ceases to meet the standards specified in Section 8.5 to provide a substitute Letter of Credit complying with all of the requirements hereof and issued by a L-C Bank that is qualified, or to substitute cash in place of the Letter of Credit.

(b) If the L-C Bank notifies Delta Wetlands and CDWA that the Letter of Credit will not be renewed, then Delta Wetlands shall have 55 days from notice of non-renewal to provide a substitute letter of credit complying with all of the requirements hereof and issued by a L-C Bank that is qualified, or to substitute cash in place of the non-renewed Letter of Credit.
If Delta Wetlands has not provided a substitute Letter of Credit or cash within the time periods specified in Section 8.5(a)-(b), the Trustee shall, without discretion, draw the full amount of the existing Letter of Credit and deposit the proceeds into the trust account defined in Section 8.6 and shall return the proceeds to Delta Wetlands when a substitute Letter of Credit is established

8.6 **Trust Account.** The cash portion of the CDWA Security Fund shall be deposited in a trust account (the "CDWA Trust") maintained with a financial institution licensed to do business in the State of California, and approved by CDWA, which will act as instructed by the Trustee, who shall have full authority to disburse from the trust account and draw on the Letter of Credit in accordance with this Agreement. The cash deposited in the CDWA Trust shall be invested in accordance with the guidelines set forth in Exhibit C, with the earnings thereon to be distributed as received to Delta Wetlands during any period when the fund is in excess of its minimum required amount and after paying trustee and administrative fees and charges.

8.7 **Replenishment.** In the event that draws are made from the CDWA Security Fund, Delta Wetlands shall replenish the CDWA Security Fund within fifteen (15) days and in any event before Delta Wetlands diverts additional water to storage on the Reservoir Islands.

8.8 **Termination of CDWA Security Fund.** Upon termination or abandonment of all water right permits for Project water diversion and storage on the Reservoir Islands, restoration of all Reservoir Islands and Habitat Islands to farmland or habitat as per the Reclamation Plan and resolution of all remaining claims against the CDWA Security Fund, the Letter of Credit may be terminated and the amount of the remaining cash deposit shall be paid to Delta Wetlands. The Letter of Credit shall be terminated and the Trustee shall return the remaining cash portion of the CDWA Security Fund within ten (10) calendar days of submission of a written instrument signed by an authorized representative of Delta Wetlands and an authorized representative of CDWA verifying that all water right permits for water diversion and storage on the Reservoir Islands have been abandoned or terminated, that the Reservoir Islands and Habitat Islands have been restored in accordance with the Reclamation Plan and all remaining claims brought against Delta Wetlands and awarded to the claimants in accordance with the CDWA Dispute Resolution Procedure have been paid from the CDWA Security Fund.

8.9 **CDWA Security Fund is Not Exclusive Remedy.**

(a) To the extent that the CDWA Security Fund does not contain sufficient funds to pay any award as ordered by the Arbitrator and Delta Wetlands has been given the opportunity to make such payment and has not made the payment within 30 days of written notice from the Arbitrator to pay the same, then the award may be enforced in the manner provided by California Code of Civil Procedure Sections 1285, et seq.

(b) The funds provided by way of this section are not intended to limit the claims of any aggrieved party. The portion of any award not paid as provided herein may be collected in any other manner allowed by law. Monetary awards pursuant to this Agreement shall be first paid out of the CDWA Security Fund unless Delta Wetlands has elected to directly pay the award.

9. **Rights of Entry**

9.1 Perpetual non-exclusive rights of entry over and across all of the Reservoir Islands and Habitat Islands including the levees thereon shall be granted by Delta Wetlands and the Project Island Reclamation Districts to CDWA, the County of San Joaquin and neighboring Reclamation Districts for the purposes encompassed by this Agreement. Subject to the limitations set forth below, the purposes include: inspecting the facilities and operations; maintaining and operating interceptor well fields; reconstructing levee slopes; installing and maintaining wave wash protection; constructing, maintaining and operating pumps, siphons, gates and other facilities to control water levels so as to curtail seepage or facilitate restoration; maintaining, repairing and rehabilitating levees to provide adequate levee cross-sections; and to otherwise implement this Agreement.

9.2 Such rights of entry shall be subject to the following conditions:

(a) Except as to the rights of entry for inspection purposes, no right of entry shall be exercised unless pursuant to authorization or order of the Arbitrator.

(b) Except in an emergency situation or pursuant to authorization or order of the Arbitrator, the right of entry for inspection shall be limited to no more than five (5) inspectors who shall travel as a group and no more than four (4) times per year.

(c) Delta Wetlands shall be notified in advance of any entry as to the nature and duration of the entry and the names of those entering. Delta Wetlands may elect to have its representatives accompany such inspectors. The time of entry and duration shall be reasonable for the circumstances at the time of entry.

(d) Except in an emergency situation or pursuant to authorization or order of the Arbitrator, at least five (5) days prior written notice to Delta Wetlands shall be provided.

(e) Exercise of the right of inspection shall to the extent practical be confined to the levee areas so as to minimize interference with Project operations, repair and maintenance and waterfowl use of the islands.

9.3 No right of access by the general public is conveyed by this Agreement.

9.4 Those individuals and entities exercising the right of entry for inspection purposes shall, prior to entry, agree in writing to hold Delta Wetlands and the Project Island Reclamation Districts, their directors, officers, agents, contractors, affiliates, partners and successors free and harmless and indemnify them from any and all claims, actions, causes of action, demands, rights, damages, costs, losses and expenses, including reasonable attorneys' fees arising out of such entry.

9.5 The rights of entry described herein shall be irrevocable during the life of the Project and recorded in the County in which the particular Reservoir Island or Habitat Island is located.

10. Assignment

Delta Wetlands agrees that it will not sell, transfer, lease, license or assign any of its rights, title or interest in and to any of the real property on the Reservoir Islands or Habitat Islands or any of the permits or other rights related to the Project or sell, transfer, assign or otherwise reorganize the entity owning such real property or any part of the ownership thereof without having the proposed transferee execute this agreement as obligor of the covenants provided herein. Notwithstanding the above, the conservation easements required as a condition of the Incidental Take Permit, agricultural land conservation easements, customary Oil and Gas Leases and the lease of land for farming or recreational purposes, on the Reservoir Islands or Habitat Islands for a term less than fifteen (15) years which does not allow for water banking or land fallowing other than as part of customary crop set aside programs shall not be subject to this requirement.

11. Withdrawal of Protests, Dismissal of the Lawsuit, and Agreements Not to Protest or Oppose

11.1 In consideration of the agreements of Delta Wetlands made herein, CDWA Parties who have filed active Protests shall, within ten (10) working days of execution of this Agreement by CDWA and Delta Wetlands, send a letter to the SWRCB withdrawing their Protests and transmitting a fully executed copy of this Agreement to the SWRCB. The letters may request that the SWRCB incorporate Delta Wetlands' compliance with the terms of this Agreement as a condition of any permit for the Project

11.2 CDWA Parties also agree that upon full execution of this Agreement and so long as Delta Wetlands is in compliance with the Program, terms of this Agreement and the conditions of all permits pertaining to the Project, they will not protest or otherwise object to the Delta Wetlands Project in any forum or encourage others to do the same. "Program" includes the Project as

described in Recital E above and all final adopted mitigation, avoidance and minimization of impact measures incorporated in the Project documents.

11.3 Notwithstanding anything herein to the contrary, the CDWA Parties shall not be restricted in any way in any forum from 1) protesting changes in the Project including without limitation any proposed storage or use of recycled water, biosolids, sludge or waste, or 2) asserting against anyone, including Delta Wetlands, rights and claims to water on behalf of the water users within the Delta, including without limitation claims and rights based upon California Water Code sections 1215 et seq., 10505 et seq., 11460 et seq., 12200 et seq., and 12230 et seq. Additionally, nothing contained herein shall restrict CDWA or any other party from any action in any forum to protect and enhance the water supply within the Delta both as to water quality, quantity and water levels, including without limitation seeking to restrict exports from the Delta to water which is truly surplus to the present and future needs for beneficial use within the Delta and other areas and watersheds of origin. CDWA Parties will not object to: any septic system or other approved facilities or processes for the disposal of waste generated on any Reservoir Island or Habitat Island; any fertilizer used in normal farming operations on any Reservoir Island or Habitat Island; a change in Project footprint or operations that decreases the average water storage quantity or residence time or reduces the maximum permitted water storage capacity of the Reservoir Island(s); a change in Project operations or infrastructure that decreases the maximum permitted daily, monthly, and combined rates of diversion; a change in Project operations or infrastructure that reduces maximum permitted discharges from the Reservoir Islands to the central Delta; or change in the authorized place of use provided that such place of use is not on the drainage-impaired lands on the west side of the San Joaquin Valley (e.g., Westlands Water District and Grasslands Water District) and provided further that such change in place of use will not directly or indirectly increase the salinity of the flows or accretions to the San Joaquin River, or otherwise degrade water quality in the Delta.

11.4 Delta Wetlands recognizes and agrees:

(a) That its rights to store and redivert water pursuant to SWRCB permits are and will be junior to the riparian and prior appropriative rights held by Delta users and others;

(b) That any rights to divert water for use on its lands within the Delta in excess of that allowed pursuant to riparian rights and pre-1914 appropriative rights are junior to the riparian and prior appropriative rights of water users within the Delta and other areas and watersheds of origin, except that Water Right Permits and Licenses used for irrigation on the Project Islands shall while so used enjoy the priority provided by California law over other water right holders;

(c) That any rights to redivert and/or use water outside the Delta are junior to the water requirements necessary for salinity control and the water required to otherwise maintain an adequate water supply in the Delta of sufficient quality and quantity to maintain and expand agriculture, industry, urban and recreational development in the Delta; and

(d) That any right to export waters from the Delta or any other areas or watersheds of origin is junior to the present and future needs of such areas.

11.5 Delta Wetlands shall not protest or otherwise object in any forum to the efforts of any of the CDWA Parties to protect and/or improve water quality, water quantities (including flushing flows) and water levels in the Delta, however Delta Wetlands reserves the right to advocate its views with regard to Delta inflow, outflow, and water quality.

11.6 CDWA, Reclamation District No. 2038, Reclamation District No. 2072, and RC Farms, Inc. each will dismiss with prejudice all of the CDWA, Reclamation District No. 2038 (Lower Jones Tract), Reclamation District No. 2072 (Woodward Island), and RC Farms, Inc.'s appeal of the Judgment entered October 29, 2012 in *Central Delta Water Agency, et al. v. Semitropic Water Storage District, et al.*, San Francisco County Superior Court Case No. CPF-11-511753. To effect these dismissals, within ten (10) working days of execution of this Agreement by CDWA and Delta Wetlands, CDWA, Reclamation District No. 2038, Reclamation District No. 2072, and RC Farms, Inc. will file with the First District Court of Appeal a request for dismissal, with prejudice, of CDWA, Reclamation District No. 2038 (Lower Jones Tract), Reclamation District No. 2072 (Woodward Island), and RC Farms, Inc.'s appeal of the Judgment, First District Court of Appeal Case No. A137300, and any other outstanding claims in the Lawsuit, against all respondents and real parties in interest, including parties not known to the CDWA Parties. CDWA, Reclamation District No. 2038, Reclamation District No. 2072, and RC Farms, Inc. will diligently and in good faith pursue having each dismissal entered as expeditiously as possible. Within ten (10) working days of receipt of entry of dismissal, CDWA shall serve on all Parties notice of entry of that dismissal.

If other parties to the Lawsuit, including San Joaquin County, the San Joaquin County Flood Control and Water Conservation District and any party who may intervene in the Lawsuit including the Attorney General's Office of the State of California, pursue claims, causes of action and requests for relief, the CDWA Parties shall not indemnify, fund, or otherwise assist such parties to the Lawsuit.

The CDWA Parties, Delta Wetlands, and other signatories hereto shall seek no further relief with regard to the Protests and the Lawsuit, including any award or collection of costs or attorneys' fees incurred in connection with the Protests, Lawsuit and previous administrative proceedings.

12. Miscellaneous Provisions

12.1 **Other Documents**. The Parties hereto agree to execute any and all additional documents reasonably necessary to carry out the purpose and intent of this Agreement.

12.2 **Entire Agreement**. Except for the documents incorporated by reference herein, this Agreement and its exhibits contain the entire understanding among the Parties and supersedes any prior written or oral agreements between them respecting the subject matter contained herein. There are no representations, agreements, arrangements, or understandings, oral or

written, between and among the Parties relating to the subject matter of this Agreement that are not fully expressed herein.

12.3 **Amendments**. The provisions of this Agreement may be amended only by written agreement executed by the Parties hereto and recorded as required herein for this Agreement.

12.4 **Attorneys' Fees**. If any action at law or in equity, including an action for declaratory or injunctive relief, is brought to enforce or interpret the provisions of this Agreement, the prevailing party shall be entitled to reasonable attorneys' fees.

12.5 **Governing Law**. All questions with respect to the construction of this Agreement and the rights and liabilities of the Parties hereto shall be governed by the laws of the State of California.

12.6 **Successors**. Subject to the restrictions against assignment set forth in Section 10 above, this Agreement shall inure to the benefit of and shall be binding upon the assigns, successors in interest, personal representatives, estates, heirs, and legatees of each of the Parties hereto. Any successor or assignee of Delta Wetlands shall be bound to the terms of this Agreement in the same manner and to the extent as Delta Wetlands. The separate and independent rights or interests of the members or equity owners of any successor and the advocacy for the same shall not be limited by the terms of this Agreement but only to the extent the separate and independent rights or interests and the advocacy for the same are unrelated to the interpretation, enforceability and performance of this Agreement.

12.7 **Covenant to Run With the Land**. This Agreement is both a personal obligation of the Parties as well as a covenant running with the Reservoir Islands and Habitat Islands presently owned by Delta Wetlands and the lands of the other Parties hereto, wherever those lands may be situated. This Agreement shall be notarized and recorded in the counties of Contra Costa and San Joaquin within thirty (30) days of receipt by Delta Wetlands of a water right permit from the SWRCB pursuant to the Applications.

12.8 **Severability**. If any non-material provision of this Agreement is declared by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions shall continue in full force and effect.

12.9 **Execution; Counterparts; Additional Parties**. This Agreement may be executed in several counterparts (including counterparts by facsimile or email in portable document format (PDF)) and all counterparts so executed shall constitute one agreement which shall be binding upon any Party whose signature appears on an executed counterpart. However, this Agreement shall not be effective until CDWA, Reclamation District No. 2038, Reclamation District No. 2072, RC Farms, Inc., Delta Wetlands, Reclamation District No. 756. Reclamation District No. 2025, Reclamation District No. 2026, and Reclamation District No. 2028 have each executed the Agreement, and the failure of any other Party to execute the Agreement shall not affect the obligations of the Parties that have executed the Agreement. Other Reclamation Districts neighboring any Project Island and owners and operators of lands within ten thousand (10,000)

feet of any Project Island may become a Party to this Agreement by executing a joinder to this Agreement approved in writing by both CDWA and Delta Wetlands.

12.10 **Headings**. The headings preceding the paragraphs of this Agreement are for convenience of reference only, are not a part of this Agreement, and shall be disregarded in the interpretation of any portion of this Agreement.

12.11 **Agents**. All rights and obligations agreed to herein by any Party may be exercised and fulfilled by the Party's authorized agent.

12.12 **Notices**. Any notice, demand, request or communication that the Parties desire or are required to give in writing pursuant to this Agreement shall be deemed to have been duly given if delivered by hand or mailed, postage prepaid, certified or registered mail, return receipt requested and addressed to the appropriate Party as set below with copies to all of the other Parties to this Agreement. Notice of change of address shall be effective only when given in accordance with this Paragraph. All notices, demands and other communications made in compliance with this paragraph shall be deemed to have been received on the earlier to occur of the date of delivery or on the third business day after mailing.

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CENTRAL DELTA WATER AGENCY
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RECLAMATION DISTRICT NO. 2038
RECLAMATION DISTRICT NO. 2072
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With a copy to:

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RECLAMATION DISTRICT NO. 756
RECLAMATION DISTRICT NO. 2025
RECLAMATION DISTRICT NO. 2026
RECLAMATION DISTRICT NO. 2028
c/o Al Warren Hoslett
311 E. Main St., Suite 504
Stockton, CA 95202
Phone: (209) 943-5551

12.13 **Hold Harmless, Indemnification and Waiver.** Delta Wetlands agrees to hold the CDWA Parties signatory hereto, their directors, officers, agents and contractors free and harmless and indemnify them from any and all claims, actions, causes of action, demands, rights, damages, costs, loss and expense including reasonable attorneys' fees arising out of seepage determined by the Arbitrator to be caused by the Reservoir Islands and Habitat Islands, Reservoir Islands and Habitat Island levee inadequacy, any breach of this Agreement and enforcement of any remedy pertaining to the same except to the extent that damage is caused by the grossly negligent or intentionally wrongful action of the CDWA Parties.

Delta Wetlands agrees that it will not make any claim for water quality benefits (if any) resulting from the Project as against the CDWA Parties or any water user applying water to Delta lands. Delta Wetlands for itself and any successor hereby waives the right to make any such claim.

12.14 **Covenant Not To Apply or Store Wastewater or Biosolids.** Within thirty (30) days of receipt of a water right permit for water storage from the SWRCB, Delta Wetlands agrees to execute and record the covenant provided in Exhibit E prohibiting the application and/or storage of wastewater (including reclaimed wastewater), sewage sludge (including treated sewage sludge sometimes called biosolids) and septage (treated or otherwise) on any Reservoir Island or Habitat Island. Said covenant shall run with the land, and will thereby burden the Reservoir Islands and Habitat Islands and benefit the other lands in the Delta.

The prohibition contained in the covenant shall only apply so long as the designated Reservoir Islands or Habitat Islands are planned for use or used for water storage or developed wetland purposes.

12.15. **Operator's Covenant**: Delta Wetlands agrees that it will not delegate, transfer or join with any Party in the operation of the Project unless such party has agreed in writing to comply with the terms hereof and has become a party signatory hereto by execution of a copy of this

Agreement in counterpart. Such party shall be bound to the terms of this Agreement in the same manner and to the same extent as Delta Wetlands.

12.16. **No Degradation of the San Joaquin River**. Delta Wetlands agrees that it will not sell or transfer water to any party if such will directly or indirectly increase the salinity of the flows and accretions to the San Joaquin River.

12.17. **Effective Date**. This Agreement shall become effective when CDWA, Reclamation District No. 2038, Reclamation District No. 2072, RC Farms, Inc., Delta Wetlands, Reclamation District No. 756, Reclamation District No. 2025, Reclamation District No. 2026, and Reclamation District No. 2028 have executed the Agreement.

12.18 **Termination Date**. This Agreement shall terminate upon the later of the following: the termination or abandonment of all water right permits for Project water diversion and storage on the Reservoir Islands; the restoration of all reservoir islands to farmland or habitat as per the Reclamation Plan; resolution of all remaining claims against the CDWA Security Fund; and return of any remaining cash deposit to Delta Wetlands in accordance with paragraph 8.8 of this Agreement.

12.19 **No Admission of Liability**. Execution of this Agreement and compliance with its terms do not constitute an admission of liability or wrongdoing by any Party.

12.20 **Time is of the Essence**. Time is of the essence with respect to the performance or observance of each of the obligations, covenants and agreements under this Agreement.

12.21 **Specific Performance**. The Parties agree that monetary damages alone would be an inadequate remedy in the event any Party breaches this Agreement, and that any Party's breach of this Agreement will result in immeasurable and irreparable harm to the other Parties. Any non-breaching Party may seek specific performance of this Agreement, including but not limited to injunctive relief, in addition to any other remedy to which it may be entitled by reason of the other Party's breach of this Agreement.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement as of the Effective Date first set forth above.

DELTA WETLANDS PROPERTIES
An Illinois general partnership

By KLMLP 2, LLC
A Delaware limited liability company,
Managing General Partner of Delta Wetlands Properties

By KLMLP, L.P.
A Delaware limited partnership,
Managing Member of KLMLP 2, LLC

By Zurich American Corporation
(fka Kemper Corporation)
A Delaware corporation,
Managing General Partner of KLMLP, L.P.

By _____

Date: 7/2/2013

CENTRAL DELTA WATER AGENCY
a political subdivision of the State of California

By _____
President of the Board of Directors

Date: _____

APPROVED AS TO FORM:

By _____
Dante Nomellini, Sr.
General Counsel

Date: _____

ACKNOWLEDGMENT

State of New York)
) ss
County of New York)

On July 2nd, 2013, before me, Ronald Rambeo, Notary Public, personally appeared Elizabeth Lawn, who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of New York that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____(SEAL)

RONALD RAMBEO
Notary Public, State of New York
No.: 01RA6182165
Qualified in New York County
Commission Expires March 10, 2016

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement as of the Effective Date first set forth above.

DELTA WETLANDS PROPERTIES
An Illinois general partnership

By KLMLP 2, LLC
A Delaware limited liability company,
Managing General Partner of Delta Wetlands Properties

By KLMLP, L.P.
A Delaware limited partnership,
Managing Member of KLMLP 2. LLC

By Zurich American Corporation
(fka Kemper Corporation)
A Delaware corporation,
Managing General Partner of KLMLP, L.P.

By _____

Date: _____

CENTRAL DELTA WATER AGENCY
a political subdivision of the State of California

By _____
President of the Board of Directors

Date: 7-9-13

APPROVED AS TO FORM:

By _____
Dante Nomellini, Sr.
General Counsel

Date: 7-9-13

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of California

County of SAN JOAQUIN

On July 9, 2015 before me, JEAN MARIE URBANI, notary public,

personally appeared GEORGE BIAGI, JR.,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

JEAN MARIE URBANI
NOTARY PUBLIC - CALIFORNIA
COMMISSION # 1982484
SAN JOAQUIN COUNTY
My Comm. Exp. December 30, 2015

Jean Marie Urbani
Signature of Notary Public

(Notary Seal)

OPTIONAL INFORMATION

The acknowledgment contained within this document is in accordance with California law. Any certificate of acknowledgment performed within the State of California shall use the preceding wording pursuant to Civil Code section 1189. An acknowledgment cannot be affixed to a document sent by mail or otherwise delivered to a notary public, including electronic means, whereby the signer did not personally appear before the notary public, even if the signer is known by the notary public. In addition, the correct notarial wording can only be signed and sealed by a notary public. The seal and signature cannot be affixed to a document without the correct notarial wording.

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(Title of document)

Number of Pages _____ (Including acknowledgment)

Document Date _____

_____
(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of California

County of San Joaquin

On July 9, 2013 before me, Jean Marie Urbani, notary public,

personally appeared Dante John Nomellini,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

JEAN MARIE URBANI
NOTARY PUBLIC - CALIFORNIA
COMMISSION # 1962484
SAN JOAQUIN COUNTY
My Comm. Exp. December 30, 2015

Jean Marie Urbani
Signature of Notary Public

(Notary Seal)

OPTIONAL INFORMATION

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Document Date _____

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(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

RECLAMATION DISTRICT NO. 756

By _____
Chair/President of the Board of Trustees

Date: 7/11/13

APPROVED AS TO FORM:

By _____
Al Warren Hoslett
District Counsel

Date: July 11, 2013

RECLAMATION DISTRICT NO. 2026

By _____
Chair/President of the Board of Trustees

Date: 7/11/13

APPROVED AS TO FORM:

By _____
Al Warren Hoslett
District Counsel

Date: July 11, 2013

RECLAMATION DISTRICT NO. 2028

By _____
Chair/President of the Board of Trustees

Date: 7/11/13

APPROVED AS TO FORM:

By _____
Al Warren Hoslett
District Counsel

Date: July 11, 2013

RECLAMATION DISTRICT NO. 2025

By _____
Chair/President of the Board of Trustees

Date: 7/11/13

APPROVED AS TO FORM:

By _____
Al Warren Hoslett
District Counsel

Date: July 11, 2013

ON BEHALF OF RECLAMATION DISTRICT NO. 756

STATE OF CALIFORNIA
COUNTY OF SAN JOAQUIN

On July 11, 2013 before me, PAMELA A. FORBUS, Notary Public, personally appeared DAVID A. FORKEL, who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature Pamela a Forbus
PAMELA A. FORBUS. Notary Public.

MEP-1 PAMELA A. FORBUS COMM. # 2000633 NOTARY PUBLIC-CALIFORNIA SAN JOAQUIN COUNTY My Commission Expires December 13, 2016 MEP-1

ON BEHALF OF RECLAMATION DISTRICT NO. 2025

STATE OF CALIFORNIA
COUNTY OF SAN JOAQUIN

On July 11, 2013 before me, PAMELA A. FORBUS, Notary Public, personally appeared DAVID A. FORKEL, who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature Pamela a Forbus
PAMELA A. FORBUS. Notary Public.

MEP-1 PAMELA A. FORBUS COMM. # 2000633 NOTARY PUBLIC-CALIFORNIA SAN JOAQUIN COUNTY My Commission Expires December 13, 2016 MEP-1

ON BEHALF OF RECLAMATION DISTRICT NO. 2026

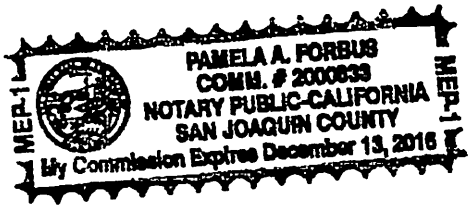
STATE OF CALIFORNIA
COUNTY OF SAN JOAQUIN

On July 11, 2013 before me, PAMELA A. FORBUS, Notary Public, personally appeared DAVID A. FORKEL, who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____
PAMELA A. FORBUS. Notary Public.



ON BEHALF OF RECLAMATION DISTRICT NO. 2028

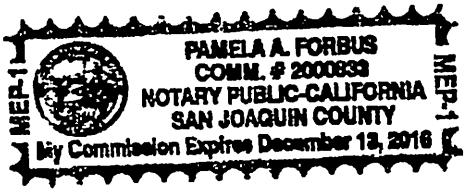
STATE OF CALIFORNIA
COUNTY OF SAN JOAQUIN

On July 11, 2013 before me, PAMELA A. FORBUS, Notary Public, personally appeared DAVID A. FORKEL, who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____
PAMELA A. FORBUS. Notary Public.



RECLAMATION DISTRICT NO. 2038

By _____
Chair/President of the Board of Trustees

Date: 7/3/13

APPROVED AS TO FORM:

By _____
Dante Nomellini, Sr.
District Counsel

Date: 7-8-13

RECLAMATION DISTRICT NO. 2030

By _____
Chair/President of the Board of Trustees

Date: 7/23/13

APPROVED AS TO FORM:

By _____
District Counsel

Date: 7/23/13

RECLAMATION DISTRICT NO. 2072

By Coleman Foley
Chair/President of the Board of Trustees

Date: 7-12-13

APPROVED AS TO FORM:

By _____
Dante Nomellini, Sr.
District Counsel

Date: 7-8-13

RC FARMS, INC.
A California corporation

By Yvonne Sharp

Date: 7/12/2013

State of California)
) ss
County of San Joaquin)

On July 23, 2013, before me, Carolyn E. Hartmann, Notary Public, personally appeared DENNIS GARDEMEYER and GEORGE V. HARTMANN, who proved to me on the basis of satisfactory evidence to be the persons whose names are subscribed to the within instrument and acknowledged to me that they executed the same in their authorized capacity, and that by their signatures on the instrument the persons, or the entity upon behalf of which the persons acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Carolyn E. Hartmann

Notary Public

CAROLYN E. HARTMANN
Commission # 2011383
Notary Public - California
San Joaquin County
My Comm. Expires Mar 11, 2017

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of California

County of SAN JOAQUIN

On July 3, 2013 before me, JEAN MARIE URBANI, notary public,

personally appeared KEVIN JONES,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/~~their~~ authorized capacity(ies), and that by his/her/~~their~~ signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

Jean Marie Urbani

Signature of Notary Public

JEAN MARIE URBANI
NOTARY PUBLIC - CALIFORNIA
COMMISSION # 1982484
SAN JOAQUIN COUNTY
My Comm. Exp. December 30, 2015

(Notary Seal)

OPTIONAL INFORMATION

The acknowledgment contained within this document is in accordance with California law. Any certificate of acknowledgment performed within the State of California shall use the preceding wording pursuant to Civil Code section 1189. An acknowledgment cannot be affixed to a document sent by mail or otherwise delivered to a notary public, including electronic means, whereby the signer did not personally appear before the notary public, even if the signer is known by the notary public. In addition, the correct notarial wording can only be signed and sealed by a notary public. The seal and signature cannot be affixed to a document without the correct notarial wording.

DESCRIPTION OF ATTACHED DOCUMENT

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(Title of document)

Number of Pages _____(Including acknowledgment)

Document Date _____

_____
(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of California

County of SAN JOAQUIN

On July 12, 2013 before me, JEAN MARIE URBANI, notary public,

personally appeared YVONNE SHARP,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

JEAN MARIE URBANI
NOTARY PUBLIC - CALIFORNIA
COMMISSION # 1982454
SAN JOAQUIN COUNTY
My Comm. Exp. December 30, 2015

Jean Marie Urbani
Signature of Notary Public

(Notary Seal)

OPTIONAL INFORMATION

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Document Date _____

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(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of California

County of SAN JOAQUIN

On July 12, 2013 before me, JEAN MARIE URBANI, notary public,

personally appeared COLEMAN FOLEY,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

JEAN MARIE URBANI
NOTARY PUBLIC - CALIFORNIA
COMMISSION # 1982494
SAN JOAQUIN COUNTY
My Comm. Exp. December 30, 2015

Jean Marie Urbani
Signature of Notary Public

(Notary Seal)

OPTIONAL INFORMATION

The acknowledgment contained within this document is in accordance with California law. Any certificate of acknowledgment performed within the State of California shall use the preceding wording pursuant to Civil Code section 1189. An acknowledgment cannot be affixed to a document sent by mail or otherwise delivered to a notary public, including electronic means, whereby the signer did not personally appear before the notary public, even if the signer is known by the notary public. In addition, the correct notarial wording can only be signed and sealed by a notary public. The seal and signature cannot be affixed to a document without the correct notarial wording.

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(Title of document)

Number of Pages _____ (Including acknowledgment)

Document Date _____

_____
(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

RECLAMATION DISTRICT NO. 2027

By _____
Chair/President of the Board of Trustees

Date: 7-22-13

APPROVED AS TO FORM:

By _____
District Counsel

Date: 7-9-13

CCRC FARMS, LLC
A California limited liability company

By _____

Date: 7-22-13

TUSCANY RESEARCH INSTITUTE
A Nevada corporation

By _____

Date: 7-22-13

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of ~~California~~ Nevada

County of Clark

On July 22 2013 before me, Meredith C. Ellis, notary public,

personally appeared Anthony A. Marnell II,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of ~~California~~ Nevada that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

Meredith C. Ellis
Signature of Notary Public

MEREDITH C. ELLIS
Notary Public State of Nevada
No. 92-0275-1
My Appt. Exp. Feb. 20, 2016
(Notary Seal)

OPTIONAL INFORMATION

The acknowledgment contained within this document is in accordance with California law. Any certificate of acknowledgment performed within the State of California shall use the preceding wording pursuant to Civil Code section 1189. An acknowledgment cannot be affixed to a document sent by mail or otherwise delivered to a notary public, including electronic means, whereby the signer did not personally appear before the notary public, even if the signer is known by the notary public. In addition, the correct notarial wording can only be signed and sealed by a notary public. The seal and signature cannot be affixed to a document without the correct notarial wording.

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Number of Pages _____ (Including acknowledgment)

Document Date _____

_____
(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

Exhibit A

Protest Dismissal Agreement between EBMUD and Delta Wetlands Properties

PROTEST DISMISSAL AGREEMENT BETWEEN DELTA WETLANDS PROPERTIES AND EAST BAY MUNICIPAL UTILITY DISTRICT

This Protest Dismissal Agreement is entered into and effective this 13th day of Sept., 2000, by and among Delta Wetlands Properties ("Delta Wetlands") and the East Bay Municipal Utility District ("EBMUD").

RECITALS

WHEREAS, Delta Wetlands has applied to the State Water Resources Control Board to appropriate water pursuant to Application Nos. 29062, 29066, 30268 and 30270 and petitions for change thereto ("Delta Wetlands Applications");

WHEREAS, EBMUD filed with the State Water Resources Control Board a protest of the Delta Wetlands Applications, said protest based upon (a) fishery and (b) levee and Mokelumne Aqueduct security grounds;

WHEREAS, the State Water Resources Control Board has conducted a hearing on the Delta Wetlands Applications and will resume the hearing on October 10, 2000;

WHEREAS, EBMUD has appeared as a protestant and an interested party in the hearing on the Delta Wetlands Applications;

WHEREAS, Delta Wetlands and EBMUD desire to resolve issues between them regarding the Delta Wetlands Applications;

WHEREAS, EBMUD has implemented and continues to implement a comprehensive program to protect and enhance the lower Mokelumne River anadromous fishery; to further protect that fishery, EBMUD and Delta Wetlands wish to ensure that Delta Wetlands implements measures to minimize potential Delta Wetlands Project impacts upon that fishery;

WHEREAS, Delta Wetlands wishes to ensure the security of its Bacon Island and Webb Tract reservoir island levees and seepage control systems;

WHEREAS, EBMUD owns and operates the Mokelumne Aqueducts, which convey water across the Delta to supply EBMUD's East San Francisco Bay service area with approximately 95% of its water;

WHEREAS, Bacon Island, a proposed reservoir island of the Delta Wetlands Project, is located just north of and adjacent to the Mokelumne Aqueducts as they pass through the Delta;

WHEREAS, EBMUD wishes to ensure that the Bacon Island levees are secure and do not fail and that the levees on adjacent islands around Bacon Island are not damaged by the Project, either of which EBMUD contends could damage or destroy the Mokelumne Aqueducts; and

WHEREAS, EBMUD wishes to ensure that all seepage from Delta Wetlands' reservoir operations on Bacon Island to neighboring islands is controlled to prevent damage to the Mokelumne Aqueducts;

NOW, THEREFORE, the parties agree as follows:

1. Delta Wetlands and EBMUD agree to present Attachment A, Fisheries Terms and Conditions, Attachment B, Geotechnical Terms and Conditions, and Attachment C, Delta Wetlands Seepage Control Plan, to the State Water Resources Control Board and to support inclusion of those terms and conditions in any and all permits or licenses issued by the State Water Resources Control Board for the Delta Wetlands Project, including any permits or licenses issued pursuant to Application Nos. 29062, 29066, 30268 and 30270.

2. EBMUD agrees not to oppose the issuance of water right permits or licenses to Delta Wetlands pursuant to the Delta Wetlands Applications and agrees to withdraw its protest on the condition that the terms and conditions contained herein as Attachments A, B and C are included in such permits and licenses where applicable.

3. Whether or not the State Water Resources Control Board includes the terms and conditions contained in Attachments A, B and C, Delta Wetlands and its successors shall be subject to and comply with the terms, conditions and requirements of Attachments A, B and C, including the procedures regarding the Design Review Board and the Monitoring and Action Board.

4. At the resumed water rights hearing on its applications, Delta Wetlands will offer this Agreement into evidence as part of its submission to the State Water Resources Control Board.

5. EBMUD may elect to participate in the Delta Wetlands Project Fishery Technical Advisory Committee. Delta Wetlands shall notify the Department of Fish and Game that EBMUD may participate on the Technical Advisory Committee and is to be provided notice of all Technical Advisory Committee meetings and discussions.

6. This Agreement shall be binding upon and inure to the benefit of the successors in interest and legal representatives of the respective parties.

7. All changes or modifications to this Agreement shall be in writing and signed by EBMUD and Delta Wetlands or their successors.

8. The signatories hereto represent that they are authorized to enter into this Agreement on behalf of the party for whom they sign. This document may be executed in duplicate originals.

DELTA WETLANDS PROPERTIES, an Illinois general partnership

By: KLMLP, L.P., a Delaware limited partnership, Special Partner

By: ZKS Real Estate Partners, LLC, a Delaware limited liability company, its authorized agent.

Dated: Sep 7, 2000

By _____
Frederick L. Stephens, President

EAST BAY MUNICIPAL UTILITY DISTRICT

Dated: 9/14/00

By _____
Dennis M. Diemer, General Manager

ATTACHMENT A
FISHERIES TERMS AND CONDITIONS

Webb Tract Operations

From January 1 to June 30, Permittee's Webb Tract operations shall be in accordance with the following diversion protocol:

1. Diversions to storage shall be made through the southeastern siphon station, except that;

2. Only after the southeastern station siphon is operating at full capacity, or in excess of 90% of full capacity due to maintenance and repair, may diversions to storage be made through the northeastern siphon station;

3. Any reductions in diversions to storage shall first be accomplished by curtailing diversions at the northeastern siphon station. Only after diversions to storage at the northeastern siphon station are reduced to less than 50 cfs shall reductions in diversions begin at the southeastern station.

4. Permittee may operate the northeastern siphon station only when diversions through the southeastern siphon station are projected to be insufficient to completely fill storage on Webb Tract within 30 days. Permittee shall then operate the northeastern siphon station at or below the rates projected to fill said storage by the end of this same 30-day period. Permittee shall report Webb Tract diversion rates and storage amounts to the Technical Advisory Committee on an annual and monthly basis, in accordance with the provisions outlined in the Water Quality Management Plan or other applicable terms and conditions.

5. This diversion operations protocol is not applicable (1) if the U.S. Fish and Wildlife Service ("USFWS") determines that delta smelt eggs, larvae, juvenile or adult life stages are found at the Webb Tract southeastern siphon monitoring stations, as set forth in the USFWS Final Biological Opinion, or (2) if the 3-day running average of salinity or dissolved organic carbon ("DOC") at the northeastern siphon station is more than 10% lower than the 3-day running average of salinity or DOC at the southeastern siphon station. This 10% salinity/DOC exception to the protocol is not expected to occur more than once every five years. If, however, this 10% salinity/DOC exception occurs more frequently than once every five years, then the diversions at the northeastern siphon station resulting from this exception may not exceed 25 thousand acre feet per year nor exceed a diversion rate of 1,375 cfs, without express written authorization from EBMUD. In the event that this salinity/DOC exception is triggered, Permittee shall reimburse EBMUD up to an additional $5,000 as provided and pursuant to paragraph 16 set forth below.

6. The diversion operations protocol is not applicable during routine repairs and maintenance of the southeastern siphon station, with such exception limited to a maximum of three days per month.

7. Any additional siphons or screening capacity constructed by Permittee will also be subject to the diversion protocol. Any such additional siphons or screening capacity will be added to the southeastern siphon station whenever possible.

Siphon Removal

8. Permittee shall limit the number of existing siphons on Bouldin Island to no more than 14. This will require Permittee to remove a number of existing siphons. This reduction shall be applied uniformly around the island. All remaining siphons shall be screened as set forth in the USFWS' Final Biological Opinion.

9. Permittee shall limit the number of existing siphons on Webb Tract to no more than 7. This will require Permittee to remove a number of existing siphons. This reduction shall be applied uniformly around the island, except that at least 50% of the existing siphons along the San Joaquin River shall be removed so that no more than 4 siphons remain on the San Joaquin River. All remaining siphons shall be screened as set forth in the USFWS' Final Biological Opinion.

10. Permittee shall complete the above-referenced siphon removal prior to beginning diversions on Webb Tract under Permittee's new water rights. Permittee shall provide EBMUD with written notice of removal within thirty days of completion of siphon removal.

Boat Docks

11. Permittee shall limit the addition of new boat docks on the exterior of Bouldin Island to no more than 150. New boat docks on the Mokelumne River shall be limited to no more than 75.

12. Permittee shall limit the addition of new boat docks on the exterior of Webb Tract to no more than 198. New boat docks on the San Joaquin River shall be limited to no more than 30.

13. The location of Permittee's new boat docks on Bouldin Island and Webb Tract shall be based on recommendations by the Technical Advisory Committee with consideration given to the proximity of the proposed new boat docks to proposed new shallow water habitat.

Webb Tract Fisheries Monitoring Program

From January 1 to June 30, Webb Tract diversions to storage from the northeastern siphon station that exceed 50 cfs shall require fishery monitoring as described below:

14. No later than January 1, February 1, and March 1 of each year, Permittee shall provide to EBMUD a monthly operations plan showing when diversions to Webb Tract and Bouldin Island are anticipated to take place for the subsequent four month period.

15. No less than three days prior to commencing diversions which exceed 50 cfs to Webb Tract or Bouldin Island, Permittee shall notify EBMUD of its proposed diversion.

16. In any year when Permittee operates its northeastern Webb Tract diversion station and EBMUD finds juvenile chinook salmon have begun outmigrating from the Mokelumne River as determined by a two-day running average of over 25 fish per day at Woodbridge Dam, Permittee will reimburse EBMUD up to $50,000 per year in year 2000 dollars (adjusted annually for inflation by the Consumer Price Index for All Items - All Urban Consumers for the San Francisco-Oakland-San Jose Metropolitan Statistical Area) for monitoring expenses and the cost to obtain any necessary permits for monitoring in the immediate vicinity of the northeastern Webb Tract diversion station and associated boat docks.

17. Monitoring shall be performed for the first five years of actual operation (these might not be consecutive years) of Permittee's northeastern Webb Tract diversion station. If the Mokelumne River juvenile anadromous fish are not present on the screens of the northeastern diversion structure or are not in the stomachs of predators in the immediate vicinity of the northeastern diversion structure during this period, then no further monitoring shall be required.[1] If, however, Mokelumne River juvenile anadromous fish are present on the screens of the northeastern diversion structure or in the stomachs of predators in the immediate vicinity of the northeastern diversion structure, this monitoring program and its associated mitigation (described in Paragraph 18, below) will continue until such time as the monitoring program fails to detect the presence of these fish for three consecutive years of operation.

18. If this monitoring program identifies that Mokelumne River juvenile anadromous fish are present on the screens of the northeastern diversion structure or in the stomachs of predators in the immediate vicinity of the northeastern diversion structure, Delta Wetlands will immediately reduce its diversions at the northeastern Webb Tract diversion station by 50% of the then current diversion rate, or down to an instantaneous diversion rate of 50 cfs, whichever is greater.

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[1]For purposes of this agreement, Mokelumne River juvenile anadromous fish are any juvenile salmonids bearing an adipose fin clip. In the event tagging techniques are modified by EBMUD, or others, that eliminates the ability to distinguish Mokelumne River juvenile anadromous fish, EBMUD shall notify Permittee and modify this definition to enable proper identification of the Mokelumne River juvenile anadromous fish.

ATTACHMENT B
GEOTECHNICAL TERMS AND CONDITIONS

Reservoir Island Design Review Board ("DRB")

1. Members:

   a. Number: Three.

   b. Qualifications: Registered professional civil engineers with experience providing engineering services in the Sacramento-San Joaquin Bay-Delta. At least one member shall be a geotechnical engineer.

   c. Appointed by: Delta Wetlands Properties ("DW" or "Permittee").

   d. While not members of the Design Review Board ("DRB"), parties such as EBMUD that hold property interests adjacent to Bacon Island or Webb Tract (the Project reservoir islands) or parties that could be substantially affected by the reservoir operations and have appeared in the DW water rights hearing, shall have the ability to participate in DRB meetings, comment on design, and shall be provided a copy of all DRB minutes so that such parties can monitor the design and construction of the Project reservoir islands.

2. Duties: Permittee shall submit Project reservoir island plans and specifications to the DRB. The DRB shall review and comment on the plans and specifications during staged design review and during construction for the Bacon Island and Webb Tract Project improvements, confirming that Project design meets the stated objectives of the Project description as defined in the 2000 Revised Draft Environmental Impact Report/Statement and the Delta Wetlands Seepage Control Plan (Attachment C), including but not limited to: levee factors of safety, wave protection for levees, levee slopes, seepage control, and monitoring programs. Comments of the DRB shall be provided to the SWRCB, Permittee, EBMUD, and to local reclamation districts adjacent to the Project reservoir islands.

3. Compensation: Members of the DRB are to be compensated by Permittee for their time, in an amount up to but not to exceed $300,000. The DRB shall cease to exist once its duties, as set forth in paragraph 2, are completed.

Reservoir Island Monitoring & Action Board ("MAB")

4. Members:

   a. Number: Three, with two alternates.

   b. Qualifications: The two primary members shall be registered professional civil geotechnical engineers with experience providing engineering services in the

Sacramento-San Joaquin Bay-Delta. The third member and the two alternate members shall be licensed professionals with experience in seepage in the Sacramento-San Joaquin Bay-Delta.

c. Appointment Process: The State Water Resources Control Board ("SWRCB") shall appoint one member and DW shall appoint one member. In the event the SWRCB does not so appoint one MAB member, then DW shall instead appoint that member after first meeting and conferring with EBMUD on the independence and objectivity of the proposed appointment and after allowing EBMUD an opportunity to object to the appointment. No appointment of this one MAB member shall be made over the objection of EBMUD. These two members ("primary members") shall appoint the third member and the two alternate members. Any party to the Delta Wetlands SWRCB hearing may provide suggestions to the SWRCB as to who to appoint to the MAB. Each of the MAB members shall be appointed for a term of four years. At the end of the four-year term, the same selection process will be used to select the MAB.

5. Term: The MAB shall be established prior to the first diversions to storage on Bacon Island or Webb Tract and shall continue thereafter for the duration of Project reservoir operations on Bacon Island and/or Webb Tract.

6. Compensation: Members of the MAB are to be compensated by Permittee for their time on an hourly basis. Such costs, including costs of reports which may be prepared and studies which may be undertaken by the MAB shall be part of the annual operation and maintenance costs of the Project.

7. Duties:

a. Permittee shall submit Project monitoring and seepage data to the MAB so that the MAB can fulfill its duties. During the first year of Project reservoir island operations, the MAB shall serve as a neutral technical engineering advisor and shall review monitoring and seepage data at each stage of initial reservoir filling. Following that initial filling, the MAB shall review monitoring and seepage data at a minimum of every three months during the remainder of the first year of Project reservoir island operation.

b. The MAB shall serve as a neutral technical engineering advisory panel, hearing and investigating identified problems purportedly caused by Permittee's reservoir operations, including but not limited to levee weakness, overtopping of levees, levee failure, scour at EBMUD's Mokelumne Aqueduct river crossings, and seepage. The MAB shall also issue Reports containing its recommendations on remedial actions to correct problems, as set forth in paragraph 14.

c. The terms of the Delta Wetlands Seepage Control Plan (Attachment C) may be adjusted over time by the SWRCB as set forth below. The SWRCB reserves jurisdiction over changes in the Delta Wetlands Seepage Control Plan to coordinate

or modify its terms for the protection of other legal users of water, fish, wildlife, instream beneficial uses, and the public interest as future conditions may warrant. The SWRCB delegates authority to the Executive Director of the SWRCB to take actions under this reservation of jurisdiction as set forth below.

(i) During the third year of Project operations, the MAB shall review the Delta Wetlands Seepage Control Plan to determine if changes in any of the Seepage Control Plan's terms are advisable. In its review, the MAB shall examine actual operation of the Project to date and any adverse effects of Project reservoir operations, including impacts on neighboring levees and islands. The MAB will base each of its recommended changes to Plan terms, if any, on its independent, professional judgment. At the conclusion of its review, the MAB shall issue a written list of its recommended changes, if any. The list shall be sent by the MAB to the SWRCB, Permittee, EBMUD, all Interested Parties who have notified Permittee as set forth in paragraph 9, and all parties to the Delta Wetlands SWRCB hearing ("Noticed Parties").

(ii) If Permittee, EBMUD, Noticed Parties and Interested Parties (as limited above) do not object to a change recommended by the MAB within 30 days of service of any proposed change, then the Executive Director of the SWRCB may approve the change without the need for a comment period or hearing. In the event of any objection, the SWRCB may only approve the change after it provides notice of and an opportunity to comment on the proposed change to Permittee, EBMUD, Noticed Parties and Interested Parties (as limited above). If requested by Permittee, EBMUD, a Noticed Party or an Interested Party (as limited above), the SWRCB may hold a hearing on the proposed change.

d. After its initial three-year review of the Delta Wetlands Seepage Control Plan as set forth above, the MAB may thereafter periodically review and change the terms of the Delta Wetlands Seepage Control Plan so long as the review and approval process set forth above is followed.

Dispute Resolution Procedure

8. Delta Wetlands and EBMUD set forth the following process to identify and remedy levee, seepage and related problems which may be caused by Project reservoir islands operations. The parties recognize, however, that in the event of an emergency, such as an imminent levee failure, there is a need for rapid action such that there may not be time for this process to take place. In the event of emergency, an Interested Party or reclamation district may notify Permittee of a problem by any available method.

9. Any entity or individual who may be injured by the reservoir operations of the Delta Wetlands Project ("Interested Party") may elect to seek a remedy through the Dispute Resolution Procedure set forth below. If such an Interested Party elects to utilize said Dispute Resolution Procedure, then the Interested Party shall notify Permittee and MAB in

writing of such election and shall be bound by all provisions set forth therein, including but not limited to paragraph 16.

10. Method of Notification: Except in cases of emergency, all notifications, determinations, completion notices, objections, and reports shall be in writing delivered by U.S. Mail, courier, messenger, facsimile or electronic mail. All written notifications, determinations, completion notices, objections, and reports must be signed by a registered engineer.

11. Notification of Problem: EBMUD, or any Interested Party that has elected to use the Dispute Resolution Procedure as set forth in paragraph 9, may notify Permittee of perceived problems caused by the Project, including but not limited to, indications of levee failure and/or seepage on Project reservoir islands or on adjacent islands. EBMUD or Interested Party shall hereafter be referred to as "Complainant."

    a. Contents of Notification: The Notification shall specify the type of problem identified, its location and when it was observed.

    b. Notification Sent to: The Notification shall be sent by Complainant to the SWRCB, Permittee, the MAB, and to the secretary of any reclamation district for land on which the identified problem is occurring.

12. Determination by Permittee: Upon receiving a written Notification pursuant to paragraph 11, Permittee shall investigate the problem. Within five working days of receiving said written Notification, Permittee shall provide a written Determination to the SWRCB, Complainant, the MAB, and to the secretary of any reclamation district to whom the Notification was sent.

    a. Contents of Determination: The Determination shall outline what actions Permittee took to investigate the identified problem, Permittee's conclusions as to the nature of the problem, an explanation of what remedial actions, if any, Permittee will take to correct the problem, and when any such remedial actions will be commenced and completed.

    b. Upon Permittee's completion of any such remedial actions, Permittee shall provide a written completion notice to the SWRCB, Complainant, the MAB, and the secretary of any reclamation district to whom the Notification was sent. The notice shall state what remedial actions were taken and when they were completed.

13. Objection to Permittee's Determination: In the event Complainant disagrees with all or part of Permittee's Determination, Complainant within five working days of receipt of Permittee's Determination, shall send to the SWRCB, Permittee, the MAB and to the secretary of any reclamation district to whom the Notification was sent, a written Objection to the Determination.

a. Contents of Objection: The Objection shall outline to which portions of the Determination Complainant objects and why. Complainant may also state its view of the problem and remedy.

14. MAB Report: Upon receipt of an Objection pursuant to paragraph 13, the MAB shall commence its own independent investigation of the matter. Permittee and/or Complainant may submit additional material to the MAB to assist in its investigation, so long as the other party is copied. If, in the opinion of the MAB, additional technical studies are necessary to its investigation, it may undertake or authorize such studies. The costs of any such studies shall be paid for as set forth in paragraph 6.

a. Within seven working days of receiving the written Objection, the MAB shall issue a written Report. Said Report shall be sent to the SWRCB, Permittee, Complainant and to the secretary of any reclamation district to whom the Notification was sent.

b. Contents of Report: The Report shall include the MAB's independent opinion on the nature of the problem, its recommendation on what remedial actions should be taken by Permittee to correct the problem, if any, and a schedule of when any such remedial actions should be commenced and completed by Permittee. The MAB shall only recommend remedial actions which address problems determined to be caused by Project reservoir operations though, if necessary, it may identify other causes only for explanatory purposes.

15. Permittee's Compliance with the Report: Permittee shall implement all recommended remedial measures listed in the MAB's Report by the deadlines included therein, and shall be solely responsible for the costs of said measures.

16. Frivolous Claims: If the Permittee believes the Complainant has filed a frivolous Notification pursuant to paragraph 11, then Permittee may, within fifteen days of receiving the MAB Report, request the MAB to determine whether the Notification by Complainant is totally and completely without merit (frivolous). If the Notification is determined to be frivolous, Complainant shall pay all costs and fees of investigating the claim incurred by the MAB.

17. Judicial Remedy: Nothing in these terms and conditions shall constitute a waiver of the rights of Permittee or Complainant to pursue judicial remedies in state court regarding an MAB Report.

Financial Assurances

18. The following four classes of financial assurances shall be required so long as the Project is owned by any party other than the state and/or federal government(s). In the event the Project is owned and operated by the state and/or federal government(s), then these provisions shall not apply. However, any governmental entity that purchases or leases the Project shall hold a financial reserve account for the Project that is sufficient to cover the annual costs of Project operations or shall provide equivalent assurances.

19. **Seepage and Monitoring Fund:** The parties wish to ensure that, prior to any diversions to storage on Bacon Island or Webb Tract in each and every year of Project operation, the Permittee have sufficient capital resources on hand to operate the seepage control and monitoring systems for the full year. To meet this objective, the following funding mechanism shall be utilized.

First Year of Operation. Prior to the first diversion to storage on a Project reservoir island, Permittee shall deposit, in an interest-bearing account in a financial institution licensed to do business in the State of California who will act as the escrow agent, with interest accruing to Permittee, $500,000 to be used for the first year's annual operating expenses of the Project's reservoir island seepage control and monitoring systems. Permittee may draw upon said monies over the course of the year only to cover routine incurred expenses for seepage control and monitoring on the two Project reservoir islands.

Following Years. Prior to the first diversion to storage on a Project reservoir island in each and every water year thereafter, Permittee shall deposit into said account a sum of money the MAB estimates, as provided below, will be required for the complete annual operating costs of the Project's reservoir island seepage control and monitoring systems for that upcoming water year. Permittee may draw upon said monies over the course of the water year only to cover routine incurred expenses for seepage control and monitoring on the two Project reservoir islands.

Estimate. No later than September 1 of each year, Permittee shall file with the MAB a written estimate of the amount of money required for the complete annual operating costs of the Project's reservoir islands seepage control and monitoring systems for the upcoming water year. (The water year shall be October 1 through September 30.) The MAB shall review that estimate and, in its own discretion, set an amount of money it estimates will be needed to operate the Project reservoir islands seepage control and monitoring systems for that upcoming water year. Said sum shall not be less than the prior year's actual seepage and monitoring costs. Permittee shall then deposit that amount of money in the designated account, as provided above.

Records. Permittee shall provide proof of deposit of the estimated annual seepage and monitoring costs to the MAB prior to the first diversion to storage on a Project reservoir island in each year of operation. Permittee shall maintain all books and records on the utilization of said account monies for each year of Project operation and shall submit to the SWRCB and MAB, no later than October 15 of each year, an accounting of how said monies were expended in the prior water year.

20. **Drawdown Fund:** The parties wish to ensure that, in the event Permittee abandons the Project or otherwise does not operate the Project after water has been diverted to storage on a Project reservoir island, there are sufficient capital resources on hand to empty the Project reservoir islands.

First Year of Operation. Prior to the first year of reservoir operations, Permittee shall deposit, in an interest-bearing account in a financial institution licensed to do business in the State of California who will act as the escrow agent, with interest accruing to Permittee, $1,000,000 to cover the expense of emptying the Project reservoir islands. Permittee may draw upon said monies over the course of the year to cover routine expenses of discharging water from the Project reservoir islands as part of normal operations.

Following Years. Prior to the first diversion to storage on a Project reservoir island in each and every water year thereafter, Permittee shall deposit into said account a sum of money the MAB estimates, as provided below, will be required for the complete annual operating costs of the Project's discharge operations for that upcoming water year. Permittee may draw upon said monies over the course of the water year only to cover routine incurred expenses for discharge of stored water on the two Project reservoir islands.

Estimate. No later than September 1 of each year, Permittee shall file with the MAB a written estimate of the amount of money required for the complete annual operating costs to discharge water from the Project reservoir islands for the upcoming water year. (The water year shall be October 1 through September 30.) The MAB shall review that estimate and, in its own discretion, set an amount of money it estimates will be needed to discharge water from the Project reservoir islands for that upcoming water year. Said sum shall not be less than the prior year's actual discharge costs. Permittee shall then deposit that amount of money in the designated account, as provided above.

Records. Permittee shall provide proof of deposit of the estimated annual discharge costs to the MAB prior to the first diversion to storage on a Project reservoir island in each year of operation. Permittee shall maintain all books and records on the utilization of said account monies for each year of Project operation and shall submit to the SWRCB and the MAB, no later than October 15 of each year, an accounting of how said monies were expended in the prior water year.

21. **Remedial Actions:** The parties wish to ensure that, in the event Permittee determines to take corrective actions in response to a Complainant's Notification or if the MAB recommends remedial actions to correct identified problems, Permittee will have sufficient capital resources on hand to implement those actions.

Prior to the first diversion to storage on a Project reservoir island, Permittee shall deposit, in an interest-bearing account in a financial institution licensed to do business in the State of California who will act as the escrow agent, with interest accruing to Permittee, $1,000,000. This fund shall be available for use by Permittee only to implement corrective actions in response to a Complainant's Notification or to implement remedial measures recommended by the MAB.

In the event this Remedial Action Fund is so used by Permittee, Permittee shall, prior to again diverting to storage on a Project reservoir island, deposit sufficient monies into said account so that its balance returns to its minimum required level. Its minimum required level shall be $1,000,000, as adjusted annually for inflation by the ENR Construction Cost Index

for San Francisco (ENR CCI-SF) for the life of the Project. In the event this Remedial Action Fund is not used by Permittee during ten years of reservoir operations, then such fund shall be canceled and the monies deposited shall revert back to Permittee.

Records. Permittee shall provide proof of deposit of the Remedial Action Fund to the MAB prior to the first diversion to storage on a Project reservoir island, and if the Remedial Action Fund is drawn upon, Permittee shall again provide proof of deposit of sufficient funds to maintain the balance at the minimum required level prior to again diverting to storage on a Project reservoir island. Permittee shall maintain all books and records on the utilization of said account monies for each year of Project operation and shall submit to the SWRCB and the MAB, no later than October 15 of each year, an accounting of how said monies were expended in the prior water year.

22. **Insurance:** The parties wish to ensure that in the event of damage caused by the Project, sufficient capital resources are available to reimburse damaged parties.

Permittee shall take out and maintain, during the life of the Project, General Liability Insurance that provides protection from claims that may arise from Project reservoir islands operations. Permittee shall annually submit certificates of said insurance to EBMUD. The policy shall not be cancelled or materially altered unless 30 days' written notice is given EBMUD. The amounts of insurance coverage shall not be less than $25,000,000/ Occurrence, Bodily Injury, Property Damage - General Liability.

ATTACHMENT C
DELTA WETLANDS SEEPAGE CONTROL PLAN

I. INTRODUCTION

A. Description of Seepage

The Delta Wetlands ("DW") Project consists of four islands. Water will be stored on the two reservoir islands (Bacon Island and Webb Tract) up to elevation +6 feet. On the habitat islands (Bouldin Island and Holland Tract), water levels will be managed for a range of crops and habitats, some of which include shallow flooding. DW intends to control groundwater in the vicinity of its reservoir islands in such a way that there is no seepage beyond that which would be produced by other uses of the DW reservoir islands currently allowed (such as intensive agriculture or shallow flooded wetlands). Controlling seepage to within these limits is referred to as "no net seepage impact".

The method by which a reservoir on Bacon Island and/or Webb Tract could create a seepage impact on an adjacent island is flow through a connecting sand aquifer extending beneath both islands. Seepage flowing from one island to the next will raise the hydrostatic head in the aquifer beneath the neighboring (receiving) island. The presence or absence of a connecting aquifer is not known at many locations. If there is a connecting aquifer and if seepage is occurring from a reservoir island through the aquifer to a neighboring island, the hydrostatic head in the aquifer beneath the neighboring island will rise and fall with the filling and emptying of the reservoir. DW will monitor the hydrostatic head in the aquifers beneath neighboring island levees to check that no seepage is occurring from DW Reservoirs. Several types of "wells" are used to control and monitor seepage. Their definition and relative location are shown on Figure C-1 (attached).

B. Groundwater Monitoring Wells

Two suites of groundwater monitoring wells will be installed.

To check whether the reservoir water level on Bacon Island or Webb Tract is affecting an adjacent island, Permittee will install seepage monitoring wells along a neighboring island's perimeter directly across from the Bacon Island and Webb Tract Reservoir islands.[1] These will be the primary tool for detecting seepage from a reservoir island. If water stored on a DW reservoir island creates added seepage toward a neighboring island, the increased hydrostatic head that would be part of the seepage can be measured in monitoring wells penetrating the aquifer transmitting the water.

To check the overall groundwater behavior in the Delta, unrelated to operation of the DW Project, a series of background monitoring wells will be installed at locations sufficiently far removed from the Bacon Island and Webb Tract reservoirs as to not be influenced by water storage

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[1]The installation of monitoring wells is subject to the approval of the neighboring island owner(s). If approval is unreasonably withheld, alternative locations will be utilized.

within the reservoirs. The measured groundwater levels will be normalized (as described below) and averaged to develop an overall characterization of the groundwater trends in the central portion of the Delta.

C. Pre-Project Baseline

To collect baseline[2] data on the overall groundwater system performance as it relates to agricultural practices or wetlands management, the groundwater monitoring wells (both seepage monitoring wells and background monitoring wells) will be monitored by DW continually for at least one year prior to the start of reservoir filling. The same measurements will be taken by DW year round, once the Project is implemented.

D. Detecting Seepage

To assess whether filling Bacon Island or Webb Tract may be impacting the groundwater level beneath neighboring islands, the groundwater levels in the seepage monitoring wells beneath adjacent islands will be compared by DW to the baseline records at those same locations. Concurrently, the overall groundwater performance of the Delta will be measured by DW in the background monitoring wells. Those locations showing increases above baseline range (adjusted for extreme variations in overall Delta groundwater performance), that coincide with filling the reservoir, will be the basis for suspending water diversion onto the nearby reservoir island. Details regarding how the various data will be compared are described in Section III set forth below. The above monitoring observations will be made on a continuing basis, allowing DW to observe the start of trends that may indicate possible seepage from the reservoirs. The goal of DW is to be proactive and to make needed groundwater control adjustments far in advance of the Diversion Suspension Limits.

E. Initial Stage Filling of Reservoirs

When the Project first begins to operate, water storage will be implemented on a vertical stage-filling basis. Water within the reservoir will first be brought to a fairly low level, not more than 25% of storage capacity, and held constant for a period of time until sufficient data are collected to verify that no net seepage impacts are occurring on neighboring islands. If impacts are found that require controlling measures, filling of the reservoir will be put on hold until appropriate measures can be brought on line so as to not cause additional risk to neighboring island levees. Such actions could include increasing the pumping capacity of interceptor wells, installing additional interceptor wells, installing relief wells on a neighboring island, and/or other mitigation that may be agreed upon among DW, the adjacent landowners, and the reclamation districts.

If impacts are not detected, the reservoir will be further filled to the next vertical stage (approximately 50% of reservoir capacity) and again held constant to allow adequate time for data collection and assessing of possible seepage impacts. This cycle of staged-filling, monitoring

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[2]"Baseline" data refer to data collected prior to the first filling of the reservoir islands. The baseline may be updated during subsequent years of no water storage on the reservoir islands.

seepage, assessing impacts, and correcting impacts will be repeated until the reservoir can be safely brought to full operational level with suitable seepage control measures in place.

F. Routine Operations

The reservoirs will commonly begin filling in late fall to early winter. Both prior to and during filling, the groundwater levels in the seepage monitoring wells will be carefully tracked by DW. The interceptor wells will begin to operate as the reservoir level is raised. Pumping rates will be increased as the pool elevation in the reservoir is raised. All this time, the seepage monitoring wells will be tracked and serve as a control for adjusting the interceptor well pumping rates. The interceptor wells will be pumped such that the water levels in the seepage monitoring wells are kept near the normal seasonal levels.

DW will continually evaluate the efficiency of the interceptor wells to verify that there is sufficient additional capacity to allow the pool elevation to continue to be raised. If the efficiency of a well drops off such that the ability of the well to pump greater volumes of water is in question, DW will redevelop the well to improve its efficiency prior to approaching the well's limits. If additional capacity is not readily available from an existing well, a new well can be drilled to increase the pumping capacity at the reservoir island's perimeter.

The reservoir pool elevation will lower as water is later exported into the adjacent slough or river. As the pool elevation decreases, the pumping rates from the interceptor wells will be gradually lowered, with the goal of keeping the water levels in the neighboring islands seepage monitoring wells near their normal seasonal levels.

During the period with little to no water storage, a thorough evaluation of the efficiency of the wells will be undertaken by DW to identify those wells that may show signs of decreasing efficiency and may be susceptible to overstressing during the following season's storage cycle. The need for additional wells will also be evaluated. To the extent practical, redevelopment of existing wells and installation of additional wells will occur during the off-season.

II. LOCATIONS OF GROUNDWATER MONITORING WELLS

A. Background Monitoring Wells

At least twenty-five (25) background monitoring wells will be sited by DW at an appropriate distance from the reservoir islands. These background monitoring wells will be at least one mile from a reservoir island and most likely will be greater than 11/2 miles from a reservoir island. Recommended typical locations of background monitoring wells are shown on Figure C-2. The purpose of these background monitoring wells is to monitor regional groundwater elevations beyond the reasonable influence of the DW reservoir islands.

B. Seepage Monitoring Wells

At least 100 seepage monitoring wells will be placed on or near levees directly opposite the perimeter of the reservoir islands. The five neighboring islands around the south half of Bacon

Island are Lower Jones Tract, Upper Jones Tract, Woodward Island, Orwood Tract and Palm Tract. Around the northern half of Bacon Island are Holland Tract, Little Mandeville Island (currently flooded), Mandeville Island and Mildred Island (currently flooded). Around Webb Tract are Bradford Island, Twitchell Island, Brannan/Andrus Island, Bouldin Island, Venice Tract, Mandeville Island, Franks Tracts (currently flooded), and Little Franks Tract (currently flooded).

Passing across Upper Jones Tract, Woodward Island and Orwood Tract is the Mokelumne Aqueduct, a critical structure. Flooding on any of the five neighboring islands (Lower Jones Tract, Upper Jones Tract, Woodward Island, Orwood Tract and Palm Tract) around the southern half of Bacon Island may increase the risk of service disruption for the aqueduct. The shortest distance between the levee on the southern half of Bacon Island and a neighboring island levee (centerline to centerline) is about 700 feet. A seepage monitoring well spacing of 1,500 to 2,000 feet on a neighbor island levee will provide essentially full coverage of a continuous aquifer at these distances. However, allowing for an importance or risk factor associated with the Mokelumne Aqueduct, DW will use minimum seepage monitoring well spacings of 500 to 1,000 feet for center-to-center levee distances of between 700 to 1,200 feet. For levees beyond a distance of 1,200 feet from a Bacon Island levee, seepage monitoring well spacing will be 1,500 to 2,000 feet. The approximate locations for seepage monitoring wells are shown on Figure C-3.

C. Other Water Level Monitoring

Reservoir stage recording stations will be established within Bacon Island and Webb Tract to document the water surface elevations in the reservoirs. A river stage recording station will be established on the outside perimeters of Bacon Island and Webb Tract to document the water surface elevations in the surrounding rivers and sloughs.

III. EVALUATION OF GROUNDWATER MONITORING WELL DATA

A. Collecting Data Prior to Filling Reservoir and Developing Reference Envelopes

Groundwater monitoring wells (both seepage and background monitoring wells) will be installed by DW at least one year prior to commencement of reservoir filling. Groundwater levels will be recorded using automatic data loggers, measuring and recording the groundwater elevation at least once each hour. The groundwater elevations recorded each day will be averaged to compute the mean groundwater elevation each day ("daily mean") at each groundwater monitoring well location (see Figure C-4). This "daily mean" value will be the primary data used by DW in assessing whether seepage impacts are occurring.

At least one year of groundwater elevation data will be collected from the groundwater monitoring wells prior to the filling of a DW reservoir island. These baseline data will be used as a measure of the initial conditions at these individual groundwater monitoring well locations.

Using the daily means as the data, the annual mean will be computed for each groundwater monitoring well (see Figure C-5). The daily means will be compared with the annual mean and the standard deviation of the difference between the daily means and the annual mean will be computed

for the baseline period. A reference envelope will be developed that is two standard deviations above and below the annual mean for each groundwater monitoring well.

B. Background Monitoring Wells

Data will be collected by DW from background monitoring wells over the same time period as data are collected for the seepage monitoring wells located directly across sloughs from the reservoirs. Daily means of the water level elevations will be calculated for each background monitoring well. Reference envelopes will be computed using at least one full year of pre-reservoir groundwater data to identify plus and minus two standard deviations relative to the annual mean.

After the two standard deviation reference envelopes are created for each background monitoring well for the baseline (pre-reservoir filling) period, subsequent daily mean data for each background monitoring well will be compared with its reference envelope, Figure C-6a. To normalize the data, the lower reference line value will be subtracted from the daily mean. The algebraic difference will then be divided by the height of the envelope (plus or minus two standard deviations). The daily mean for each background monitoring well will be reported as a percent of its envelope height, Figure C-6b. A normalized plot will be prepared comparing the current background groundwater data to the height of the plus or minus two standard deviation baseline envelope for the same well and presented as a percentage of its envelope, Figure C-6c.

The above computed normalized percentage results from each of the background monitoring wells will be combined with the results for all other background wells and averaged for each day. They will be plotted versus time, with the hydraulic head expressed as a percent of the background groundwater monitoring wells' reference envelopes, Figure C-6d. The intent of this last plot is to track general groundwater variations that may be occurring in the central portion of the Delta but that are unrelated to water stored by the Project.

DW anticipates that this plot will show increases in groundwater levels during sustained periods of locally heavy rainfall and low evapotranspiration and during higher water levels in the rivers and sloughs as a flood stage passes through. Many fields are flooded from mid-fall to winter for a variety of reasons. This shallow flooding will also be detected. Low background groundwater levels are expected during late spring through early autumn when evapotranspiration is high and rainfall negligible.

Individual seepage monitoring wells or groups of seepage monitoring wells showing similar responses to those indicated by the average background conditions will indicate that the individual seepage monitoring wells or groups of seepage monitoring wells are responding to the same regional conditions that are affecting the background monitoring wells.

C. Reservoir Stages

Reservoir stage will be measured by DW within the reservoir islands. The daily means of reservoir stage will be computed and recorded. The reservoir stage daily mean will be shown on a graph of pool elevation versus time, similar in format to the daily mean groundwater elevation plots for groundwater monitoring wells.

D. River and Slough Stages

River and slough stage will be measured by DW and daily means computed. The daily mean of slough and river stage will be shown on a graph of water surface elevation versus time, similar in format to the daily mean groundwater elevation plots for groundwater monitoring wells.

E. Limiting Conditions Using Groups of Groundwater Monitoring

1. General

If the groundwater in a group of three or more contiguous seepage monitoring wells located on neighboring islands surrounding a reservoir island rises more than 0.25 foot above their upper bound envelopes of baseline data and if the timing of the increase correlates with the filling of the reservoir or storage of water in the reservoir (adjusted for changes in the daily means for the background groundwater monitoring wells), the reservoir filling will be stopped. This limiting condition is referred to as the Diversion Suspension Limit. Reservoir filling will not resume until the increased hydrostatic head condition is corrected or otherwise satisfactorily remediated. The details of this evaluation are described below.

2. Correlation with Local Activities

If an individual background monitoring well exceeds its upper base data reference envelope, then the land use practices in the general vicinity of each groundwater monitoring well will be checked to see if the irrigation and/or drainage practices have recently changed. Some groundwater variations may result from changes in land management practices, including irrigation patterns, shallow flooding for leaching the soil and suspension of ditch maintenance for land in a set-aside program. Activities in the nearby river or slough will also be checked. Dredging of rivers or sloughs can have substantial impacts on groundwater levels. DW will contact and query reclamation districts on dredging activity or other substantial marine activity near their islands if a marked increase in groundwater levels is observed.

3. Regional Corrections

The background monitoring well data will track the regional variations occurring in the groundwater levels beyond the influence of the reservoir islands. This evaluation will be both qualitative and quantitative. There is considerable imprecision in attempting to correlate one or more seepage monitoring wells with another well, including the background monitoring wells. DW will use a quantitative correction to the extent that the average background condition is above 80% of the full height of the background reference envelope, shown in Figure C-7a. The additional percentage above the 80% level in the background monitoring wells will be multiplied by the plus or minus two standard deviation baseline envelope for each seepage monitoring well. The resulting product will be added to the upper envelope for each seepage monitoring well as shown in Figure C-7b.

4. Initial Evaluation

The daily mean will be computed by DW for each individual seepage monitoring well for the period of time under consideration (referred to as "current" data). The current data for each seepage monitoring well will be compared with the reference (baseline) envelope for the same groundwater monitoring well. (The reference envelope will have been prepared based on a pre-reservoir-filling period as described above in section III.A and adjusted for average changes in background groundwater levels described in the previous paragraph.)

For each seepage monitoring well in the group, the difference between the current groundwater level and the upper envelope will be computed (see Figure C-8). The differences will be averaged for three or more contiguous seepage monitoring wells. The Diversion Suspension Limit for a group of three or more wells will be defined as exceeding the average difference between the current data and upper reference envelopes by 0.25 feet or more, contingent on the conditions in the following sections.

5. Correlation with DW Activities

Finally, the variation over time for the average of the differences between the current data and the upper envelope for the group of wells under consideration will be compared by DW with the changes in reservoir stages (and interceptor pumping rates) over the same period. This comparison will be used to check whether there is a correlation between the reservoir pool elevation and the measured increased head at the groundwater monitoring wells. If the increased head in the groundwater monitoring well correlates with the fluctuations in reservoir pool elevation and the average increase is 0.25 feet above the envelope after adjustments, this will define the Diversion Suspension Limits. DW will be required to suspend diversions of water into the reservoir and to implement measures to lower the groundwater level at the neighboring island perimeters facing the reservoir island. DW will not be allowed to resume diversions until the indicated seepage is resolved.

F. Limiting Conditions Using Individual Groundwater Monitoring Wells

The following procedure will be used by DW to assess whether an individual groundwater monitoring well on a neighboring island is being impacted by water storage on a reservoir island.

1. The daily mean for an individual groundwater monitoring well will be plotted for a current year against time. The current data will be compared with the reference envelope for this groundwater monitoring well. (The reference envelope will have been prepared based on a pre-reservoir filling period as described in section III.A. and adjusted for average changes in background levels as described in section III.B.3.) If the current water level is less than or equal to one foot above the upper reference line, no action will be indicated based on the single groundwater monitoring well data. If the current groundwater level is greater than one foot above the upper reference line, a seepage impact may be indicated, and the evaluation will continue to the following steps.

2. The land use practices in the general vicinity of the individual groundwater monitoring well, including flooding fields and dredging in the river or slough, will be checked to see if practices have changed as discussed in the previous section.

3. The variation of the individual groundwater monitoring well's daily means will be compared with the changes in reservoir stages recorded over the same period of time and/or marked decreases in interceptor well pumping across from the groundwater monitoring well. If the increased head in the groundwater monitoring well correlates with the fluctuations in reservoir pool elevation (or with marked decreases in interceptor well pumping rates) and the head in the aquifer is more than one foot above the adjusted upper reference envelope, this will be a Diversion Suspension Limit, and DW will be required to suspend diversions of water into the reservoir island. DW will not be allowed to resume diversions into that reservoir island until the indicated seepage is resolved.

G. Future Modifications

The methods described herein are intended to provide a rational and responsive evaluation of changes in groundwater levels and seepage that may be attributed to water storage on Bacon Island and Webb Tract. These methods have been assessed using samples of data collected during the initial groundwater monitoring program previously conducted by DW. If, after implementation of this procedure deficiencies are discovered, EBMUD and/or DW will report such deficiencies to the Monitoring and Action Board for consideration as set forth in paragraph 7.c of Attachment B to the EBMUD and DW Protest Dismissal Agreement.

H. Data Availability

Delta Wetlands will make the following groundwater data publicly available on the internet or similarly accessible means as soon as readily available:

- Daily mean of groundwater level in each seepage and background monitoring well, reference envelope, and any Project adjustments based on background monitoring wells.
- Average normalized groundwater level for all background monitoring wells, presented as a percentage of their reference envelopes.
- Daily mean of pool elevations for both reservoirs.
- Daily mean of water level in slough/river.

Delta Wetlands will also maintain a historical database of the above information.

IV. ACTIONS BY DELTA WETLANDS

Delta Wetlands shall take actions to control seepage. These actions may include the following, and are intended to be taken before seepage reaches the Diversion Suspension Limits.

1. Increase pumping rates in interceptor wells.

2. Lower outfall head at relief wells.

3. Redevelop interceptor wells to improve specific capacity of the wells.

4. Redevelop relief wells to improve specific capacity.

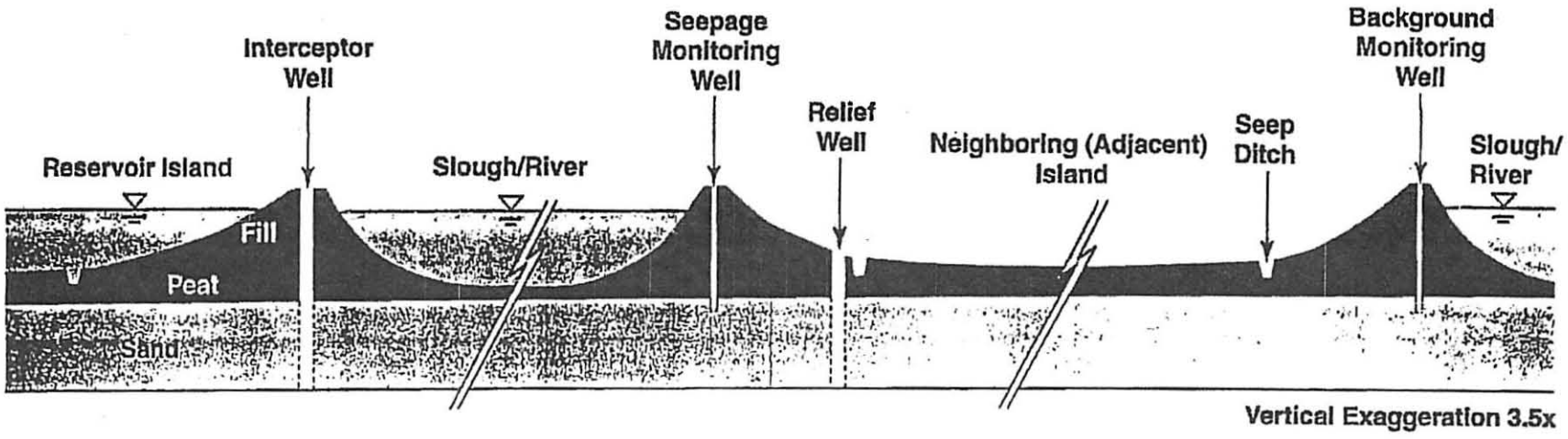
5. Install additional interceptor wells.

6. Install additional relief wells.

7. Implement other mitigation that may be mutually agreeable between Delta Wetlands, the affected adjacent landowners and the neighboring island reclamation district.

8. Stop diversion.

If the Diversion Suspension Limits are reached, DW shall immediately suspend additional water diversion into the reservoir island. Diversions may not renew until groundwater levels are brought below the Diversion Suspension Limits. If DW cannot lower the groundwater to below Diversion Suspension Limits within one week, the reservoir pool elevation shall be lowered at a rate of at least 0.5 feet per day until groundwater levels fall below Diversion Suspension Limits.



Groundwater Monitoring Wells

Seepage Monitoring Wells - Placed at the perimeter of an adjacent island, seepage monitoring wells will detect increased groundwater elevation if increased seepage occurs from slough or reservoir island.

Background Monitoring Wells - Placed far from reservoir islands, often on the far opposite perimeter of an adjacent island. Background monitoring wells will be used as a group to record Delta-wide variations in groundwater levels.

Groundwater Extraction Wells Note: All extraction wells, whether interceptor wells or relief wells, will have slotted screens extending through the full depth of the underlying aquifer.

Interceptor Wells - Pumped wells placed on the perimeter of a resevoir island. The pumping rate will be controlled to essentially capture all water tending to seep from beneath the reservoir perimeter.

Relief Wells - Placed at toe of adjacent island levee. Elevations of the tops of wells will be set such that the wells flow as artesian wells as groundwater surface rises. Where groundwater is not artesian, low head pumps may be used.

Figure C-1
Idealized Cross Section of Well Locations

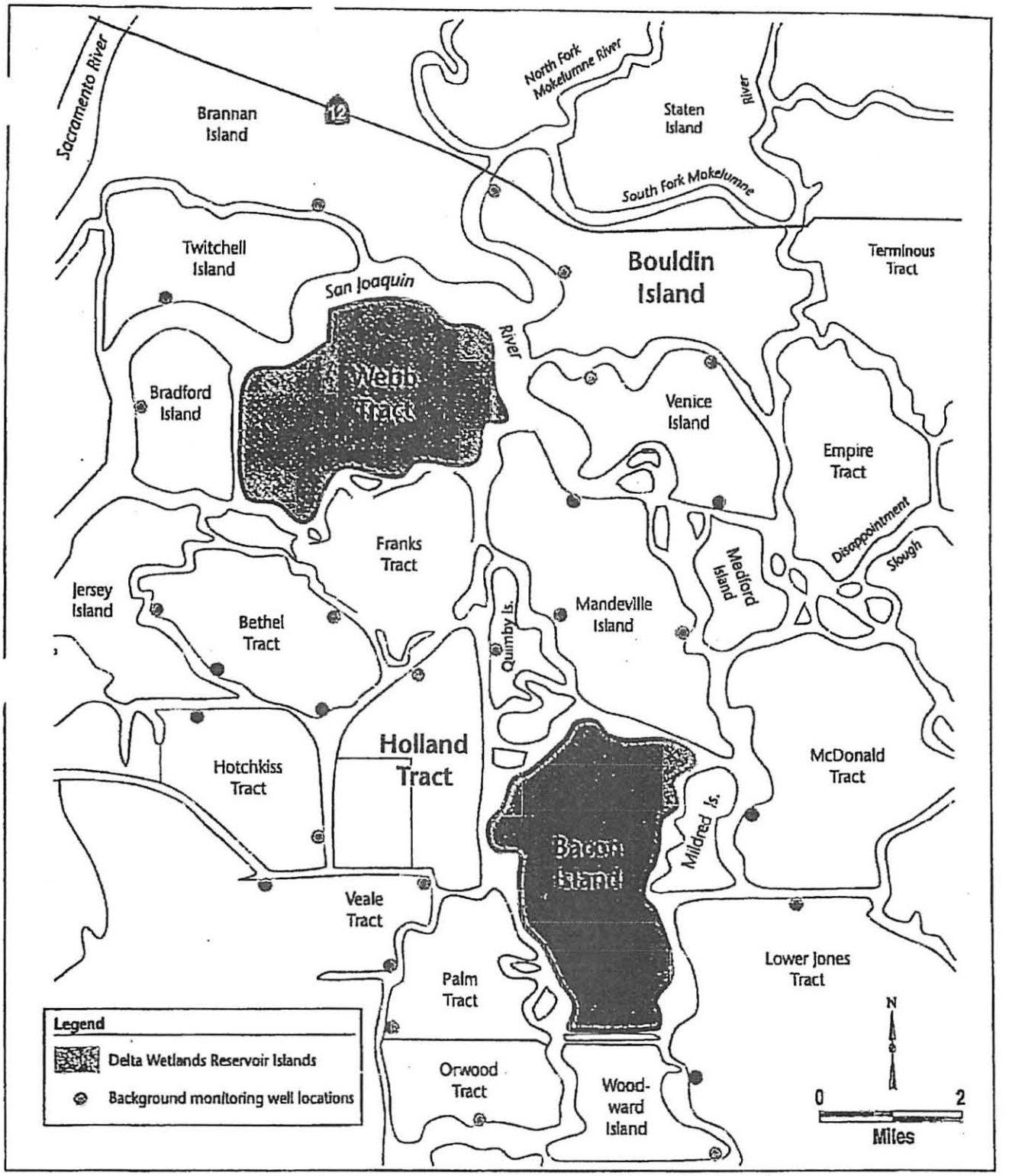


Figure C-2
Approximate Locations of Background Monitoring Wells

Exhibit DW-103

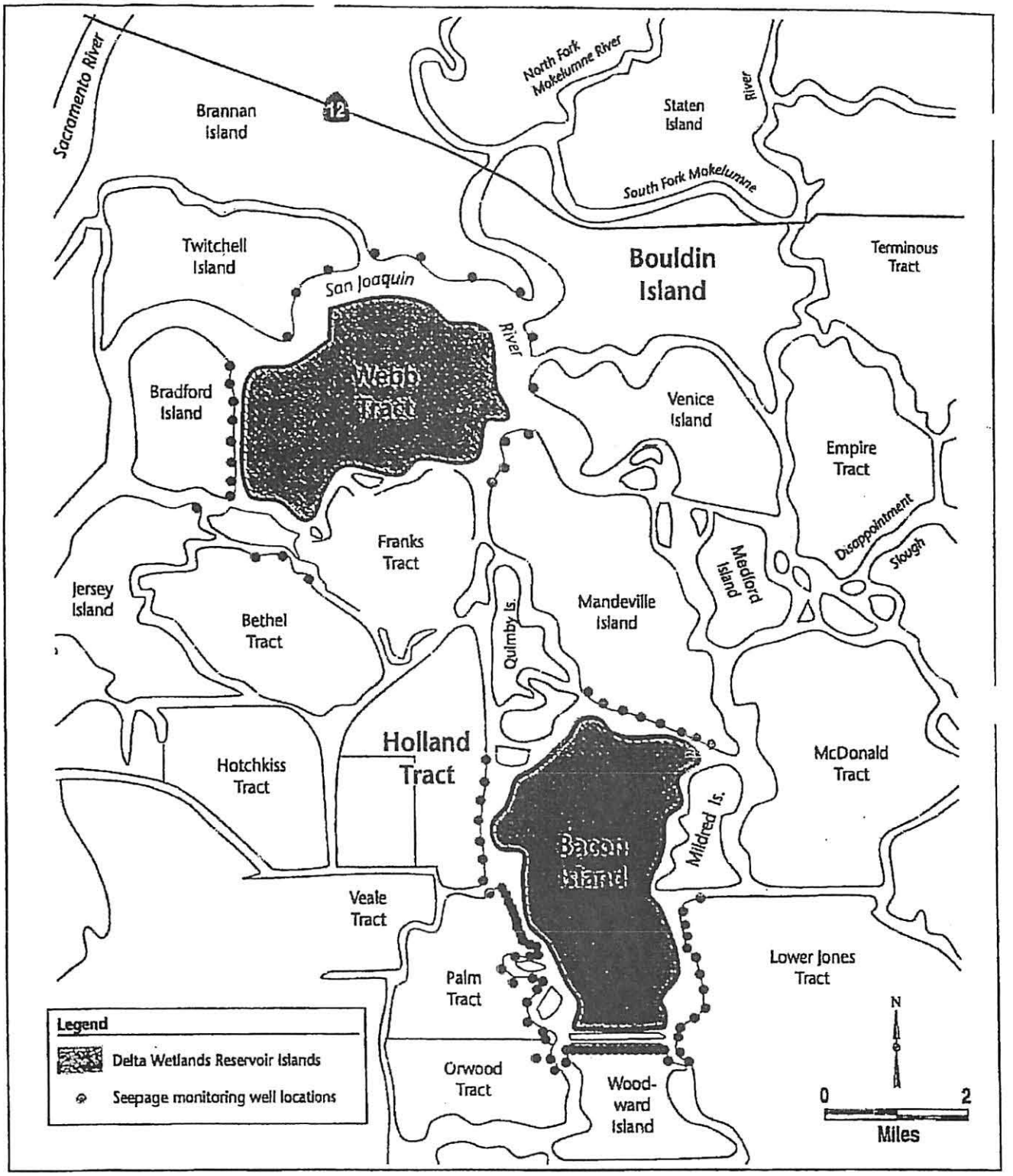


Figure C-3
Seepage Monitoring Well Locations

Exhibit DW-103

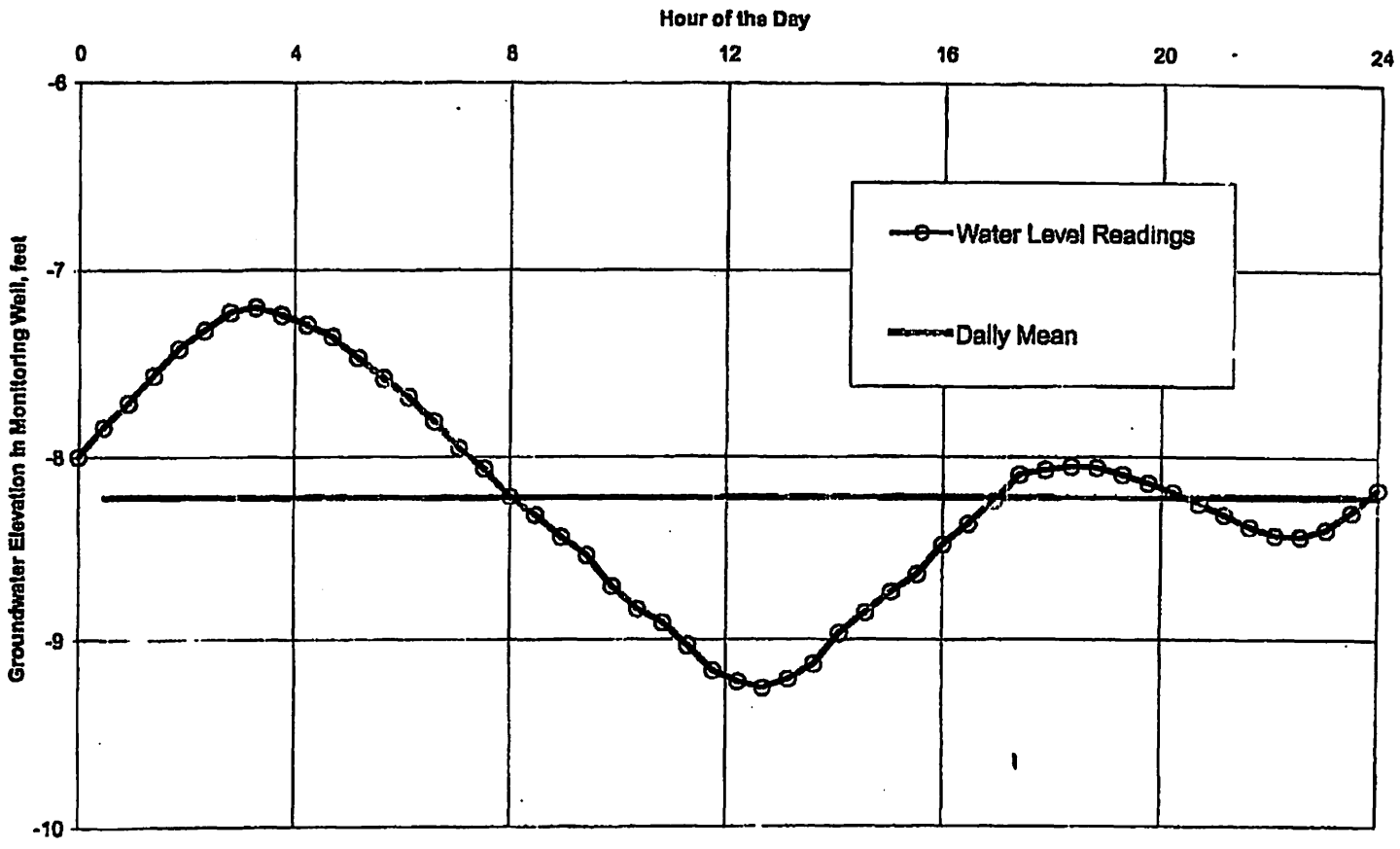
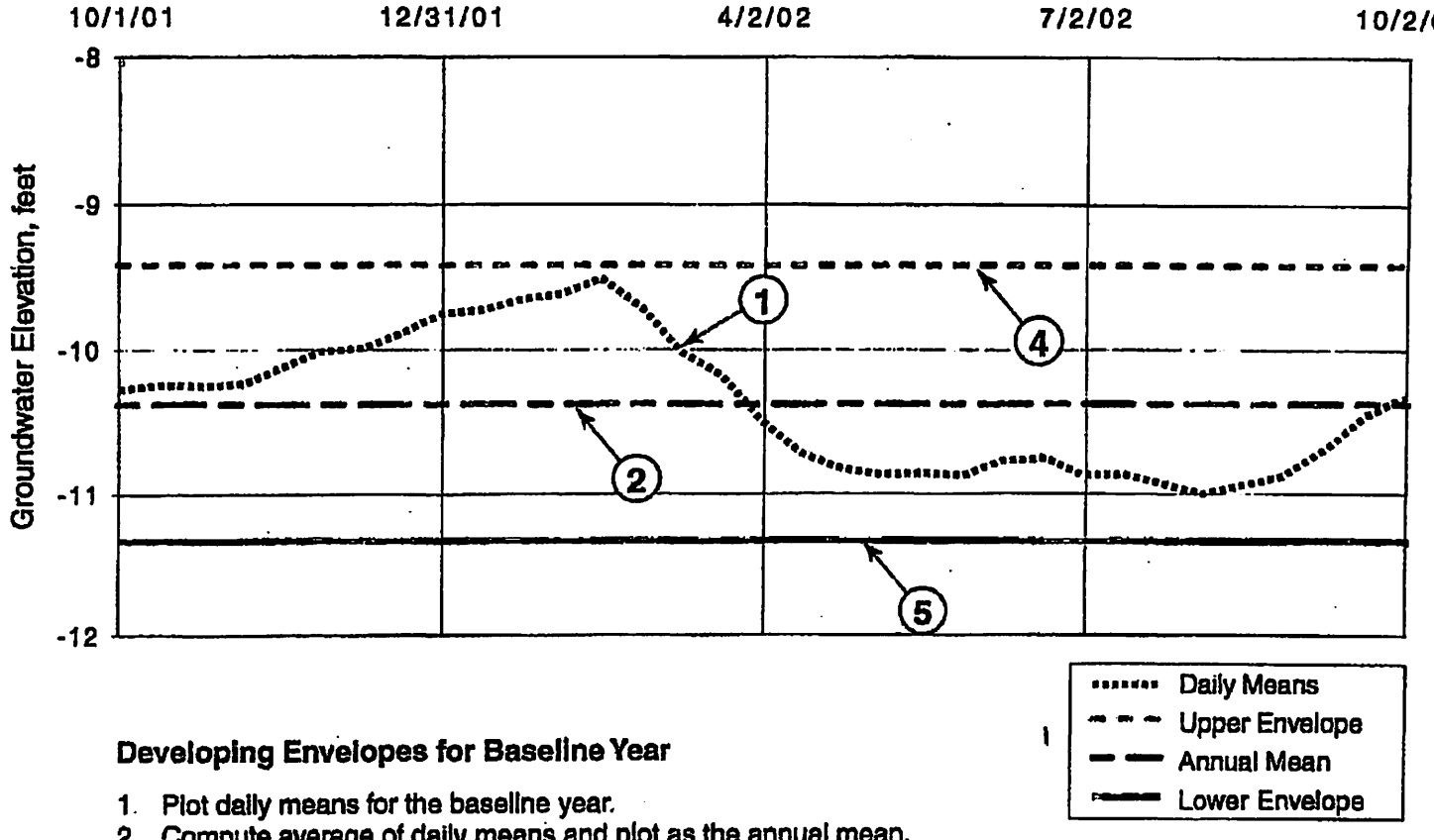


Figure C-4
Daily Mean

Exhibit DW-103



Developing Envelopes for Baseline Year

1. Plot daily means for the baseline year.
2. Compute average of daily means and plot as the annual mean.
3. Compute standard deviations of daily means around annual mean.
4. Compute and plot upper envelope as annual mean plus two standard deviations.
5. Compute and plot lower envelope as annual mean minus two standard deviations.

Figure C-5
Reference Envelope for Baseline Year

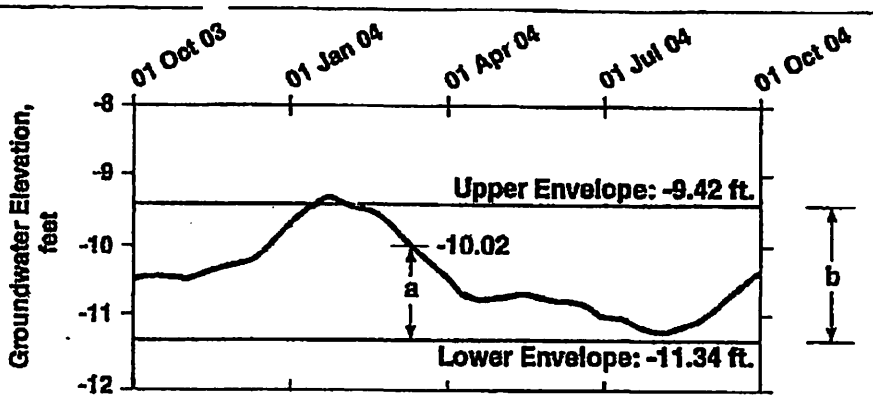


Figure C-6a. Background Monitoring Well Data for a Single Well

To normalize background monitoring well data to its unique envelope, subtract the lower envelope elevation from the daily mean and divide the remainder by the height of the envelope:

a/b = [(-10.02) - (-11.34)] / [(-9.42) - (-11.34)] = 65%

Figure C-6b. Computation for Normalizing Background Monitoring Well Data

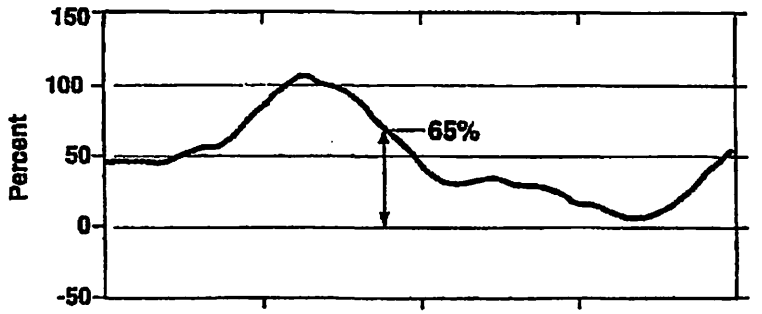


Figure C-6c. Plot of Normalized Background Monitoring Well Data for a Single Well

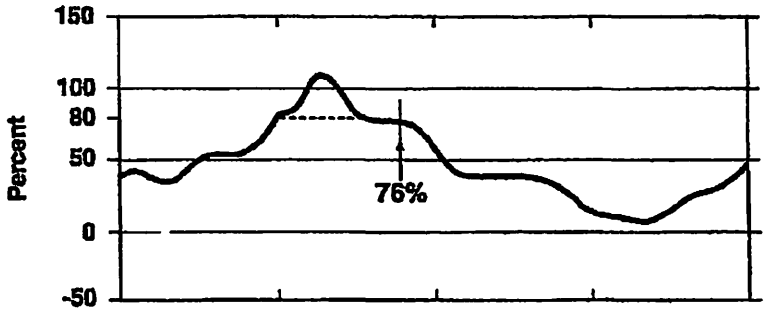


Figure C-6d. Average of Normalized Data for All Background Monitoring Wells

Figure C-6
Normalizing and Averaging Background Well Data

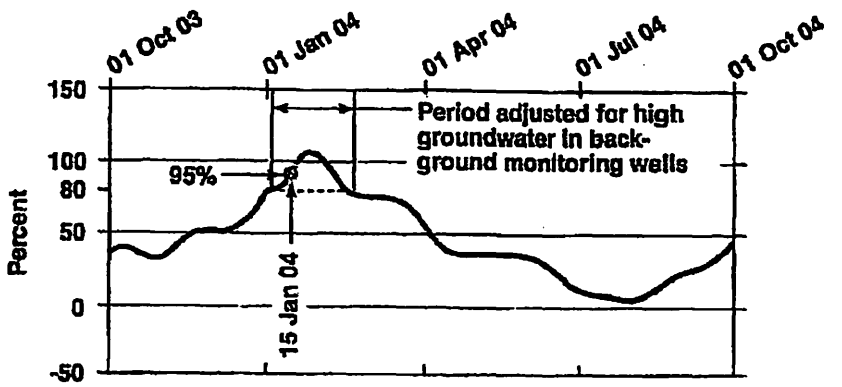


Figure C-7a. Average Normalized Data for All Background Monitoring Wells

On January 15, 2004, the average normalized data from the background monitoring well is 95%. At Seepage Monitoring Well A, the groundwater is at elevation -13.59 feet. To adjust Seepage Monitoring Well A's upper envelope for high groundwater conditions in the background monitoring wells:

1) Subtract 80% from the average for the background conditions:
   95% - 80% = 15%

2) Multiply the height of Seepage Monitoring Well A's envelope by the above percentage remainder:
   [(-13.84) - (-14.86)] x 15% = 0.17 ft.

3) Add the above product to the upper envelope:
   -13.84 + 0.17 = 13.67 ft.

4) The above value is the adjusted upperbound envelope for this particular well on the particular day.

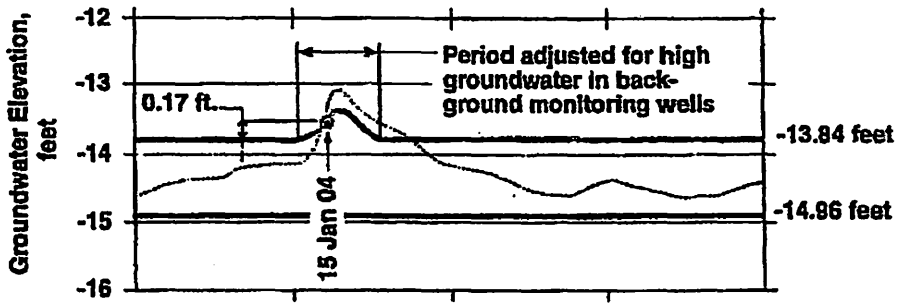
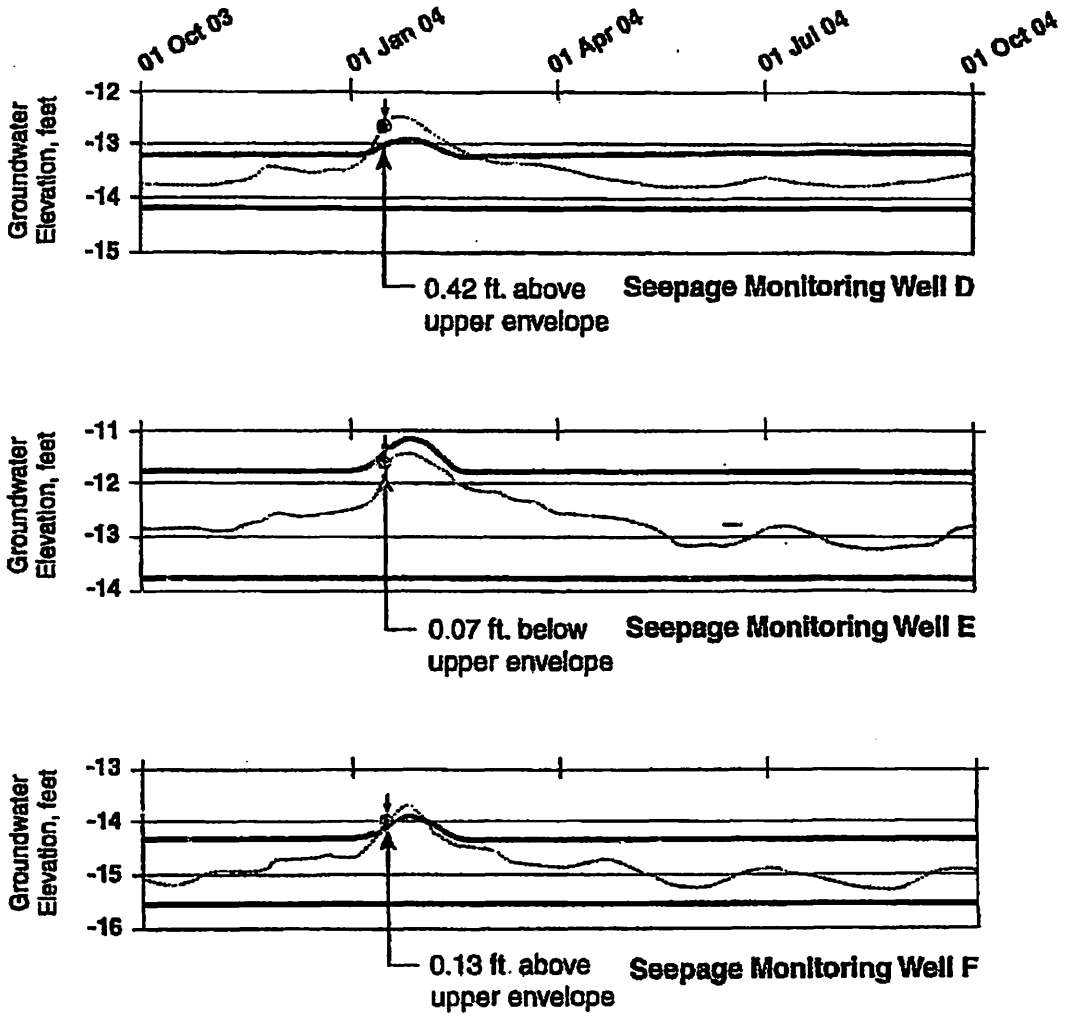


Figure C-7b. Upper Envelope of Seepage Monitoring Well A Corrected for High Groundwater in Background Monitoring Wells

Figure C-7
Correcting Upper Envelope for High Groundwater



Well No.	Groundwater Height Above Upper Envelope
D	0.42
E	-0.07
F	0.13
	0.48 ft ÷ 3 wells = 0.16 ft.

On January 15, 2004, the average groundwater height above upper envelopes for 3 wells is 0.16 ft. If the average is less than 0.25 feet above the upper envelope, the average groundwater level for these three wells is below the diversion suspension limit.

Figure C-8
Groundwater Evaluation Using Three Seepage Monitoring Wells

Exhibit DW-103

Exhibit B

Arbitrator List

Arbitrators Qualified to Arbitrate Disputes Under the Protest Dismissal and Settlement Agreement between Delta Wetlands Properties and Central Delta Water Agency, et al.

The following neutral arbitrators with JAMS, 2520 Venture Oaks Way, Suite 400, Sacramento, CA 95833, (916) 921-5300, are qualified to arbitrate any dispute involving this Agreement between the Parties in accordance with Section 6 of the Agreement. This list of arbitrators may be amended in writing by CDWA and Delta Wetlands.

Agliano (Ret.) - Hon. Nat A.
Agretelis (Ret.) - Hon. Demetrios P.
Ambler (Ret.) - Hon. Read
Baines (Ret.) - Hon. Robert A.
Bates, Jr., Esq. - John B.
Bennett (Ret.) - Hon. Richard
Bettinelli (Ret.) - Hon. William L.
Biafore, Jr. (Ret.) - Hon. Joseph F.
Bond (Ret.) - Hon. Cecily
Brainerd, Esq. - Alexander "Lex"
Brazil (Ret.) - Hon. Wayne D.
Cahill (Ret.) - Hon. William J.
Chernick, Esq. - Richard
Claiborne, Esq. - Zela "Zee" G.
Davis, Esq. - Gary S.
DeBene, Esq. - Linda
Edwards, Esq. - Bruce A.
Falk, Jr., Esq. - Jerome B.
Flaherty (Ret.) - Hon. John A.
Folberg, Esq. - Jay
Gack, Esq. - Kenneth D.
Gallagher (Ret.) - Hon. Catherine A.
Garcia (Ret.) - Hon. David A.
Gibbs, Esq. - Kenneth C.
Hagen (Ret.) - Hon. David Warner
Haning III (Ret.) - Hon. Zerne P.
Hanlon (Ret.) - Hon. Daniel "Mike"
Herlihy (Ret.) - Hon. John F.
Hunter (Ret.) - Hon. David E.
Jacobs-May (Ret.) - Hon. Jamie
James (Ret.) - Hon. Ellen Sickles
Kawaichi (Ret.) - Hon. Ken M.
Komar (Ret.) - Hon. Jack
Kurland, Esq. - Gerald A.
Larson (Ret.) - Hon. James
Legge (Ret.) - Hon. Charles A.
Levy, Esq. - Lester J.
Loeb, Esq. - Michael J.
Low (Ret.) - Hon. Harry W.
Luft, Esq. - Robert S.
Lynch (Ret.) - Hon. Eugene F.
Mahoney (Ret.) - Hon. Patrick J.
Marlo (Ret.) - Hon. John A.
McAdams (Ret.) - Hon. Richard J.
McDonald (Ret.) - Hon. V. Gene
Meredith, Esq. - Craig S.
Mills, Esq. - Lawrence R.
Morrison (Ret.) - Hon. Fred K.
Newsome (Ret.) - Hon. Randall J.
Ornstil - Michael G.
Panelli (Ret.) - Hon. Edward A.
Person, Esq. - Donald R.
Polsky, Esq. - Alexander S.
Quinn - Martin
Ranahan, Esq. - Michael D.
Rushing (Ret.) - Hon. Elaine
Sabraw (Ret.) - Hon. Ronald M.
Sawyer (Ret.) - Hon. Laurence K.
Sheppard (Ret.) - Hon. Harry R.
Silver (Ret.) - Hon. Richard M.
Smith (Ret.) - Hon. Fern M.
Snowden (Ret.) - Hon. W. Scott
Stevens, Esq. - Charles J.
Stone (Ret.) - Hon. Peter G.
Strankman (Ret.) - Hon. Gary E.
Ware (Ret.) - Hon. James
Warren (Ret.) - Hon. James L.
Westerfield (Ret.) - Hon. Rebecca
Yanni, Esq. - Catherine A.

Exhibit C

Indenture of Trust

INDENTURE OF TRUST

This Indenture of Trust ("Indenture"), made and entered as of _____, 2013 is by and between the parties to the Protest Dismissal and Settlement Agreement dated _____, 2013 ("Settlement"), pertaining to the Delta Wetlands Project and Wells Fargo Bank, National Association, a banking association organized and existing under the laws of the United States of America with a principal corporate trust office in San Francisco, California and being qualified to accept and administer the trust created hereby ("Trustee").

Witnesseth

WHEREAS, the Protest Dismissal and Settlement Agreement dated _____, 2013 ("Settlement") a copy of which is attached hereto was entered to resolve issues pertaining to the Delta Wetlands Project; and

WHEREAS, there are two groups of parties to said agreement, the Delta Wetlands related parties consisting of Delta Wetlands Properties, an Illinois General Partnership, and any successor entity that owns and/or operates the Delta Wetlands Project ("Delta Wetlands Parties") and the Central Delta Water Agency and related parties defined in the Settlement ("Central Delta Parties"); and

WHEREAS, the Settlement provides for specific Financial Assurances, including a fund called the CDWA Security Fund, which is a continuously maintained combined amount of thirty-five million dollars ($35,000.000.00) consisting of cash in the minimum amount of ten million dollars ($10,000,000.00) and a "Letter of Credit" in the amount of twenty-five million dollars ($25,000,000.00); and

WHEREAS, Sections 8.2 and 8.4 the Settlement provide that the Delta Wetlands Parties can, upon 30 days prior written notice from Delta Wetlands Parties to the Central Delta Parties, substitute cash for all or a portion of the Letter of Credit without the consent of the parties or the Trustee;

WHEREAS, Sections 8.3 and 8.7 of the Settlement provide that the Delta Wetlands Parties shall within fifteen days after any disbursement reducing the CDWA Security Fund below $35.000,000.00 restore the CDWA Security Fund to the required $35,000,000.00 amount and shall continuously maintain said fund at that level until termination or abandonment of the Project in compliance with Section 8.8 of the Settlement; and

WHEREAS, the Settlement provides that the Delta Wetlands Parties shall maintain a Letter of Credit in accordance with Section 8.5 of the Settlement if the Delta Wetlands Parties have not elected to substitute cash for the Letter of Credit; and

WHEREAS, the Settlement provides for the appointment of a Trustee to hold the cash and Letter of Credit comprising the CDWA Security Fund and to manage and disburse the same as set forth herein.

NOW THEREFORE, in consideration of the promises and of the mutual covenants herein contained, the Delta Wetlands Parties, Central Delta Parties and Trustee agree as follows:

1. **Management of CDWA Security Fund.** Trustee shall hold, invest and disburse the cash and hold, draw upon and disburse the "Letter of Credit" portion of the CDWA Security Fund in accordance with the provisions herein.

(a) Trustee shall immediately draw from the CDWA Security Fund and shall disburse the funds upon presentation of a "Qualified Draw Request" and in the amount specified in the "Qualified Draw Request". "Qualified Draw Request" means (i) a notarized written instrument signed by the authorized representatives of both the Central Delta Parties and the Delta Wetlands Parties, or (ii) a certified final order of the Arbitrator authorizing a draw on the CDWA Security Fund pursuant to the CDWA Dispute Resolution Procedure described in the Settlement, or (iii) a certified interim or final order of the Emergency Arbitrator as provided under paragraph 6.15 of the Settlement. The request shall specify the amount of the draw to be made on the CDWA Security Fund, and specify the person or entity to whom the draw is to be payable. All draws on the CDWA Security Fund shall be paid. at Delta Wetlands Parties election, from the cash portion thereof or from any Letter of Credit that is part of the security fund, or from any combination of the cash portion and Letter of Credit. Said election shall be made in writing in advance of, or simultaneously with, the submittal of any Qualified Draw Request, and if not so made the draw shall be first made from the cash and then from the Letter of Credit. Trustee shall upon receipt of a Qualified Draw Request in excess of the cash on hand forthwith submit the request for payment certification and a copy of the Letter of Credit as per the terms of the attached Letter of Credit. The certified orders of the Arbitrator or Emergency Arbitrator shall state under penalty of perjury that the Arbitrator is acting pursuant to the Settlement. The Trustee shall act upon such certified order without further inquiry or determination of any part of the arbitration proceeding.

(b) Trustee shall draw the full amount of the existing Letter of Credit and deposit the proceeds into the trust account defined in Section 1(c) below in event that the Delta Wetlands Parties have not provided a substitute Letter of Credit complying with all of the requirements of Section 8.5 of the Settlement within either (1) 55 days from notice that the Letter of Credit provider ceases to meet the standards specified in Section 8.5 of the Settlement or (2) 55 days from notice that the Letter of Credit provider will not renew the Letter of Credit at the end of its term Trustee shall return the proceeds to Delta Wetlands Parties when a substitute Letter of Credit is established or if the Delta Wetlands Parties elect to substitute cash for the Letter of Credit.

(c) The cash portion of the CDWA Security Fund shall be deposited in an interest bearing trust account (the "CDWA Trust") maintained with a financial institution licensed to do business in the State of California, and approved by Central Delta Parties, which will act as instructed by the Trustee, who shall have full authority to disburse from the trust account and draw on the Letter of Credit in accordance with this Agreement. The cash deposited in the CDWA Trust shall be held in a manner which will provide FDIC insurance for the entire amount. The earnings thereon shall be distributed on July 1st and January 1st of each year to

Delta Wetlands Parties during any period when the fund is in excess of its minimum required amount and after paying trustee and administrative fees and charges. The Trustee may disburse from the CDWA Trust to itself to pay the administration fees and charges as provided herein.

(d) Upon termination or abandonment of all water right permits for Project water diversion and storage on the Reservoir Islands, restoration of all Reservoir and Habitat Islands to farmland or habitat as per the Reclamation Plan and resolution of all remaining claims against the CDWA Security Fund, the Letter of Credit may be terminated and the amount of the remaining cash in the CDWA Trust shall be paid to Delta Wetlands Parties. The Letter of Credit shall be Terminated and the Trustee shall return the remaining cash portion of the CDWA Security Fund within ten (10) calendar days of submission of a written instrument signed by an authorized representative of the Delta Wetlands Parties and an authorized representative of the Central Delta Parties verifying that all water right permits for water diversion and storage on the Reservoir Islands have been abandoned or terminated, that the Reservoir and Habitat Islands have been restored in accordance with the Reclamation Plan and all remaining claims brought against Delta Wetlands Parties and awarded to the claimants in accordance with the CDWA Dispute Resolution Procedure have been paid from the CDWA Security Fund.

(e) The Central Delta Parties and Delta Wetlands Parties may modify the terms of the Settlement, including terms for the Security Fund and Letter of Credit, without consent of trustee. The Central Delta Parties and Delta Wetlands Parties shall notify Trustee of any material changes to the Settlement affecting this Indenture of Trust.

2. **Appointment of Trustee.** Wells Fargo Bank, National Association, in San Francisco, a national banking association organized and existing under and by virtue of the laws of the United States of America, is hereby appointed Trustee by the parties for the purpose of receiving all moneys required to be deposited with the Trustee hereunder and to allocate, use and apply the same as provided in this Indenture. The Delta Wetlands Parties and Central Delta Parties agree that any successor Trustee appointed hereunder shall be: (a) authorized by law to perform all the duties imposed upon it by this Indenture, (b) shall have (or, in the case of a bank or trust company which is part of a bank holding company system, the related bank holding company shall have) a combined capital and surplus of at least Fifty Million Dollars ($50,000,000), and (c) be subject to supervision or examination by Federal or State authority, so long as any cash or Letters of Credit for the CDWA Security Fund are outstanding. If such bank or trust company publishes a report of condition at least annually pursuant to law or to the requirements of any supervising or examining authority above referred to, then for the purpose of this Section the combined capital and surplus of such bank or trust company shall be deemed to be its combined capital and surplus as set forth in its most recent report of condition so published.

The Trustee shall keep accurate records of all funds administered by it and of all disbursements. The Trustee shall provide an accounting to the parties quarterly.

3. **Acceptance of Trusts.** The Trustee hereby accepts the trusts imposed upon it by this Indenture, and agrees to perform said trusts, but only upon and subject to the following express terms and conditions:

(a) The Trustee undertakes to perform such duties and only such duties as are specifically set forth in this Indenture and no implied covenants shall be read into this Indenture against the Trustee. The Trustee may exercise such of the rights and powers vested in it by this Indenture, and shall use the same degree of care and skill and diligence in their exercise, as is consistent with the fiduciary responsibilities of a trustee.

(b) The Trustee may execute any of the trusts or powers hereof and perform the duties required of it hereunder by or through attorneys, accountants, agents, or receivers, and shall not be liable for the acts or omissions of such attorneys, agents, accountants, and receivers appointed with due care, and shall be entitled to advice of counsel concerning all matters of trust and its duty hereunder. The Trustee may conclusively rely on an opinion of counsel, as full and complete protection for any action taken or suffered by it hereunder.

(c) The Trustee shall not be responsible for any recital herein, or in the Settlement, or for any of the supplements thereto or instruments of further assurance, or for the sufficiency of the CDWA Security Fund and the Trustee shall not ascertain or inquire as to the observance or performance of any covenants, conditions or agreements on the part of the Delta Wetlands Parties or Central Delta Parties hereunder or under the Settlement.

(d) The Trustee shall be protected in acting, in good faith and without negligence, upon any notice, request, consent, certificate, order, affidavit, letter, telegram or other paper or document believed by it to be genuine and correct and to have been signed or sent by the proper person or persons. The Trustee shall not be bound to recognize any person as a representative of the parties hereto unless such representation is supported by a writing from Delta Wetland Properties in the case of the Delta Wetland Parties, and in the case of the Central Delta Parties, a writing from the Central Delta Water Agency.

(e) As to the existence or non-existence of any fact or as to the sufficiency or validity of any instrument, paper or proceeding, the Trustee shall be entitled to rely upon a Certificate of any arbitrator under the Settlement as sufficient evidence of the facts therein contained.

(f) The permissive right of the Trustee to do things enumerated in this Indenture shall not be construed as a duty and it shall not be answerable for other than its negligence or willful misconduct. The immunities and exceptions from liability of the Trustee shall extend to its officers, directors, employees and agents.

(g) The Trustee shall not be required to take notice or be deemed to have notice of any breach of the Settlement. Notices or other instruments required by this Indenture to be delivered to the Trustee must, in order to be effective, be delivered at the Trust Office, and in the absence of such notice so delivered the Trustee may conclusively assume there is no requirement for disbursement from the CDWA Security Fund.

(h) The Trustee shall not be required to give any bond or surety in respect of the execution of the said trusts and powers or otherwise in respect of the premises hereof.

(i) All moneys received by the Trustee shall, until used or applied as herein provided, be held in trust for the purposes for which they were received and maintained as a separate account.

(j) Whether or not therein expressly so provided, every provision of this Indenture and the Settlement relating to the conduct or affecting the liability of the Trustee shall be subject to the provisions of this Section.

(k) Trustee hereby waives all rights set forth in California Probate Code Section 17200.

4. **Fees, Charges and Expenses of Trustee.** The Trustee shall be entitled to payment and reimbursement for reasonable fees for its services rendered hereunder and all advances, counsel fees (including expenses) and other expenses reasonably and necessarily made or incurred by the Trustee in connection with such services.

5. **Removal of Trustee.** Delta Wetlands Parties and Central Delta Parties, together, may at any time remove the Trustee initially appointed, and any successor thereto, by an instrument or concurrent instruments in writing delivered to the Trustee, whereupon such parties shall appoint a successor or successors thereto; provided that any such successor shall be a bank or trust company meeting the requirements set forth in Section 8 above.

6. **Resignation by Trustee.** The Trustee and any successor Trustee may at any time give thirty (30) days' written notice of its intention to resign as Trustee hereunder, such notice to be given to Delta Wetlands Parties and Central Delta Parties by registered or certified mail. Upon receiving such notice of resignation, the parties shall promptly appoint a successor Trustee. Any resignation or removal of the Trustee and appointment of a successor Trustee shall become effective upon acceptance of appointment by the successor Trustee.

7. **Appointment of Successor Trustee.** In the event the parties shall for any reason whatsoever fail to appoint a successor Trustee within ninety (90) days following the delivery to the Trustee of the instrument described in Section 5or within ninety (90) days following the receipt of notice by the parties pursuant to Section 6, the Trustee may, at the expense of the CDWA Security Fund, apply to a court of competent jurisdiction for the appointment of a successor Trustee meeting the requirements herein. Any such successor Trustee appointed by such court shall become the successor Trustee hereunder until a successor Trustee is appointed by the parties.

8. **Merger or Consolidation.** Any company into which the Trustee may be merged or converted or with which it may be consolidated or any company resulting from any merger, conversion or consolidation to which it shall be a party or any company to which the Trustee may sell or transfer all or substantially all of it corporate trust business, provided that such company shall meet the requirements set forth in Section 2, shall be the successor to the Trustee and vested with all of the title to the trust estate and all of the trusts, powers, discretions, immunities, privileges and all other matters as was its predecessor, without the execution or filing of any paper or further act, anything herein to the contrary notwithstanding.

9. **Concerning any Successor Trustee.** Every successor Trustee appointed hereunder shall execute, acknowledge and deliver to its predecessor and also to the parties an instrument in writing accepting such appointment hereunder and thereupon such successor, without any further act, deed or conveyance, shall become fully vested with all the estates, properties, rights, powers, trusts, duties and obligations of its predecessors; but such predecessor shall, nevertheless, on the Request of the Parties, or of the Trustee's successor, execute and deliver an instrument transferring to such successor all the estates, properties, rights, powers and trusts of such predecessor hereunder; and every predecessor Trustee shall deliver all Letters of Credit and moneys held by it as the Trustee hereunder to its successor. Should any instrument in writing from the parties be required by any successor Trustee for more fully and certainly vesting in such successor the estate, rights, powers and duties hereby vested or intended to be vested in the predecessor Trustee, any and all such instruments in writing shall, on request, be executed, acknowledged and delivered by the parties.

10. **Appointment of Co-Trustee.** It is the purpose of this Indenture that there shall be no violation of any law of any jurisdiction (including particularly the law of the State) denying or restricting the right of banking corporations or associations to transact business as Trustee in such jurisdiction. It is recognized that in the case of litigation under this Indenture, and in particular in case of the enforcement of the rights of the Trustee as to collection of funds or any Letter of Credit the Trustee deems that by reason of any present or future law of any jurisdiction it may not exercise any of the powers, rights or remedies herein granted to the Trustee or hold title to the properties, in trust, as herein granted, or take any other action which may be desirable or necessary in connection therewith, it may be necessary that the Trustee appoint an additional individual or institution as a separate co-trustee. The following provisions of this Section are adopted to these ends.

In the event that the Trustee appoints an additional individual or institution as a separate or co-trustee, each and every remedy, power, right, claim, demand, cause of action, immunity, estate, title, interest and lien expressed or intended by this Indenture to be exercised by or vested in or conveyed to the Trustee with respect thereto, shall be exercisable by and vest in such separate or co-trustee but only to the extent necessary to enable such separate or co-trustee to exercise such powers, rights and remedies, and every covenant and obligation necessary to the exercise thereof by such separate or co-trustee shall run to and be enforceable by either of them.

Should any instrument in writing from the parties be required by the separate trustee or co-trustee so appointed by the Trustee for more fully and certainly vesting in and confirming to it such properties, rights, powers, trusts, duties and obligations, any and all such instruments in writing shall, on request, be executed, acknowledged and delivered by the parties. In case any separate trustee or co-trustee, or a successor to either, shall become incapable of acting, resign or be removed, all the estates, properties, rights, powers, trusts, duties and obligations of such separate trustee or co-trustee, so far as permitted by law, shall vest in and be exercised by the Trustee until the appointment of a new trustee or successor to such separate trustee or co-trustee.

17. **Indemnification; Limited Liability of Trustee.** The parties further covenant and agree to indemnify and save the Trustee and its officers, directors, agents and employees, harmless against any loss, expense and liabilities which it may incur arising out of or in the exercise and

performance of its powers and duties hereunder, including the costs and, expenses of defending against any claim of liability, but excluding any and all losses, expenses and liabilities which are due to the negligence or willful misconduct of the Trustee, its officers, directors, agents or employees. No provision in this Indenture shall require the Trustee to risk or expend its own funds or otherwise incur any financial liability hereunder if it shall have reasonable grounds for believing repayment of such funds or adequate indemnity against such liability or risk is not assured to it. The obligations of the parties under this paragraph shall survive the resignation or removal of the Trustee under this Indenture.

18. **Trustee Compensation**. Trustee shall be entitled to compensation and reimbursement as per Exhibit A attached hereto which the parties and Trustee may modify from time to time.

19. **Amendment of Indenture.** This Indenture may be modified by written agreement executed by the Trustee, and the designated agent of both the Delta Wetlands Parties and the Central Delta Parties.

20. **Duty of Trustee to Perform.** In the event Trustee fails or refuses to act in the manner herein set forth, the parties hereto shall have the right to compel such performance and to seek all remedies at law or equity.

21. **Time is of the Essence.** Time is of the essence in the execution by the Trustee in making disbursements pursuant to this indenture.

22. **Effective Date.** This indenture shall be effective as of the date of the deposit with Trustee of the $10,000,000.00 cash by the Delta Wetlands Parties and/or the delivery to the Trustee of the Letter or Letters of Credit for the balance of the CDWA Security Fund.

Wells Fargo Bank, National Association,
as Trustee

by _____

Delta Wetlands Parties

by _____

Central Delta Parties

by _____

Exhibit D

Form of Letter of Credit

_____ BANK
IRREVOCABLE LETTER OF CREDIT

Letter of Credit Number:	_____
Date:	_____, 2013
Amount:	Twenty-Five Million Dollars ($25,000,000)
Expiration Date:	_____, 2014 (5:00 p.m. Pacific time), subject to renewal as provided below
Issuer:	_____ Bank _____ _____ _____
For Account of:	[Delta Wetlands Properties, an Illinois general partnership; or its successor] _____ _____ _____
To Beneficiary:	[insert name of Trustee under Section 8.4 of the Protest Dismissal and Settlement Agreement] _____ _____ _____
For Notification:	_____ _____ _____ _____ _____

Ladies and Gentlemen:

We hereby irrevocably authorize [insert name of Trustee under Section 8.4 of the Protest Dismissal and Settlement Agreement] or its successors or assigns (collectively, "Trustee") to draw on us up to an aggregate amount of US $25,000,000 available by the Trustee's draft at sight. Partial drawings are permitted.

Documents required for payment:

1. A written request for payment under this Letter of Credit purporting to be signed by an officer or other authorized person on behalf of Trustee; the request shall include the statement:

> "The undersigned hereby certifies that it is the duly appointed and acting Trustee under Section 8.4 of the Project Dismissal and Settlement Agreement, dated as of _____, 2013, between Delta Wetlands Properties, an Illinois general partnership ("Delta Wetlands"), Central Delta Water Agency and certain others (the "Settlement Agreement"). The undersigned is authorized to make this request. The amount requested is $_____. and

2. The original or a copy of this Letter of Credit.

All payments by us will be in immediately available funds. The Beneficiary may designate, by any writing accompanying a demand for payment or otherwise delivered to us prior to the actual payment of a drawing under this Letter of Credit, that any drawing shall be honored by wire transfer to a custodian designated by the Beneficiary, and we agree to abide by any such instructions.

Any draft must be presented to our place of business set forth above for payment at any time no later than the Expiration Date and time set forth above, provided, the Expiration Date shall be automatically extended, without amendments, for successive one-year periods from the Expiration Date unless, at least ninety (90) days prior to the then applicable Expiration Date, the Beneficiary and those listed for notification receive notification in writing from us (which notification shall be sent by registered mail or overnight delivery to the addresses set forth herein), that we do not elect to extend the Expiration Date for any such additional period. If the Expiration Date is not a date on which we are open for business, then the Expiration Date shall be the next day on which we are open for business.

This Letter of Credit shall be governed by and construed in accordance with the laws of the State of California without regard to its conflict of laws rules.

The exclusive jurisdiction for disputes arising out of or related to this Letter of Credit shall be in the state courts of the State of California. The Issuer in issuing this Letter of Credit and Beneficiary in accepting this Letter of Credit consent to such exclusive jurisdiction.

The Issuer agrees that legal process related to this Letter of Credit may be served on it in the State of California at the following address: _____

This Letter of Credit sets forth our undertaking and such undertaking shall not in any way be modified, amended, amplified or limited without the Beneficiary's written consent.

We hereby agree that all drafts under this Letter of Credit, in whole or in part, and in compliance with the terms and conditions of this credit, will be duly honored without delay or objection if drawn and presented for payment on or before the initial Expiration Date or any automatic extended date as set forth above.

In the event we elect not to renew this Letter of Credit prior to expiration according to its terms, and no notice has been provided to us that a replacement Letter of Credit of equal terms has been obtained and is in force within 35 days prior to expiration hereof, then, without the further act or consent of any person, we agree to, and shall, then pay the entire face amount of this Letter of Credit to the Trustee in the manner and method specified in instructions from the Trustee as if a conforming unconditional draw request for the full amount hereof had been received by us in a timely manner.

Very truly yours,

_____ Bank

By _____
Name: _____
Title: _____

Exhibit E

Covenant Not to Apply or Store Wastewater or Biosolids

RECORDING REQUESTED BY AND WHEN RECORDED, RETURN TO:	THIS SPACE RESERVED FOR RECORDER ONLY (Govt. Code § 27361.6)

RESTRICTIVE COVENANT

This Restrictive Covenant dated _____, 2013 ("Covenant"), is made by the undersigned property owner, Delta Wetlands Properties, an Illinois General Partnership ("Delta Wetlands"), as the grantor, with reference to the following:

WHEREAS, Delta Wetlands is proposing to develop a project (the "Project") on that involves water storage reservoirs for diversion and storage of water on and discharge of water from Bacon Island and Webb Tract and seasonal diversion and use of water on Bouldin Island and Holland Tract for farming and wildlife habitat;

WHEREAS, the Project "Reservoir Islands" will be constructed on Bacon Island and Webb Tract on the following parcels:
Bacon Island (San Joaquin County APNs _____);
Webb Tract (Contra Costa County APNs _____);

WHEREAS, the Project "Habitat Islands" will be constructed on Bouldin Island and Holland Tract on the following parcels:
Bouldin Island (San Joaquin County APNs _____);
Holland Tract (Contra Costa County APNs _____).

COVENANT

NOW, THEREFORE, based on the foregoing recitals, which are incorporated into the operative provisions of this Covenant, and pursuant to the laws of California, Delta Wetlands covenants as follows:

Delta Wetlands shall not apply and/or store wastewater (including reclaimed wastewater), sewage sludge (including treated sewage sludge sometimes called biosolids) and septage (treated or otherwise) on any Reservoir Island or Habitat Island. Said covenant shall run with the land, and will thereby burden the Reservoir Islands and Habitat Islands and benefit the other lands in the Delta.

The prohibition contained in the covenant shall only apply so long as the designated Reservoir Islands or Habitat Islands are planned for use or used for water storage or developed wetland purposes'

IN WITNESS WHEREOF, Delta Wetlands has executed this Covenant as of the day and year written above.

DELTA WETLANDS PROPERTIES
An Illinois general partnership

By KLMLP 2, LLC
A Delaware limited Liability Company,
Managing General Partner of Delta Wetlands Properties

By KLMLP, L.P.
A Delaware limited partnership,
Managing Member of KLMLP 2, LLC

By Zurich American Corporation (fka Kemper Corporation)
A Delaware corporation,
Managing General Partner of KLMLP, L.P.

By _____

Date: _____

EXHIBIT D

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY EDMUND G. BROWN JR., Governor

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

July 12, 2016

Reclamation District 2130
Dr. Terry Huffman
Huffman-Broadway Group, Inc.
828 Mission Avenue
San Rafael, California 94901

Dear Dr. Huffman:

The California Department of Water Resources (DWR) has received your conceptual design plans, submitted on behalf of Reclamation District 2130 (RD 2130), dated February 25, 2016, to support the implementation of the Mallard Farms Conservation Bank Project (MFCB) located within the Suisun Marsh. Specifically, the conceptual plans address two significant features: 1) breaching the Honker Bay levee and 2) constructing a Double Wall Impact Resistant Levee (DWIRL) with a double row of vinyl sheet piles with filling material on the Roaring River Distribution System (RRDS) embankment. DWR has performed a cursory review of the conceptual plans and has concerns that the MFCB proposal is not sufficiently substantiated in the following areas: 1) RD 2130's legal responsibility to maintain the Honker Bay levee; 2) technical concerns as to the implied impacts to the RRDS to perform as an exterior levee with proposed DWIRL constructed of vinyl sheet piles; and 3) economic concerns regarding credit values of the proposed project. DWR recognizes the potential opportunity to work with you to develop a multi-benefit project which could incorporate necessary flood control measures that protect the RRDS facility while enabling tidal marsh restoration. DWR continues to be willing to explore solutions to this project with you in the future.

RD 2130 Legal Responsibility Considerations:

The primary concern continues to be RD 2130's fundamental intent to breach the Honker Bay levee despite RD 2130's responsibility and obligations to operate and maintain the existing Honker Bay levee infrastructure as an exterior levee. This decision will have great lasting impacts to the RRDS as it is DWR's responsibility to operate and maintain the State Water Resources Development System (SWRDS) and its facilities, which includes this portion of the RRDS. It is DWR's statutory responsibility to maintain the safety, security, and integrity of the SWRDS at all times.

As part of the SWRDS, the RRDS is governed by Water Code section 12899, and the related regulations, Cal. Code Regs., Title 23 sections 600-635. Section 12899.6 and Regulation 625.6 prohibit unauthorized drainage of water, storage or distribution of water causing overflow that results in damage to the SWRDS. RD 2130 is responsible for maintaining the Honker Bay levees so that water does not reach the RRDS. If that were to occur, the RRDS embankment could be compromised and fail, resulting in flooding of numerous surrounding properties, including, but not limited to, the Grizzly Island Wildlife Area. Failure of the embankment would prevent DWR from fulfilling its flood control and water delivery obligations.

Technical Considerations:
Based upon a cursory review of the submitted conceptual plans of a DWIRL, and recognizing that the RRDS functions as an embankment, not a levee, the design as proposed does not support the RRDS to perform as an exterior levee. At minimum, DWR does not believe the proposed vinyl sheet piles are designed to be used under the proposed conditions. However, without submission of formal plans, including supportive engineering calculations, DWR is unable to make a formal determination whether the proposed DWIRL design is adequate to support tidal action against the RRDS.

In order to perform and provide a formal review, under Cal. Code Regs., Title 23, Section 610.1(b), (1) and (2), DWR requires that RD 2130 submit final plans with an original California registered professional engineer's stamp and signature before undertaking any work within DWR's right-of-way. DWR also requires submission of the engineering calculations, specifications, and detailed construction and work plans that support the final plans. This information will allow DWR to adequately determine if the improvements will be constructed to the standards required to protect the RRDS and be engineered to function in the manner proposed, thereby supporting impacts from full tidal action. As previously provided in DWR's July 15, 2014 comment letter to RD 2130, "for this location, those standards include an elevation of approximately 10.2 feet (NAVD88) with an appropriate width to allow legal vehicle access, and bank-stabilization." Furthermore, DWR's review will determine whether proposed improvements within DWR's right-of-way are in compliance with the Cal. Code Regs. Title 23, Sections 600-635. Any costs associated with long-term maintenance of the improvements should be addressed by the Project proponents in their formal proposal.

DWR recognizes that the Project proponents own the underlying fee interest. Therefore, California Water Code 12899.8 applies, requiring submittal of plans for DWR to review and comment upon before undertaking the work. Upon formal submission of stamped and signed plans, DWR will provide formal written comments. Cal. Code Regs., Title 23, Section 607.3 requires RD 2130 to comply with DWR's required changes to the project design before proceeding with the work within DWR's right-of-way. Please submit for DWR's review and comment RD 2130's formal design plans that depict and ensure that the integrity of the RRDS system will not be adversely impacted.

Economic Considerations:
The stated purpose of the proposed MFCB Project is to restore tidal marsh habitat for fish mitigation (Delta smelt, salmonids) and to sell the resulting mitigation credits. However, the habitat restoration costs, together with the substantial estimated costs required to provide adequate protection of DWR RRDS facilities could challenge the project to be economically feasible.

DWR looks forward to working with you on the issues identified above and continues to be willing to explore solutions to this project with you in the future. If you have any questions regarding this matter, please contact Ms. Alejandra Lopez, Senior Right of Way Agent, Real Estate Branch, by email at Alejandra.Lopez@water.ca.gov, or by phone directly at (916) 653-9283, or toll free at (800) 600-4397.

Sincerely,

Angelica Aguilar, Chief
Property Management and Encroachment Permit Section
Real Estate Branch

cc: James K. Openshaw, Senior Attorney
State of California
Department of Water Resources
Office of Chief Counsel, Room 1148-3
Post Office Box 942836
Sacramento, California 94236-0001

STATE OF CALIFORNIA
CALIFORNIA NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
P.O. BOX 942836
SACRAMENTO, CALIFORNIA 94236-0001

SACRAMENTO
CA 957
12 JUL '16
PM 7 L



RECLAMATION DISTRICT 2130
DR TERRY HUFFMAN
HUFFMAN-BROADWAY GROUP INC
828 MISSION AVE
SAN RAFAEL CA 94901

94901-320928

EXHIBIT 5

Mae Empleo

From: Mae Empleo <Mae@semlawyers.com>
Sent: Friday, November 17, 2017 10:48 AM
To: 'catherine.cavanaugh@water.ca.gov'
Cc: Osha Meserve (osha@semlawyers.com); Dennis.McEwan@water.ca.gov; islandsfarmer@hotmail.com; Chris Neudeck (cneudeck@ksninc.com); 'jtootle@engeo.com'; mvanzandt@hansonbridgett.com
Subject: Response from LAND/RD 501 to DWR Letter Dated September 14, 2017 re: Prospect Island Tidal Habitat Restoration Project
Attachments: LAND RD501 Ltr to DWR 11.17.17.pdf

Dear Ms. Cavanaugh:

Attached please find the correspondence from Local Agencies of the North Delta and Reclamation District 501. This is in response to your September 14, 2017 letter regarding the Prospect Island Tidal Habitat Restoration Project. Thank you for your attention to this matter. We look forward to hearing from you.

Sincerely,

Mae Ryan Empleo
Legal Assistant
Soluri Meserve, A Law Corporation
510 8th Street
Sacramento, CA 95814

☎ *tel:* 916.455.7300 ▪ *fax*: 916.244.7300 ▪ *mobile:* 559.361.5363 ▪ ✉ *email*: mae@semlawyers.com
This email and any attachments thereto may contain private, confidential, and privileged material for the sole use of the intended recipient.

SOLURI MESERVE
a law corporation

tel: 916.455.7300 · fax: 916.244.7300
510 8th Street · Sacramento, CA 95814

November 17, 2017

SENT VIA EMAIL (catherine.cavanaugh@water.ca.gov)

Catherine Cavanaugh
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

RE: Response to DWR Letter Dated September 14, 2017

Dear Ms. Cavanaugh:

Local Agencies of the North Delta and Reclamation District 501 ("LAND/RD 501") have received your letter dated September 14, 2017. As we discussed subsequently, we were somewhat surprised by the tone of the letter, indicating that the Department of Water Resources ("DWR") does not believe further discussions about the Prospect Island Tidal Habitat Restoration Project ("project") would be fruitful. According to the letter, "DWR has gone above and beyond what is legally necessary to identify and alleviate impacts" by undertaking the bulleted actions below, yet we are still unclear on what DWR proposes to do, as described in the italicized responses below.

- Completed a multi-year groundwater and surface water study on Prospect and Ryer Islands, at the request of RD 501
- Analyzed new hydrologic data collected since the completion of the above study, at the request of LAND and RD 501

Response: The results of these studies have not yet been provided to LAND/RD 501.

- Agreed to monitor existing wells on Prospect and Ryer Island post-restoration project, at the request of RD 501.

Response: DWR has not stated which wells would be monitored, and if the requested additional wells would be monitored. Nor has a monitoring program been defined.

- Hosted a half-day technical workshop to share technical information and gather input from RD 501 on groundwater and surface water conditions
- Met with LAND and RD501 on several occasions to discuss concerns about the restoration project

Response: LAND/RD 501 acknowledge and appreciate the time and resources DWR has committed to this collaborative process in order to pursue beneficial outcomes for the project and its neighbors.

- Agreed to include many additional mitigation measures in the final EIR to help alleviate concerns about potential impacts

Response: LAND/RD 501 have not been provided the proposed mitigation measures to review and assess for adequacy with respect to local concerns.

- Conducted additional modelling of velocities in the Miner Slough channel
- Analyzed wind direction, intensity, and wind-wave erosion data

Response: It is unclear what new analysis DWR is relying on to support its conclusion that "potential impacts not identified in the EIR will occur." Our review of the information generated during our discussions leads us to believe that new channel scour, levee damage and seepage (among other impacts) would occur as a result of the project.

LAND/RD 501 support and agree with DWR's commitment in the letter that: "in the unlikely event that impacts to Ryer Island occur and are attributable to the Prospect Island restoration project, DWR is committed to mitigate the impacts at that time." In order to make that commitment a reality, specific mitigation language is necessary. Though LAND/RD 501 do not agree with DWR's position that no advanced mitigation is necessary to prevent damage to the RD 501 levees, for instance, it is still necessary to develop appropriate triggers for mitigation of the various impacts with which LAND/RD 501 are concerned. Additionally, we discussed, but have not seen a specific commitment with respect to conducting periodic bathymetry and other baseline development activities that would be necessary to determine whether impacts are occurring.

As local stakeholder representatives, we believe an additional meeting would be helpful to review and discuss:

- Specific proposed mitigation measures
- Appropriate action triggers with respect to each LAND/RD 501 concern area
- Development of baseline and ongoing data collection to inform future interactions regarding project impacts
- Development of an alternative process for resolution of any disputes that may arise during project implementation

Additional details regarding these LAND/RD 501 concerns and proposals for how to address them were listed in our August 16, 2017 Settlement Discussions Document, on pages 7 and 8. No response has been provided to these suggestions. These suggestions were developed to establish clear approaches and metrics for a mutually agreeable response strategy to potential impacts from the project.

While it may not be possible to reach agreement on whether certain impacts are likely to occur as a result of the project, we believe that a true good neighbor approach would include comprehensive planning for all reasonably foreseeable impacts on neighboring lands. Reaching agreement on development of baseline data, monitoring approach, trigger levels and mitigation measure language would ultimately make the project more likely to succeed. This information should be included in the final environmental documentation and/or project approvals. Please let me know if DWR is willing to continue working with us to address these key issues in a follow-up meeting.

Very truly yours,

SOLURI MESERVE
A Law Corporation

By: 
Osha R. Meserve

ORM/mre

cc (via email): Dennis McEwan (dennis.mcewan@water.ca.gov)
Tom Hester (islandsfarmer@hotmail.com)
Chris Neudeck (cneudeck@ksninc.com)
Joe Tootle (jtootle@engeo.com)
Michael Van Zandt (mvanzandt@hansonbridgett.com)

EXHIBIT 6

ENGEO
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Project No.
9306.000.000

August 20, 2018

Mr. Dennis McEwan (dennis.mcewan@water.ca)
SWP Mitigation and Restoration Branch
Division of Environmental Services
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

Subject: Comments on February 2018 DWR Hydrologic Analysis Report
Prospect Island Tidal Habitat Restoration Project Solano County, California

Dear Mr. McEwan:

This letter provides the comments of Reclamation District 501 (RD 501) and Local Agencies of the North Delta's (LAND) (collectively, RD 501) on the February 18, 2018 report by the California Department of Water resources (DWR) titled, *Memorandum Report: Prospect and Ryer Island Hydrologic Data Analysis October 1, 2013 to April 1, 2017 Prospect Island Tidal Habitat Restoration Project Solano County, California* (Attachment A, referred to as the DWR Report). As explained below, RD 501 continues to have serious concerns regarding increases in seepage on Ryer Island as a result of the proposed Prospect Island Tidal Habitat Restoration project that would damage farming and other activities on the island if left unaddressed.[1]

1. Background on RD 501 Concerns

RD 501 and LAND representatives, and other RD 501 landowners, have expressed concerns regarding impacts on neighboring islands and local infrastructure since (and even before) DWR began its planning for the project. DWR has asserted that Miner Slough is the dominant control on the Prospect Island seepage in the project's Draft Environmental Impact Report and elsewhere. RD 501 has expressed its concerns about the lack of a substantiating scientific statistical analysis of correlations between Miner Slough stages and seepage. To support its position that no mitigation is required for seepage impacts, RD 501 has requested that DWR substantiate by how much and when, under which slough stages, the flooding of Prospect Island controls the observed Ryer Island seepage.

As described in the DWR Report, DWR collected data from wells on both Prospect and Ryer Islands to inform an analysis of the relationship between the relative water levels on each island during various conditions.[2] For its Report, DWR used well data from existing wells. Wells should be located as close to the seepage locations as physically possible. Additional proposed well locations on Ryer Island 1-5 were identified in the Monitoring Wells figure prepared by ENGEO (Attachment B), but these additional wells have not yet been established.

[1] This letter focuses on the DWR Report and seepage concerns, and does not discuss other impacts and concerns associated with this project, which remain unaddressed.
[2] A complete drying of Prospect Island and a subsequent statistical analysis of the monitoring well network would be necessary to develop a complete set of action triggers for seepage.

An adequate analytical approach would include a description of methods and a comparison and include a statistical analysis of the channel stage/surface elevations and well data. With the data, monthly correlations between each individual Ryer well elevation and the Miner Slough stage for the period of record, and weekly correlations since the Prospect has begun drying out (after the gates were maintained) can be analyzed, along with monthly correlations between Ryer wells and Prospect's water surface elevations. Time series lag correlations between Ryer wells and Prospect water surface elevation also should be assessed. A null hypothesis should also be tested, and a draft well monitoring approach and schedule provided.

2. Discussion of the 2018 DWR Report

The DWR Report includes conclusions of a limited, non-statistical analysis not supported by the collected data. The Report is a very simplified document and attempts to make its argument primarily based on a series of hydrographs (Attachment A). Subsurface water flows are governed by multiple inputs and it is too complex to be easily understood by any single model or set of hydrographs. It is extremely difficult to know what the effect of flooding Prospect Island will have on Ryer Island, and thus ongoing monitoring will be necessary to evaluate the actual impacts of the project.

The DWR Report fails to directly address the principal concern of RD 501 regarding the relationship of water levels on Prospect Island to those on Ryer Island. Instead, DWR attempts to argue, without supporting data, that Ryer Island water levels are governed by the level of Miner Slough. Page 2 of the report under Section 2.2 admits that DWR does not believe that Miner Slough is the only contributing factor that can impact Ryer Island groundwater conditions, by characterizing Miner Slough as the "…dominant drive force of water flow (surface water and groundwater) in the Project area." While the dominance of Miner Slough is in dispute, the Report concedes that there are other water sources that could potentially impact Ryer Island, such as Prospect Island; this is the point RD 501 and others have been making for years.

The hydrographs do not support the conclusions drawn by DWR in the Report regarding the relationship of water levels on the two adjacent islands. For instance, Figure 4A *Hydrographs of Stage and Groundwater Elevations along North Transect with Precipitation at Hastings Tract East Daily Mean Water Levels, Daily Precipitation - January 1, 2011 to April 1, 2017* is presented by DWR as supporting data. DWR draws erroneous conclusions from a visual interpretation of the well data. Specifically:

- Miner Slough stage height elevation is shown as a blue line. Prospect Island elevation is shown as a black line.

- Figure 4A shows that Prospect Island (PI) elevations initially generally track Miner Slough stages and then as the Island is closed off from the slough with the repair of the tidal gate structure, the Prospect Island elevations no longer track Miner Slough. By April 2014, Prospect Island elevations typically respond (outside of the precipitation signal) in the opposite direction during the higher Slough flows typical of later summer project releases. (See July-October 2014, and May to November 2015, elevated river stages and conversely 2 to 3 foot declines on Prospect Island.)

- PI-6B (deep; screen interval - 29.13 to -39.13 feet MSL) elevations are shown as a gray solid line, and PI-6A (shallow; screen interval 0.19 to -9.81 feet MSL) elevations are shown as a red dashed line. PI-6A does not respond or track the deeper PI-6B, but it responds nearly identically to Miner Slough at a slightly lower elevation, as would be expected if it was directly influenced by the Slough.

- Monitoring Well (MW) 99-7 (deep; screen interval -34.76 to -39.76 feet MSL) elevations are shown as a solid green line and MW 99-8 (shallow; screen interval -10.62 to -15.62 feet MSL) as a yellow dashed line. MW-99-7 and 99-8 track each other at nearly identically at the same elevation and at the same amplitude.

Contrary to the assertions made in the DWR Report, a simple comparison of the relative elevations shown in Figure 4A, excluding precipitation signals, show a 3 to 5-foot hydraulic head difference from Prospect Island *to* Ryer Island, and a monotonic response from PI-6B and MW 99-7 and -8. This difference in head from Prospect Island to Ryer Island and the close matching of the elevations from those wells is a clear demonstration of what appears to be a direct hydraulic connection between Prospect and Ryer Island.

Similarly, as shown on Figure 4C, *Select Hydrographs of Stage and Groundwater Elevations along North Transect with Precipitation at Hastings Tract East Daily Mean Water Levels, Daily Precipitation - January 1, 2011 to April 1, 2017*, a set of 6 points are identified to assert that elevation trajectories (relative slope) differ from Prospect Island and MW-99-7 and 99-8, as they are declining on Prospect Island and increasing on Ryer Island. While not performing any statistical time step and lag assessment as RD 501 previously requested, this assessment further fails to provide a correlation of all the other periods in the record which shows and identical trend, “cherry-picking” the only points that are not correlated.

A far simpler explanation for these differences exists on Figure 5A, *Hydrographs of Stage and Groundwater Elevations along Middle Transect with Precipitation at Hastings Tract East*, as the specific periods that identified Ryer Island wells MW-99-7 and 99-8 as counterpoints to Prospect Island elevation trends. When the West Canal 1 and the Elkhorn Slough 1 water delivery systems *are adding water* for agriculture on Ryer, water levels in two wells rises.

The same approach of ignoring the broad correlation of elevations on Prospect Island and focusing on brief inflections is found on Figure 5C, *Select Hydrographs of Stage and Groundwater Elevations along Middle Transect with Precipitation at Hastings Tract East*. While the abstract inflections can provide information, the overall trend and correlation of the data, elevated head on Prospect as compared to Ryer, and the documented sand layers between these islands, all point to the opposite conclusions from those of the Report. If Miner Slough was the primary hydraulic driver on Ryer Island well elevations, we would expect to see some correspondence in elevations on Ryer. Instead we have an *inverse correlation* visible in the same figure: Ryer is declining when Miner Slough is high, except during precipitation events. But Ryer does fundamentally track Prospect elevations.

Conclusions

Nowhere in the DWR Report does DWR conclusively demonstrate that Prospect Island water levels will not impact Ryer Island. The Report fails to provide any statistical analysis and lacks even basic correlation analysis about the relationship between water surface observations of Prospect Island and consequent trends on Ryer Island. The highlighted textbook illustrations of hydraulic head in the report on Attachment 1 Appendix page 9, identify exactly the fundamental inability of DWR's analysis to support its stated conclusions, as described above with respect to Figure 4A. Miner Slough's water surface elevations are the highest, Prospect's elevations are second and lower, and Ryer Island's elevations are lower still.

The hydraulic head and gradient does not need to move from Miner Slough to Ryer Island. Instead, these data clearly support that the movement is from Miner Slough to Prospect Island to Miner Slough as shown in the relative elevations. Conversely, if Miner Slough actually directly controlled the gradient to Ryer Island, the periodicity of the elevations on Ryer Island would match Miner Slough. It does not except under major precipitation events, as expected. The inverse relationship is shown in the data: most periods show a decline on Ryer Island while stage in Miner Slough is increasing.

The analysis is silent on the obvious correlation between Prospect and Miner elevations and their periodicity for the vast majority of the time after closure. Instead, the DWR Report focuses on a few times where there is an apparent lag between the responses. In the rare cases where the trajectory of the response is different between Prospect and Ryer, the analysis ignores its own data identifying irrigation and drainage operations within Ryer Island, as demonstrated by the interior drainage water surface elevations. Instead of a visual analysis that doesn't support the conclusions, the analysis should be made statistically, with correlations drawn over the period after Prospect Island is closed, lag analysis for transit time, and informed by the irrigation and drainage operation modifications to the shallow water table on Ryer Island.

Visual interpretations may be sufficient as a screening tool, but they should not be used to isolate periods with other causal explanations and ignore the vast majority of other periods. A statistical analysis would also allow the removal of precipitation signals, and quantify the response lags. The DWR Report does not address in any meaningful way the RD 501's concerns that the flooding of Prospect Island increases seepage on Ryer Island and would cause a loss of farming opportunities and other damages.

In summary, the DWR Report use the appropriate basic scientific methods, and doesn't support the conclusions it makes regarding the causes of increases in water levels on Ryer Island relative to conditions on Prospect Island, as explained above. For DWR to make any scientifically founded conclusion regarding the potential hydrogeologic connections between islands, Miner Slough and the proposed flooding, it must fully consider the prior comments and its own data. If the project proceeds, installation of adequate well network to assess baseline and post-project conditions and maintenance of the monitoring program will be necessary.

Given the likelihood of seepage effects on Ryer shown in the DWR Report and elsewhere, specific mitigation must be formulated and included in the approved project to address these reasonably foreseeable project impacts. Broad statements such as "in the unlikely event that impacts to Ryer

Island occur and are attributable to the Prospect Island restoration project, DWR is committed to mitigate the impacts at that time" (DWR letter, September 14, 2017) are inadequate and must be replaced with specific, enforceable commitments to mitigate these and other potentially significant effects from the project on RD 501 and neighboring landowners prior to project approval. RD 501 has already made numerous recommendations in that regard, which should be adopted.

Please feel free to contact the undersigned with any questions about these comments.

Sincerely,

ENGEO Incorporated



Josef J. Tootle, GE
Principal

Christopher H. Neudeck, P.E.
Reclamation District No. 501 - Ryer Island
District Engineer

Attachment: Attachment A – Memorandum Report: Prospect and Ryer Island Hydrologic Data Analysis October 1, 2013 to April 1, 2017 Prospect Island Tidal Habitat Restoration Project Solano County, California
Attachment B – July 17, 2017 ENGEO Monitoring Wells Figures

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EXHIBIT 7

PROPOSED GOOD NEIGHBOR ACTIONS FOR THE PROSPECT ISLAND TIDAL HABITAT RESTORATION PROJECT

This list of good neighbor actions for the Prospect Island Tidal Habitat Restoration Project ("project") is proposed by Local Agencies of the North Delta ("LAND"), Reclamation District 501, International Farming Corporation, and Fahn Family Farming (collectively "LAND"). The project's potentially significant impacts on the environment, public health, and infrastructure are cause for concern. LAND supports Delta restoration activities, so long as potentially significant impacts are adequately monitored and mitigated. This list is a culmination of LAND's considerable efforts to create viable long-term solutions to the project's issues. LAND's primary goal with this list is that these actions are enforceable and included in the project in some form, whether as good neighbor policies or mitigation.

Proposed Actions:

- Install rock or rip rap on Ryer Island levee across from the project breaches.
- Installation cutoff walls on Ryer Island levee.
- Utilize other buffer methods such as adjusting slope of Ryer Island levee.
- Fund maintenance for Ryer Island levee for the life of the project.
- Periodic surveys to monitor the bathymetry of Miner Slough.
- Commitment to mitigation in the event of seepage impacts, including payment of additional pumping and repair costs.
- Installation of interception or relief wells, development of interception plans, and other drainage improvements.
- Cap the inside of Prospect Island levee.
- Construct dirt/rock groins on the inside of and perpendicular to Prospect Island levee.
- Site levee breaches to not be at right angles to the predominant wind direction.
- Armor levee edges at the breaches.
- Install concrete apron or rock to harden the bottom of breach openings.
- Install operable gates at breaches.
- Further develop invasive species control plans to include specific density standards.
- Use of an adequate seepage model supported with a tracer study and three-dimensional erosion analysis for neighboring levees.
- Establish seepage monitoring criteria and action level triggers prior to construction.
- Establish invasive clam and mussel monitoring and response plan.

EXHIBIT 8

2.27 Mitigation Measure AG-1: Develop an Agricultural Land Stewardship Plan (ALSP) to Maintain Agricultural Productivity and Mitigate for Loss of Important Farmland and Land Subject to Williamson Act Contracts or in Farmland Security Zones

Commitment/Mitigation Measure	Responsible Party/Parties	Timing	Associated Impacts
Chapter 14, Agriculture			
Mitigation Measure AG-1: Develop an Agricultural Land Stewardship Plan	DWR	Prior to construction	Impact AG-1, AG-2, AG-3, AG-4

Action: DWR shall develop Agricultural Lands Stewardship Plans (ALSPs) (i) prior to the commencement of any construction activities or other physical activities associated with the project that would involve adverse effects (under NEPA) or significant effects (under CEQA) on Important Farmland or land subject to Williamson Act contracts or in Farmland Security Zones, and (ii) as part of the site-specific environmental review for all other environmental commitment or other site-specific project activities that could involve adverse effects (under NEPA) or significant effects (under CEQA) on Important Farmland or land subject to Williamson Act contracts or in Farmland Security Zones. For each environmental commitment or site-specific project activity other than the water conveyance facility that would cause such effects, a draft ALSP will be included with any publicly circulated environmental document for the proposed environmental commitment or project activity in order to obtain public input. The Plans will contain the three elements identified below for this measure. If a programmatic ALSP is developed for the project, parts of the project, the Delta or parts of the Delta, DWR may rely on these plans to the extent that they include all the elements in this measure.

AG-1a: Promote agricultural productivity of Important Farmland

DWR will ensure that the following measures are implemented to reduce adverse effects and/or significant effects as described above if the measures are applicable and feasible. Not all measures listed below may be feasible or applicable to each conservation measure or to individual parts of each conservation measure. Rather, these measures serve as an overlying mitigation framework to be used for mitigation of impacts caused by the implementation of specific conservation measures. The applicability of measures listed below would vary based on the location, timing, nature, and feasibility of each measure.

- Early Planning
    - Describe the current land use in the project area and identify acreage of all land devoted to agricultural use, including farmland of local importance, grazing land, and confined animal agriculture.
    - Describe the extent to which the project can be part of or complement existing or planned land uses for the Delta. For California WaterFix, this means consulting with county

governments, the Delta Protection Commission, the Delta Conservancy and other individuals and organizations that are considering plans or activities designed for agricultural use; flood management; mitigation and enhancement relating to aquatic and terrestrial habitat; recreation; and tourism. This consultation is particularly important when there are multiple uses being considered for one specific area of land, but it is also important to look at how the project affects or fits into other plans for the region or sub-regions where the project is located.

- DWR should consult with farmers, local agencies and other State and federal agencies, including the California Natural Resources Agency, the California Department of Water Resources, the Central Valley Flood Protection Board, the California Department of Conservation, the California Department of Food and Agriculture, the California Department of Fish and Wildlife, the Delta Stewardship Council, the California Delta Protection Commission, the Delta Conservancy, the United States Fish and Wildlife Service, the National Marine Fisheries Service, and the U.S. Department of Agriculture, including the Natural Resources Conservation Service, to identify design features of the project, if any, that will benefit flood management, agricultural production and natural resource protection.
- Consider whether the proposed land use is consistent with State, regional and local plans. For the California WaterFix, this could include local General Plans, the Delta Protection Commission's Land Use and Resource Management Plan and Economic Strategy, the Delta Stewardship Council's Delta Plan, the California Water Plan Agriculture Strategy, the Delta Conservancy Strategy, the California Department of Food and Agriculture's Ag Vision; the California Natural Resources Agency's California Climate Adaptation Plan, and the California Fish and Wildlife Strategic Vision;
- Consider whether agriculture and/or habitat management activities undertaken pursuant to the proposed land use are consistent with State and local policies relating to flood protection and whether they might provide additional protection because, for example, they (i) provide flood management activities that provide additional protection for agricultural activities or (ii) prevent or divert potential higher groundwater levels that would thwart flood control efforts

- Site Related Avoidance and Mitigation
  - Site projects and project footprints to minimize the permanent conversion of Important Farmland, to nonagricultural uses.
  - When identifying and selecting project areas, give priority to public lands and existing conservation lands.
  - Where choices are possible among or between particular parcels or lands that are available for a project, DWR should look at the characteristics of the different parcels or lands to determine whether one choice would be better from an agricultural resource perspective. If choices can be made regarding different locations for a project and still achieve the project purposes, it may be possible to avoid areas that may have more value from an agricultural resources perspective such as whether the property is (1) "high quality" farmland. (2) unique or has special values, (3) important to maintaining viability of agriculture in a certain area, (4) important to maintaining habitat lands in agriculture in a certain area.
  - Manage project operations to minimize the introduction of invasive species or weeds that may affect agricultural production on adjacent agricultural land.

- Mitigate on Site
    - Design projects so as to optimize contiguous parcels of agricultural land of a size sufficient to support their efficient use for continued agricultural production.
    - Where the construction or operation of a facility could limit access to ongoing agricultural operations, maintain a means of convenient access to these agricultural properties as part of project design, construction, and implementation.
    - At borrow sites to be returned to agricultural production, remove and stockpile, at a minimum, the upper 2 feet of topsoil and replace the topsoil after project completion as part of borrow site reclamation.
    - In areas permanently disturbed by project activities, and where topsoil is removed as part of project construction (e.g., stripping topsoil under a levee foundation) and not reused as part of the project, make the topsoil available to less productive agricultural lands that could benefit from the introduction of good-quality soil.
    - For temporarily impacted diversions:
        - Provide new water wells until diversion connection is reestablished to ensure agricultural production is maintained
        - Provide alternate water supply from a permitted source, such as trucking in water or negotiating with adjacent land owners
        - Compensate owners for production losses attributable to reduction in water supply from the impacted diversions
    - For permanently impacted diversions:
        - Carry out those measures for temporarily impacted diversions until the measures listed below are completed
        - Relocate and/or replace wells, pipelines, power lines, drainage systems, and other infrastructure that are needed for ongoing agricultural uses and would be adversely affected by project construction or operation.
        - Provide negotiated settlement that may include some of the above and/or compensation
    - Minimize disturbance of Important Farmland and continuing agricultural operations during construction by (1) locating construction laydown and staging areas on sites that are fallow, already developed or disturbed, or are to be discontinued for use as agricultural land and (2) using existing roads to access construction areas.
    - Consult with landowners and agricultural operators to develop appropriate construction practices to minimize construction-related impairment of agricultural productivity. Practices may include coordinating the movement of heavy equipment and implementing traffic control measures.
    - Consult with landowners and agricultural operators with the goal of sustaining existing agricultural operations, at the landowners' discretion, until the individual agricultural parcels are needed for project construction.
- Consult with landowners and agricultural operators on what role they can take if they wish be involved in project development. Issues to consider include whether:

- Owner(s) or operator(s) could carry out project activities on their land. To the extent that Important Farmland is part of the project, consideration should be given to providing flexibility to the farmer. To the extent that Important Farmland is part of the project, consideration should also be given to developing working landscapes[3] on project lands
- Some or all of the ownership interests on any project land could remain in private hands or in the hands of a private conservancy in order to keep the property in nongovernmental ownership and thereby on the County tax base;
- Owner(s) and/or operator(s) of land displaced by project facilities and activities could maintain or obtain full or partial ownership of the land on which project activities will be carried out or could be compensated to manage said land;
- Existing agricultural operations on lands could be modified, through such things as crop change, new integrated pest management strategies, altered water usage, or full or partial conversion to habitat uses, in a manner that renders such operations consistent with the goals and objectives of the project by enhancing environmental outcomes in a manner beneficial to species covered by the project;
- Limited agriculture could take place within areas identified for habitat restoration under the project without undermining the achievement of the project goals and objectives;
- Subsidies to allow economically viable rice farming on particular lands could be justified due to the environmental benefits of such rice farming such as the stabilization of subsiding areas or the creation of sinks for greenhouse gases and methylmercury;
- Subsidies to assist the owner(s) and/or operator(s) to make a viable living managing wetlands or other habitat areas could be justified due to the environmental benefits of wetlands or habitat such as the stabilization of subsiding areas or the safer accumulation and isolation of greenhouse gases and methylmercury;

- Implementation
  - The plans should include a framework that encourages adaptive management with regard to agricultural land management.
  - The plans should include reporting and monitoring actions necessary to show that the actions agreed to were being carried out.

[3] The Cal-Fed Working Landscapes Subcommittee of the Bay Delta Public Advisory Committee defined a working landscape as "a place where agriculture and other natural resource-based economic endeavors are conducted with the objective of maintaining the viability and integrity of its commercial and environmental values. On a working landscape, both private production, as well as public regulatory decisions account for the sustainability of families, businesses and communities, while protecting and enhancing the landscape's ecological health. The working landscape is readily adaptable to change according to economic and ecosystem needs. With respect to CALFED, a working landscape is both an objective and a means to achieve it. A working landscape is efficiently managed largely by private agricultural landowners and managers who are supported and encouraged to manage their lands in ways that fulfill CALFED goals, allowing them to pursue ecological health goals while yielding economic returns on investments, and generating tax revenues that support their local governments" (California Bay-Delta Public Advisory Committee 2002).

AG-1b: Minimize impacts on land subject to Williamson Act contracts or in Farmland Security Zones

DWR will ensure that the following measures are implemented as applicable to reduce effects and preserve agricultural uses on lands with designated agricultural preserves and subject to Williamson Act contracts or in Farmland Security Zones:

- DWR will comply with applicable provisions of California Government Code Sections 51290–51295 with regard to acquiring lands within agricultural preserves and subject to Williamson Act contracts. Sections 51290(a) and 51290(b) specify that State policy, consistent with the purpose of the Williamson Act to preserve and protect agricultural land, is to avoid locating public improvements and any public utilities improvements in agricultural preserves, whenever feasible. If it is infeasible to locate such improvements outside of a preserve, they will be located on land that is not under contract, if feasible.
- More specifically, DWR will comply with the following basic requirements stated in the California Government Code:
    - Whenever it appears that land within a preserve or under contract may be required for a public improvement, the DOC and the city or county responsible for administering the preserve must be notified (Section 51291(b)).
    - Within 30 days of being notified, DOC and the city or county must forward comments, which will be considered by the proponents of the public improvement (Section 51291(b)).
    - A public improvement generally may not be located within an agricultural preserve unless DWR makes specific findings to the effect that (1) the location is not based primarily on the lower cost of acquiring land in an agricultural preserve and (2) for agricultural land covered under a contract for any public improvement, no other land exists within or outside the preserve where it is reasonably feasible to locate the public improvement (Sections 51921(a) and 51921(b)). Findings do not need be made if the action falls within one of the exemptions in Section 51293. The contract is normally terminated when land is acquired by eminent domain or in lieu of eminent domain (Section 51295).
    - DOC must be notified within 10 working days upon completion of the acquisition (Section 51291(c)).
    - DOC and the city or county must be notified before completion of any proposed work of any significant changes related to the public improvement (Section 51291(d)).

If, after acquisition, the acquiring public agency determines that the property would not be used for the proposed public improvement, DOC and the city or county administering the involved preserve must be notified before the land is returned to private ownership. The land will be reenrolled in a new contract or encumbered by an enforceable restriction at least as restrictive as that provided by the Williamson Act (Section 51295).

AG-1c: Consideration of an Optional Agricultural Land Stewardship Approach or Conventional Mitigation Approach

Where DWR has determined that compliance with Mitigation Measures AG-1a and AG-1b is not sufficient to mitigate to a less than significant or adverse level the impacts from the conversion of

Important Farmland or of land subject to Williamson Act contracts or in Farmland Security Zones, they will undertake additional feasible mitigation pursuant to this measure (AG-1c).

Exceptions to this requirement will apply where the mitigation already being required for the biological resource values for the land at issue (e.g., for its value as habitat for Swainson's hawk) pursuant to the cultivated lands natural community strategy of Environmental Commitment 3 already requires the equivalent of 1:1 mitigation (based on the net area of land remaining in agriculture) for impacts to Important Farmland or of land subject to Williamson Act contracts or in Farmland Security Zones, provided that the easements for biological values also incorporate agricultural preservation.

DWR will determine the nature and form of any necessary additional mitigation after consultation with, at least, all of the following: (i) the County in which the affected property is located; (ii) the owner(s) and/or operator(s) of said property; (iii) the California Natural Resources Agency; (iv) the California Department of Water Resources; (v) the Central Valley Flood Protection Board; (vi) the California Department of Conservation; (vii) the California Department of Food and Agriculture; (viii) the California Department of Fish and Wildlife; (ix) the Delta Stewardship Council; (x) the California Delta Protection Commission; (xi) the Delta Conservancy; (xii) the United States Fish and Wildlife Service; (xiii) the National Marine Fisheries Service; and (xiv) the U.S. Department of Agriculture, including the Natural Resources Conservation Service. After consulting with these agencies, entities, and/or individuals, the DWR will determine whether or not, under the circumstances surrounding the conversion of particular agricultural lands, the best overall approach to the additional required mitigation is the conventional use of agricultural land conservation property interests (see discussion below on Conventional Mitigation Approach). In making this determination, DWR will give considerable weight to the willingness of the County in which the affected property is located and the owner(s) and/or operator(s) of said property to participate in an Optional Agricultural Land Stewardship Approach, which would seek opportunities to protect and enhance agriculture in the Delta as part of the project landscape and focus on maintaining economic activity on agricultural lands instead or in conjunction with the Conventional Mitigation Approach for purposes of CEQA/NEPA mitigation. Where the County and the owner(s) and/or operator(s) have a preference for participating in an Optional Agricultural Land Stewardship Approach, DWR will attempt to develop a feasible Optional Agricultural Land Stewardship alternative mitigation program acceptable not only to the County and the owner(s) and/or operator(s), but also to the California Department of Fish and Wildlife, the United States Fish and Wildlife Service, and the National Marine Fisheries Service. Where DWR, despite a good faith effort, cannot succeed in achieving the consensus necessary to carry out a feasible Optional Agricultural Land Stewardship Approach, they will undertake instead a Conventional Mitigation Approach, where necessary and feasible, based on the use of agricultural conservation property interests or other measures requiring the preservation or, enhancement of other land of similar agricultural quality in areas that are threatened with encroaching urban development.

Specific strategies that could be used in formulating an Optional Agricultural Land Stewardship Approach are described in Appendix 14B, *Delta Agricultural Stewardship Strategies*. In determining the potential nature and form of an Optional Agricultural Land Stewardship Approach, DWR will, at a minimum, consider the following, as applicable:

- whether there is Important Farmland in the Delta reasonably accessible to DWR and/or to the owner(s) and/or operators for use for agriculture and/or habitat management in a manner consistent with the goals and objectives of the California WaterFix;

- whether there is Important Farmland that might not remain in agriculture if it was not protected by means of an agricultural conservation property interest because of threats of urban development (e.g. in the secondary zone in the Delta) or wind/solar and other non-renewable energy projects, or the productive value of which is so high, it should remain in agriculture instead of being used for restoration or other open-space projects because, for example, it is:
    - unique or has special values
    - important to maintaining viability of agriculture in the region
    - critical to prevent a "tipping" point that could lead to elimination of a crop in the region
    - important to maintaining habitat lands in agriculture in the region
- whether Agricultural Land Stewardship Strategies[4] benefit agricultural lands by providing feasible CEQA/NEPA mitigation (or providing funding for such mitigation) for potential significant environmental agricultural impacts at both the farm and the regional level. In determining whether the funds necessary to make an Optional Agricultural Land Stewardship Approach feasible are available, DWR will be guided by the principle that funds that might otherwise be used for off-site preservation or another form of compensation may be made available instead to assist with making the Optional Agricultural Land Stewardship Approach work. Such strategies could include:
    - Potential strategies to help maintain farming in the Delta
        - Improve flood protection (Strategy 1)
        - Provide technical and financial assistance to help farmers maintain or improve agricultural production (Strategy 2)
        - Provide technical and financial assistance to help farmers comply with regulatory requirements for water quality (Strategy 3)
        - Control terrestrial weeds (Strategies 6a, 6b, and 6c)
        - Reduce conflict between agriculture and nearby habitat lands by creating a "good neighbor" policy (Strategy 7)
        - Work with other interests to explore the value of reinstating state funding of Williamson Act subventions (Strategy 8)
        - Work with counties to expand Williamson Act authorized uses to include open space/habitat lands in Williamson Act Preserves (Strategy 9)
        - Investigate options for in lieu tax revenue for counties and payments for local districts (Strategy 10)
        - Provide for Agricultural Conservation Easements (Strategy 11)
    - Potential strategies that provide incentives for conservation on farmland

[4] Strategies developed so far, and other materials relating to their development and implementation, can be found at https://bdcpdfl.water.ca.gov/home. These are given as examples to consider at this time. It is expected that existing strategies will evolve and change over time and that additional strategies will be developed.

- Partner with others to maintain and enhance environmental quality on farmland (Strategy 12)
- Compensate farmers to manage agricultural land as habitat for wildlife (Strategy 13)
- Provide incentives for farmers to take part in a market-based conservation program (Strategy 14)

  - Potential strategies to manage land for purposes other than conventional crop production
    - Provide technical and financial assistance to stabilize or reverse land subsidence on Delta island (Strategy 15)
    - Assist landowners to produce and sell greenhouse gas offset credits in the AB 32 Cap-and-Trade program (Strategy 16)
    - Compensate farmers to manage habitat lands (Strategy 17)
    - Designate carbon sequestration and subsidence reversal crops as agricultural production for regulatory and incentive programs (Strategy 18)
  - Potential strategies that provide for economic development and other benefits
    - Provide technical and financial assistance to develop an economic study of agricultural activity and related infrastructure (Strategy 19)
    - Provide technical and financial assistance for to promote economic development (Strategy 20)
    - Provide technical and financial assistance to promote transportation infrastructure improvements (Strategy 21)
    - Provide technical assistance to farmers to help in complying with the regulatory framework present in the Delta (Strategy 22)
    - Provide technical, risk reduction, promotion, and financial assistance for farmers to manage land to incorporate recreation and tourism (Strategy 23)
    - Work with others to better align the regulatory system to help farmers who engage in ecological restoration and enhancement projects (Strategy 24)
    - Develop Agricultural Land Stewardship Plans (Strategy 25)

- In addition, DWR will explore the following funding sources to implement strategies that are in addition to those required under CEQA/NEPA in order to maintain agriculture In the Delta. These strategies include those listed above for CEQA/NEPA mitigation.
  - Work with the California Air Resources Board (CARB) to establish a greenhouse gas offset market using credits created through the development and restoration of wetlands.
  - Seek available funding from CARB's "Cap and Trade" program developed pursuant to the Global Warming Act Solutions Act of 2006 (AB 32).
  - Work with others to explore the value of reinstating state funding for Williamson Act subventions from Cap and Trade Funding or other sources

- Consider recommending to the Governor and Legislature that funds for be included in any bond measure(s) placed on the statewide ballot (e.g. the Delta Investment Fund authorized by the Delta Reform Act).
- Work with other governmental and private entities to identify other funds that can be used for the Optional Agricultural Land Stewardship Approach.

Strategy for implementing a Conventional Mitigation Approach. Where DWR, despite a good faith effort, cannot succeed in achieving the consensus necessary to carry out a feasible Optional Agricultural Land Stewardship Approach, they will undertake instead, where necessary and feasible, a Conventional Mitigation Approach based on the purchase of property interests in agricultural lands (e.g., conservation easements) or other compensation arrangements (collectively referred to as "agricultural conservation property interests"), requiring the preservation and/or enhancement of other land of similar agricultural quality. The standard ratio for purchase of agricultural conservation property interests to mitigate for permanently converted Important Farmland not included, as discussed above, as part of mitigation for biological resources, will be at a ratio of 1:1 for similar types of Important Farmland.

Where feasible, mitigation will generally result in the purchase of agricultural conservation property interests, such as easements on other agricultural lands of the same overall quality and acreage either directly or indirectly. The two preferred forms of mitigation in this context will be (i) the inclusion of sufficient acreages within agricultural preserves within California WaterFix lands to satisfy CEQA and NEPA agricultural resource mitigation in addition to meeting DWR objectives under the Endangered Species Act and California's Natural Community Conservation Planning Act and (ii) reliance on the California Farmland Conservancy Program or on other established programs in the Delta supported by the county where the project is located, the Delta Stewardship Council, the Delta Planning Commission, or the Delta Conservancy. Where DWR chooses to rely on the latter strategy, they will confirm, prior to submitting funds into any program both (a) that the program meets the standards under CEQA case law for a "reasonable mitigation plan" and (b) that they can spend the funds at issue for the preservation and, where appropriate, the enhancement, of land that is reasonably proximate to the land being impacted and of a similar quality or extent. Where these two preferred options are unavailable or infeasible, DWR will be responsible for purchasing agricultural conservation property interests on their own.

Where feasible, agricultural land conservation interests should be acquired in the county in which the conversion will take place, provided that any such land either would be at-risk for conversion from agricultural uses in the absence of such long-term protection, unless such purchases would potentially put off-limits lands that may be needed for habitat purposes under Alternative 4Aor are necessary for other habitat conservation plans. Thus, acquisition of such agricultural land conservation interests cannot be located in areas targeted for habitat restoration if doing so would thwart implementation of the long-term habitat restoration objectives of the California WaterFix.

Where a property identified for purchase of an agricultural land conservation interest serves non-agricultural purposes such as providing wildlife habitat or flood control or flood management benefits, the terms of the agricultural land conservation interest will require the farm operator to continue to use the property in a manner that preserves these benefits (e.g., by continuing to support certain crop types known to provide, or be consistent with, such benefits) unless similar benefits are provided through some other means. The value of the agricultural land conservation interest would need to take such limitations on agricultural practices into account.

Absent an adequate supply of similar quality Important Farmland within the county where conversion occurs, the agricultural land conservation interest may be obtained in another county. If so, the proponents will seek to obtain farmland of equivalent qualities, preferring locations within the greater Sacramento and Stockton metropolitan areas. The priority for purchase or encumbrance would be Important Farmland at-risk for conversion from agricultural uses to urban development without such long-term protection. However, no purchase shall conflict with or undermine the overall California WaterFix by potentially putting off-limits lands that may be needed for habitat purposes during the permit duration of the project.

Responsible Parties: DWR

Regulating/Permitting Agencies: DFW, USFWS, NMFS, County Boards of Supervisors

Location: Plan Area and Areas of Additional Analysis

Timing: Prior to construction.

Monitoring DWR will appoint a coordinator responsible for oversight of the development and implementation of ALSPs and any other appropriate mitigation practices as described above. The coordinator will periodically monitor land protection efforts and manage communications with the appropriate agencies, entities, and individuals necessary to perform the actions described above.

Reporting Requirements: After completion of activities DWR shall prepare a report explaining how, in carrying out such activities, DWR successfully implemented the pertinent requirements of these Mitigation Measures (AG-1a, 1b, and 1c).

2.28 Mitigation Measure REC-2: Provide alternative bank fishing access sites

Commitment/Mitigation Measure	Responsible Party/Parties	Timing	Associated Impact
REC-2: Provide alternative bank fishing access sites	DWR in consultation with Yolo, Sacramento, and Contra Costa counties.	Prior to construction	REC-2 REC-4

Action: Construction-related impacts on informal fishing access sites near the proposed water conveyance facilities, such as along the east bank of the Sacramento River, in the vicinity of the proposed intakes, and in the vicinity of the expanded Clifton Court Forebay, would be considered significant because construction would alter the river bank and/or restrict access, making these sites unusable. To compensate for the loss of these informal sites during construction, DWR will enhance nearby formal fishing access sites, including partnering with Yolo County to enhance the Clarksburg Fishing Access site on the west bank of the Sacramento River, and with the Sacramento County Department of Regional Parks to enhance the Cliffhouse Fishing Access site on the east bank of the Sacramento River and the Georgiana Slough Fishing Access site east of the Sacramento River, and with Contra Costa County to enhance fishing sites near Clifton Court Forebay, as well as other nearby sites. Prior to construction of the proposed water conveyance facilities, DWR will ensure adequate signage will be placed at the informal sites that would be directly affected by construction of the intakes, directing anglers to the formal sites. Upgrading the existing fishing access sites will be completed prior to beginning construction of the intakes.

EXHIBIT 9

Osha Meserve

From: Morrow, Michelle@DWR <Michelle.Morrow@water.ca.gov>
Sent: Wednesday, April 3, 2019 11:59 AM
To: Osha Meserve
Subject: RE: Prospect RDEIR

Hi Osha

Here is the link to our website where the air emissions information can be found (Appendix G of the original DEIR). https://water.ca.gov/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects.

We will not be extending the comment period on the RDEIR beyond 04/15/2019.

Thank you

Michelle Morrow
Assistant Chief Counsel
1416 9th Street Room 1104
Sacramento, CA 95814
michelle.morrow@water.ca.gov
(916) 653-7352

From: Osha Meserve <Osha@semlawyers.com>
Sent: Friday, March 29, 2019 4:55 PM
To: Morrow, Michelle@DWR <Michelle.Morrow@water.ca.gov>; Morrow, Michelle@DWR <Michelle.Morrow@water.ca.gov>
Subject: Prospect RDEIR

Hi Michelle,
For the Prospect RDEIR, may we please have the air emissions worksheets and their associated assumptions?

In addition, due to some ongoing negotiations regarding critical access from a neighboring landowner, I think DWR would benefit from holding the comment period open so other groups can delay submittal of detailed comments. Please call me to discuss.

Thanks,
Osha

Osha R. Meserve
Soluri Meserve
510 8th Street
Sacramento, CA 95814
☎ *tel:* 916.455.7300 ▪ *fax:* 916.244.7300 ▪ *mobile:* 916.425.9914 ▪ *email:* osha@semlawyers.com
This email and any attachments thereto may contain private, confidential, and privileged material for the sole use of the intended recipient.

EXHIBIT 10

Appendix 1A
Best Available Science

Note: All content of this appendix is newly adopted.

Best Available Science

The Delta Reform Act requires the Council to make use of the best available science in implementing the Delta Plan. Best available science is specific to the decision being made and the time frame available for making that decision. Best available science is developed and presented in a transparent manner consistent with the scientific process (Sullivan et al. 2006), including clear statements of assumptions, the use of conceptual models, description of methods used, and presentation of summary conclusions. Sources of data used are cited and analytical tools used in analyses and syntheses are identified. Best available science changes over time, and decisions may need to be revisited as new scientific information becomes available. Ultimately, best available science requires scientists to use the best information and data to assist management and policy decisions. The processes and information used should be clearly documented and effectively communicated to foster improved understanding and decision making.

Steps for Achieving the Best Science

Science consistent with the scientific process includes the following elements:

- Well-stated objectives
- A clear conceptual or mathematical model
- A good experimental design with standardized methods for data collection
- Statistical rigor and sound logic for analysis and interpretation
- Clear documentation of methods, results, and conclusions

The best science is understandable; it clearly outlines assumptions and limitations. The best science is also reputable; it has undergone peer review conducted by active experts in the applicable field(s) of study. Scientific peer review addresses the validity of the methods used, the adequacy of the methods and study design in addressing study objectives, the adequacy of the interpretation of results, whether the conclusions are supported by the results, and whether the findings advance scientific knowledge (Sullivan et al. 2006).

There are several sources of scientific information and tradeoffs associated with each (Sullivan et al. 2006, Ryder et al. 2010). The primary sources of scientific information, in a generalized ranking of most to least scientific credibility for informing management decisions, include the following:

- Independently peer-reviewed publications including scientific journal publications and books (most desirable)
- Other scientific reports and publications
- Science expert opinion
- Traditional knowledge

Each of these sources of scientific information may be the best available at a given time and contain varying levels of understanding and uncertainty. These limitations should be clearly documented when scientific information is used as the basis for decisions.

Guidelines and Criteria

There have been several efforts to develop criteria for defining and assessing best available science. In 2004, the National Research Council Committee on Defining the Best Scientific Information Available for Fisheries Management prepared a report (National Research Council Report) that concluded guidelines and criteria must be defined in order to apply best available science in natural resource management (National Research Council 2004). Major findings and recommendations included establishing procedural and implementation guidelines to govern the production and use of scientific information. The guidelines were based on six broad criteria: relevance, inclusiveness, objectivity, transparency and openness, timeliness, and peer review.

Best available science for proposed covered actions and for use in the Delta Plan should be consistent with the guidelines and criteria in Table 1A-1. These criteria were adapted from criteria developed by the National Research Council. Proponents of covered actions should document their scientific rationale for applying the criteria in Table 1A-1 (i.e., the format used in a scientific grant proposal).

Table 1A-1
Criteria for Best Available Science

Criteria	Description
Relevance	Scientific information used should be germane to the Delta ecosystem and/or biological and physical components (and/or process) affected by the proposed decisions. Analogous information from a different region but applicable to the Delta ecosystem and/or biological and physical components may be the most relevant when Delta-specific scientific information is nonexistent or insufficient. The quality and relevance of the data and information used shall be clearly addressed.
Inclusiveness	Scientific information used shall incorporate a thorough review of relevant information and analyses across relevant disciplines. Many analysis tools are available to the scientific community (e.g., search engines and citation indices).[a]
Objectivity	Data collection and analyses considered shall meet the standards of the scientific method and be void of nonscientific influences and considerations.
Transparency and openness	The sources and methods used for analyzing the science (including scientific and engineering models) used shall be clearly identified. The opportunity for public comment on the use of science in proposed covered actions is recommended. Limitations of research used shall be clearly identified and explained. If a range of uncertainty is associated with the data and information used, a mechanism for communicating uncertainty shall be employed.
Timeliness	Timeliness has two main elements: (1) data collection shall occur in a manner sufficient for adequate analyses before a management decision is needed, and (2) scientific information used shall be applicable to current situations. Timeliness also means that results from scientific studies and monitoring may be brought forward before the study is complete to address management needs[c]. In these instances, it is necessary that the uncertainties, limitations, and risks associated with preliminary results are clearly documented.
Peer review	The quality of the science used will be measured by the extent and quality of the review process. Independent external scientific review of the science is most important because it ensures scientific objectivity and validity. The following criteria represent a desirable peer review process[e]. Coordination of Peer Review. Independent peer review shall be coordinated by entities and/or individuals that (1) are not a member of the independent external review team/panel and (2) have had no direct involvement in the particular actions under review. Independent External Reviewers. A qualified independent external reviewer embodies the following qualities: (1) has no conflict of interest with the outcome of the decision being made, (2) can perform the review free of persuasion by others, (3) has demonstrable competence in the subject as evidenced by formal training or experience, (4) is willing to utilize his or her scientific expertise to reach objective conclusions that may be incongruent with his or her personal biases, and (5) is willing to identify the costs and benefits of ecological and social alternative decisions. When to Conduct Peer Review. Independent scientific peer review shall be applied formally to proposed projects and initial draft plans, in writing after official draft plans or policies are released to the public, and to final released plans. Formal peer review should also be applied to outcomes and products of projects as appropriate.

a. McGarvey 2007
b. National Research Council 2004, Sullivan et al. 2006
c. National Research Council 2004
d. Meffe et al. 1998
e. Adapted from Meffe et al. 1998

It is recognized that differences exist among the accepted standards of peer review for various fields of study and professional communities. When applying the criteria for best available science in Table 1A-1, the Council recognizes that the level of peer review for supporting materials and technical information

(such as scientific studies, model results, and documents) included in the documentation for a proposed covered action is variable and relative to the scale, scope, and nature of the proposed covered action. The Council understands that varying levels of peer review may be commonly accepted in various fields of study and professional communities.

References

McGarvey, D. J. 2007. Merging precaution with sound science under the Endangered Species Act. Bioscience 57: 65-70.

Meffe, G. K., P. R. Boersma, D. D. Murphy, B. R. Noon, H. R. Pulliam, M. E. Soule, and D. M. Waller. 1998. Independent scientific review in natural resource management. Conservation Biology 12: 268-270.

National Research Council, Committee on Defining the Best Scientific Information Available for Fisheries Management. 2004. Improving the use of "Best Scientific Information Available" Standard in Fisheries Management. National Academy Press, Washington D.C. Available from http://www.nap.edu/catalog.php?record_id=11045#toc. Accessed June 2011.

Ryder, D. S., M. Tomlinson, B. Gawne, and G. E. Likens. 2010. Defining and using "best available science": a policy conundrum for the management of aquatic ecosystems. Marine and Freshwater Research 61: 821-828.

Sullivan, P. J., J. M. Acheson, P. L. Angermeier, T. Faast, J. Flemma, C. M. Jones, E. E. Knudsen, T. J. Minello, D. H. Secor, R. Wunderlich, and B. A. Zanetell. 2006. Defining and implementing best available science for fisheries and environmental science, policy, and management. American Fisheries Society, Bethesda, Maryland, and Estuarine Research Federation, Port Republic, Maryland. Available at http://www.fisheries.org/afs/docs/policy_science.pdf. Accessed June 2011.

EXHIBIT 11

Mae Empleo

From: Mae Empleo <Mae@semlawyers.com>
Sent: Thursday, March 29, 2018 5:51 PM
To: 'Kaleigh.Maze@usace.army.mil'
Cc: Osha Meserve (osha@semlawyers.com); Chris Neudeck (cneudeck@ksninc.com); islandsfarmer@hotmail.com; 'jtootle@engeo.com'
Subject: LAND Comments re: Prospect Island Tidal Habitat Restoration (19227)
Attachments: 18.03.29 Section 408 LAND Comments.pdf

Dear Ms. Maze:

Attached please find the comments, which are submitted on behalf of Local Agencies of the North Delta on the Section 408 Notice for the Prospect Island Tidal Habitat Restoration project (19227). Thank you for your attention to this matter. Should you have questions, please do not hesitate to contact our office.

Sincerely,

Mae Ryan Empleo
Legal Assistant
Soluri Meserve, A Law Corporation
510 8th Street
Sacramento, CA 95814

☎ *tel:* 916.455.7300 ▪ *fax*: 916.244.7300 ▪ *mobile:* 559.361.5363 ▪ *email*: mae@semlawyers.com
This email and any attachments thereto may contain private, confidential, and privileged material for the sole use of the intended recipient.

SOLURI MESERVE
a law corporation

tel: 916.455.7300 · fax: 916.244.7300
510 8th Street · Sacramento, CA 95814

March 29, 2018

SENT VIA EMAIL (Kaleigh.Maze@usace.army.mil)

Kaleigh Maze, Biologist
U.S. Army Corps of Engineers, Sacramento District
1325 J Street, Room 1460
Sacramento, California 95814-2922

RE: U.S. Army Corps of Engineers, Sacramento District
Request for permission to alter a U.S. Army Corps of Engineers, Project under Section 408, Prospect Island Tidal Habitat Restoration (19227)

Dear Ms. Maze:

These comments are submitted on behalf of Local Agencies of the North Delta ("LAND")[1] on the Section 408 Notice for the Prospect Island Tidal Habitat Restoration project. It is our understanding that California Department of Water Resources ("DWR") through the Central Valley Flood Protection Board (["CVFPB"] non-federal sponsor of the federally authorized flood control project) is requesting from the U.S. Army Corps of Engineers ("USACE") to alter the Sacramento River Flood Control Project. This is an existing federal flood risk management project, authorized by the Flood Control Act of March 1, 1917, Public Law ("PL") 367, Sixty-fourth Congress. The current guidance for processing these requests is the Engineer Circular ("EC") 1165-2-216.[2][3]

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[1] LAND member agencies cover an approximately 120,000 acre area of the Delta. Current LAND participants include: Reclamation Districts 3, 150, 307, 317, 407, 501 551, 554, 744, 755, 813, 999, 1002, 2067, 2011 and the Brannon-Andrus Levee Maintenance District. Some of these agencies provide both water delivery and drainage services, while others only provide drainage services. These districts also assist in the maintenance of the levees that provide flood protection to homes and farms.

[2] http://www.publications.usace.army.mil/Portals/76/Publications/EngineerCirculars/EC_1165-2-216.pdf?ver=2016-09-01-111054-827

[3] The revised EC is currently undergoing review, and the public comment period ended on March 7, 2018. (See https://www.gpo.gov/fdsys/pkg/FR-2018-02-05/html/2018-02207.htm.)

LAND has been engaged with DWR to ensure that the flood protection of the adjacent Reclamation District 501 ("RD 501"), Ryer Island, does not have its project levee function impaired or damaged through the hydromodifications directly caused by this proposed action. RD 501 has asserted the injury to the public interest from recent historic flooding of Prospect Island, and the likelihood of both levee scour and seepage (and associated liquefaction) as a result of this proposed project. In addition, RD 501 has provided proposed detailed mitigation measures and monitoring actions to DWR to avoid these injuries. Finally, despite being publicly engaged for years on this issue, we did not receive notice of this permit request from the CVFPB or the USACE.

We have reviewed the relevant project submissions provided on your website,[4] including: Public Notice; Vicinity Map, Project Plan, Planting Plan, Invasives Removal Plan, Habitat Plan, Elderberry Map, GGS Habitat, T and E Species Effects. The "project plan" is simply 3 cartoon diagrams of the plan view of the project with some site features, but does not include topography or details regard levee degrading or berm slopes. This is not a project plan sufficient to meet *any technical review* of this project, and the provided information lacks any engineering information. The other provided materials purport to have some additional project information, but instead are cursory drawings or simple tables.

The USACE's authority is contained in the following 2-part test (Section 14 of the Rivers and Harbors Act of 1899 and codified in 33 USC 408): (T)hat the Secretary may, on the recommendation of the Chief of Engineers, grant permission for the alteration or permanent occupation or use of any of the aforementioned public works when in the judgment of the Secretary such occupation or use will not be injurious to the public interest and will not impair the usefulness of such work.

Pursuant to applicable authorities, the application is incomplete, and further appears to fail to analyze or even acknowledge:

1. Obvious injuries to the public interest from environmental impacts, including that the issues are well-identified as matters of public controversy, and
2. The alterations or modification(s) of the public works would result in significantly degraded conditions in areas adjacent to the project.

Moreover, the proposed project as submitted appears on its face to be non-responsive to the basic requirements of the alteration request and fails to provide required substantiation according to EC 1165-2-216, including but not limited to:

[4] http://www.spk.usace.army.mil/Media/USACE-Project-Public-Notices/

> k. Authorized Project Purpose. No granting of permission is allowed under Section 408 for a proposed alteration that would have an effect of deauthorizing a project or eliminating an authorized project purpose.
>
> l. Completeness. Requests must be for complete alterations. A proposed alteration is considered complete if it results in a fully functional element once construction is completed.
>
> m. Design and Construction Standards. A proposed alteration pursuant to Section 408 must meet current USACE design and construction standards. However a requester is not required to bring those portions or features of the existing USACE project that are not impacted by the alteration up to current USACE design standards.
>
> n. Hydrologic and Hydraulics Impacts. As a general rule, proposed alterations that will result in substantial adverse changes in water surface profiles will not be approved.

(EC 1165-2-216, pp. 4-5)

This project would breach flood control berms, reduce effective levee height, and eliminate applicable flood design standards for an undisclosed length of project levee. This is all without providing concurrent improvements and/or mitigation measures to other project structures, and places adjacent authorized flood control structures at direct risk from seepage, scour or breaching. Apparently, no hydraulic modeling is provided in support of this application.

There is no information regarding the modifications to the levee/berm, its initial and final cross-section, profiles, and flow modifications during and post-construction. The only "details" as to construction on the slough are found in the T and E Species Effects Attachment. Even then, there is no actual analysis, observation documentation, impacts assessment, mitigation or any kind of project species impact information found in that attachment.

We require the project engineering design drawings, Hydrologic Engineering Center modeling, scour analysis, and sediment deposition modeling to understand the flood flow modifications at various stage heights, flow impacts, and the potential impacts to Delta Smelt in the adjacent Cache Slough. We require the project adequately evaluate the seepage impacts onto adjacent lands associated with the proposed flooding of Prospect Island. RD 501 has a long history of seepage impacts associated with the

flooding of Prospect Island and has engaged ENGEO, a Geotechnical Engineering firm, to prepare a seepage Impact Analysis.

These physical changes to the project flood protection purpose, incompleteness of the provided application, including but not limited to lack of any design standard for existing or proposed alterations, and any other supporting engineering information fail to provide the public any understanding of the proposed alterations and resulting impacts on the public interest, and further require Headquarters review.[5]

As this project is a matter of significant public controversy (shown in our prior comments on this project to DWR, which are included herewith[6]) and the complete lack of supporting application information, the public comment period should be extended for at least 60 days after the complete Section 408 application is made available to the public for review. In addition, at least one public meeting should be held in the vicinity of the project area. In summary, the information provided in the notice is simply insufficient for any substantive public comment under the National Environmental Policy Act and Section 14 and Section 10 of the Rivers and Harbors Act.

Very truly yours,

SOLURI MESERVE
A Law Corporation

By: 
Osha R. Meserve

ORM/mre

cc (via email): Tom Hester (islandsfarmer@hotmail.com)
Chris Neudeck (cneudeck@ksninc.com)
Josef Tootle (jtootle@engeo.com)

Attachment 1: Comments from Local Agencies of the North Delta on Prospect Island Tidal Habitat Restoration Project (November 7, 2016)

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[5] http://cvfpb.ca.gov/wp-content/uploads/2016/11/20161110_Section-408-Interim-Guidance-for-Decision-Level.pdf

[6] See, e.g., Attachment 1, Comments from Local Agencies of the North Delta on Prospect Island Tidal Habitat Restoration Project (November 7, 2016).

ATTACHMENT 1

LOCAL AGENCIES OF THE NORTH DELTA

1010 F Street, Suite 100, Sacramento, CA 95814
(916) 455-7300, osha@semlawyers.com

November 7, 2016

SENT VIA EMAIL (Dan.Riordan@water.ca.gov)

Dan Riordan
California Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236

RE: Comments from Local Agencies of the North Delta on Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

These comments on the proposed Prospect Island Tidal Habitat Restoration ("project") are submitted on behalf of the Local Agencies of the North Delta ("LAND"). LAND is a coalition comprised of reclamation and water districts in the northern geographic area of the Delta.[1] As local agencies in the areas most impacted by the restoration projects such as that now proposed on Prospect Island, we are providing these comments to assist in the design and environmental analysis of this project so that it achieves the project goals, and provides effective mitigation of project impacts to nearby flood protection facilities and agricultural operations.

Generally, we are disappointed that Department of Water Resources ("DWR") has not responded to our comments on the Notice of Preparation submitted on November 4, 2014. Upon review of the Draft Environmental Impact Report ("DEIR") for the project, there is a systematic failure to respond to our technical comments or even to our general environmental impacts comments in in any substantive way. Our comments in this letter do not attempt to catalog every possible issue, but rather, expand on specific technical environmental impacts based on our prior comments and discussions with staff. These comments are in addition to comments from other LAND-associated Reclamation Districts ("RDs"). In response to these deficiencies, we have developed an immediate process by which we feel that these impacts can be mitigated and address the local

[1] LAND member agencies cover an approximately 110,000 acre area of the Delta; current LAND participants include Reclamation Districts 3, 150, 307, 317, 349, 407, 501, 551, 554, 556, 744, 755, 813, 999, 1002, 2111, 2067 and the Brannan-Andrus Levee Maintenance District. Some of these agencies provide both water delivery and drainage services, while others only provide drainage services. These districts also assist in the maintenance of the levees that provide flood protection to homes and farms.

concerns about the impacts of the proposed project. We are again reiterating that offer to work together toward a project that is both beneficial for the Delta ecosystem and also acceptable to local landowners and districts. In particular, we would like to follow up informally on our conversation in West Sacramento last week, which discussed ways in which the concerns outlined below could be addressed in a mutually beneficial manner.

I. COMMENTS

Habitat projects in the Delta have had a variety of outcomes, many of which are not intentional or even fully understood. LAND has actively worked with DWR and other parties to attempt to better understand the potential impacts of these habitat projects on reclamation and water districts, as well as agricultural operations and residents. The results of millions of dollars of restoration efforts in the Delta have been poorly documented, poorly monitored, and ecologically uncertain. For instance, despite over 40,000 acres of publically held or managed intertidal and open water habitat in the Delta primary zone, and 116,000 acres in Suisun, native fish species declines do not appear to be stabilizing. Moreover, the vast majority of publically held land in the Delta receives little or no invasive weed management, ecological monitoring, or any ecological-oriented site management.

Though past restoration successes have been limited, we believe it is possible for the proposed project to be a showcase for effective community and RD engagement in the context of habitat creation or restoration projects in the Delta. To that end, LAND proposes that the project planning consider, and implement key project features and address the underlying scientific, technical and economic questions before proceeding on the project. Our comments are organized into the following categories and discussed in detail below: Communications, Technical Premises, Mitigation, Monitoring and Funding, Operations and Maintenance, Water Rights and New Diversion, Good Neighbor Issues, and Adaptive Management.

Issue 1 – Communications

DWR had initially undertaken direct communications with the local RDs and LAND, and has also provided a field visit to discuss the proposed project features. These efforts were very important for the common understanding of the physical elements of the project, as well as understanding of the potential impacts of the project and possible mitigation under CEQA. LAND appreciated those efforts and urges their expansion for this and future projects. We are concerned that DWR has failed to respond systematically to these comments and failed to take advantage that such communications can lead to early inclusion of project features to enhance compatibility with adjacent land

uses and effective mitigation from the outset, thereby avoiding conflict. We still believe that the long-term success of the project will require the clear communication with neighboring landowners and RDs.

Issue 2 – Technical Premises

LAND has found that in some cases that the scientific basis for the habitat restoration in the Delta is thin at best and is far likelier to improve conditions for the very invasive species that currently "stress" the Delta ecosystem. It is important that the technical basis for restoration elements be clearly articulated, and where habitat creation is being used, that that premise is identified as well. Under the existing conditions (baseline) there is high riparian and wetland bird use at the site; thus, the explicit tradeoffs between current uses by species and projected benefits for other species in the future need to be identified.

Elevations

LAND has reviewed several LiDAR elevation figures for the island and it appears that there may be some discrepancies associated with the current elevations and the proposed design elevations. It would be critical for the success of the project that an independent review by a licensed surveyor of the survey, bathymetry, and LiDAR data occur to ensure that the vertical datum and the control points for these data are correct and consistent. The vertical error associated with some LiDAR data in general and the use of too widely spaced control points can lead to significant cut and fill errors that will prevent the project from meeting its design requirements.

Salinity, Nutrients and Toxins

The project design has a high possibility of altering local tidal dynamics, sediment deposition in and around Cache Slough, reducing available nitrogen, and increasing salinity. Suisun Marsh projects and their operations have a clear potential to change tidal dynamics and salinity intrusion throughout the northern Delta; when those effects are combined with this project and other DWR' barrier projects throughout the Delta, there are similar confounding effects, which must be identified and planned for effectively.

The same complexities are associated with the premise that nutrients would be exported from this site. The tradeoffs between nutrient cycling that occurs there now and the proposed conditions should be analyzed. For example, any unoxidized organic matter currently being trapped onsite would be exported, with greenhouse gas implications, which must identified. This would also include the need for analysis of localized

eutrophication and toxic cyanobacterial blooms, and conversely the depletion of local nitrogen and reduction of productivity in the Cache Slough complex.

Accordingly, the project's facilitation of invasive aquatic weeds and invasive clams, and the potential for new mussel invasions must be fully analyzed. For example, if the project intent is to export nutrients, how will the project ensure that it simply does not promote these invasives and export methylmercury (dissolved and sediment-associated) into the food chain?

Sediment

Sediment dynamics must be fully disclosed. The site sediment mechanics (assessing the local distribution of sediment) need to be fully described from a seasonal, as well as an early and late project perspective. The local-regional sediment balance should also be identified, and the implications of the long-term decline of sediment in the Sacramento River system on the project performance should be fully described. Equally importantly, the implications on sediment mechanics as a result of this project on other nearby locations should also be described.

Sediment plays a complex role in aquatic ecosystems. Too much sediment in high elevation streams can cause significant water quality problems and lead to fish declines. In the Delta however, sediment provides visual cover for some fish, such as Delta smelt, which protects them from predators. Sediment is also the building block for streambanks through over bank deposits. Sediment is critical for the maintenance of floodplains and the associated riparian habitat by creating the new locations for plants to grow and for creating and maintaining topographic complexity.

Reductions in stream sediment loads can also lead to scouring, whereby previously accumulated sediment is stripped and mobilized from existing floodplains. Project-associated invasive aquatic (and some terrestrial) weeds can also lead to the additional removal of sediment, exacerbating this problem.

Seepage and Erosion

The extent and impact of project-associated seepage and wave run-up at any levee breaks is unclear. The seepage modeling should be supported with a tracer study, and a 3–dimensional analysis for erosion on neighboring levees. Optimization of intake locations to minimize hydraulic effects is also essential. Inclusion of operable gates could also minimize impacts of the project on neighboring levees. Additionally, construction of cutoff walls, installation of interception wells, or other means, may be

necessary to control seepage to adjacent islands. Moreover, mitigation in the form of levee maintenance funds for the neighboring islands will likely be necessary due to hydraulic and other effects of the project. Wind fetch effects could feasibly be monitored with bank pins.

Weed Management

Terrestrial weeds such as perennial pepperweed and *Arundo donax*, which interfere with crops and levee maintenance, and aquatic weeds, such as Hydrilla, Hyacinth and Egeria, which clog pumps and wildlife impacts, have to be carefully managed and their management fully funded for the life of the project. The DEIR includes no weed management beyond initial construction.

Issue 3 – Mitigation, Monitoring and Funding

Mitigation, monitoring and reporting plans ("MMRP") are required by CEQA and this project will have ongoing impacts that will require follow-up and long-term funding. This project will be under considerable scrutiny to ensure it meets these requirements, as this is just one project among about 28,000 acres of habitat creation requirements already required by the currently applicable Biological Opinions. Currently, the erroneous less-than-significant conclusions for virtually every impact of concern to local interests has led to a complete lack of mitigation.

All impacts that require mitigation must be clearly identified in the MMRP and be adequately funded. The funding should include adequate compensation for the expected types and extents of impacts with a contingency. Typical small claims of road and fence damage, damage to irrigation and drainage facilities, localized groundwater impacts from dewatering or restoration, weed management issues, and loss of access to property can be handled in an expeditious and fair manner by maintaining a mitigation fund for the project. For instance, funding for levee stability if erosion occurs on neighboring levees should be clearly identified. Weeds and the island's own remaining levees will require routine maintenance, as will ongoing environmental monitoring under adaptive management.

Issue 4 – Operations and Maintenance

Operations and maintenance are where these projects typically fail to meet their goals and objectives. The Delta has numerous examples of "restoration projects" that have environmental impacts that were not intended. A long-term management plan and associated funding are critical to maintain these goals and objectives and to meet the

requirements under CEQA. A passive management approach will not suffice. The current condition of the island is a direct result of the passive approach and a lack of funding.

Issue 5 – Water Rights and New Diversion

We believe that the project should still identify the source and legal rights to water. (*Cf*. DEIR, pp. 3-36 to 3-37.) Specifically, the project must identify the legal water rights basis (including compliance with the no injury rule), and the point of diversion by which water will be diverted away from the Miner Slough and drained into the Sacramento Deep Water Ship Channel/Cache Slough Complex. The environmental impacts of diverting additional water from the slough must also be addressed. According to DWR data, open water and riparian vegetation consume about 67.5 acre-feet per year, which is much greater than most agricultural uses. (See Exhibit A.)[2] Additionally, the project's potential to further reduce outflow must also be considered.

Issue 6 – Good Neighbor Issues

An ongoing focus of LAND has been to minimize the local impacts from restoration projects. In general, the project should include "good neighbor policies." This includes adequate planning, monitoring and maintenance funding to ensure that impacts such as seepage, increased levee erosion, invasive weeds, and other issues are managed effectively so as not to interfere with adjacent and nearby land uses. It is important that the project description and/or mitigation measures include good neighbor principles. DWR has developed a Good Neighbor Checklist as part of its Agricultural Land Stewardship Strategies effort for projects that should be consulted in the development of this project. (See Exhibit B.)

As discussed in this letter, neighboring landowner impacts from this project requiring special attention are:

- Loss of agricultural productivity/crop damage from seepage;
- Damage to levees from wind fetch, increased wave action and changes in flow patterns;
- Increased flood risks from levee damage and changes in flow patterns;

[2] Department of Water Resources, Bulletin 168 (October 1978) titled, "Sacramento Valley Water Use Survey 1977," Table A-5 (showing 1976-77 Estimated Crop Evapotranspiration Values for the Delta Service Area).

- Impairment of water quality and reduced surface water availability;
- Increased terrestrial and aquatic weeds leading to crop damage and damage to water diversions;
- Endangered Species take jeopardy by listed species introduction/enhancement of habitat;
- Sound, dust and traffic from construction and ongoing maintenance; and
- Damage to roads and levees along the travel route to the site from heavy equipment needed for construction and ongoing maintenance.

The DEIR should be revised to analyze and provide adequate mitigation for these impacts. Unfortunately, the DEIR does not mention good neighbor policies at all. We would like to work with DWR to address these issues, as discussed at our meeting last week.

One issue that still requires attention is the potential for increased take liability concerns for operation of existing water diversions in the vicinity of the project. If the project is successful in improving conditions for listed fish (an explicit goal), listed species may become more abundant than they are currently. Though local intakes are not currently a cause of concern with respect to take of listed species,[3] that could change as a result of the project. Thus, the project should include some means to extend take coverage to these intakes, or otherwise provide assurances, if needed.

Though this issue can be complex, on the project-level, there are means by which this issue could be addressed, for instance, through extension of take coverage to neighboring landowners in the C/ESA permitting processes. A low effects HCP could also be a possibility for the surrounding area. There is also the option of the project including funding for screening or other improvements to neighboring intakes in determined necessary to prevent the possibility of take (even though they are below the size on which the fish agencies have been most focused). The key is to create *no-harm*

---

[3] "[S]mall agricultural Delta agricultural diversions are likely to have a minor effect on pelagic (open water) fish, such as the [D]elta smelt." (Ecosystem Restoration Program, Ecosystem Strategy for Stage 2 Implementation Sacramento San Joaquin Delta Ecological Management Zone July 21, 2010 report, p. 50, citing Nobriga, M., Z. Matica, and Z. Hymanson. 2004. Evaluating Entrainment Vulnerability to Agricultural Irrigation Diversions: A Comparison Among Open-Water Fishes. American Fisheries Society Symposium 39:281-295, available at: http://www.fws.gov/stockton/afrp/SWRCB/12.%20Nobriga%20et%20al.%202004.pdf. As a result, larger diversions (over 250 cfs), have been the focus for consideration of screening by state and federal agencies.

strategy for existing Delta water users, which will in turn prevent negative impacts on neighboring agricultural land uses. We discussed this issue extensively with DWR staff in the context of the now abandoned BDCP, and are willing to continue the dialogue in the context of this project, which should be much more straightforward in comparison.

Issue 7 – Adaptive Management

The project needs to include functional adaptive management features, specifically including an operable gate to control the connection of the slough to the restoration. The only means by which the project can minimize or mitigate its salinity intrusion and methylmercury production is through operable water control structures. These structures can also be used to manage aquatic and terrestrial weeds and aquatic primary production. While a passive spill system may seem ideal from an engineering standpoint, it fails to meet several significant environmental considerations. Currently, incoming water to the island is managed through a controlled gate, and to apply adaptive management in any substantive sense, gates and/or other operable structures will be necessary. We understand an adaptive management plan is being prepared, and would like to have input into the final plan.

II. CONCLUSION

LAND and local communities continue to desire a positive outcome from the Prospect Island restoration. With successful collaboration, this project *could be* the hallmark of ecological improvements and functional restoration with minimal impacts on adjacent flood control structures and agriculture. Alternatively, this project could become the hallmark of irresponsible reclamation that is not sensitive to existing adjacent land uses and users. LAND would like to see this project succeed not just on paper, but in practice. To do anything less will create yet more barriers to the completion of future restoration projects.

Very truly yours,

SOLURI MESERVE
A Law Corporation

By: 
Osha R. Meserve

ORM/mre

Enclosures: Exhibit A - DWR Bulletin 168 (October 1978), Table A-5
Exhibit B – DWR Good Neighbor Checklist

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EXHIBIT A

TABLE A-5
1976-77 Estimated Crop Et Values
Delta Service Area
(in inches)

Land Use Category	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Total Oct.76-Sep.77	Oct.77	Total Nov.77-Oct.77
Sacramento-San Joaquin Delta															
Irrigated Pasture	3.2	1.5	1.0	0.7	1.5	3.6	5.4	4.8	6.9	7.7	6.4	4.7	47.4	3.4	47.6
Alfalfa	3.2	1.5	1.0	0.7	1.5	3.2	4.9	4.4	6.5	7.5	6.5	4.9	45.8	3.4	46.0
Deciduous Orchard (Fruits & Nuts)	2.6	1.5	1.0	0.7	1.5	2.7	3.8	4.0	6.1	7.4	6.1	4.3	41.7	2.6	41.7
Tomatoes	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.6	4.0	8.2	6.0	2.3	34.3	1.9	33.8
Sugar Beets	2.4	1.5	1.0	0.7	1.5	1.9	2.2	3.7	7.6	8.3	6.4	4.4	41.6	2.4	41.6
Grain Sorghum (Milo)	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.0	5.9	7.3	4.3	2.5	33.2	1.9	32.7
Field Corn	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.3	5.7	6.9	5.1	2.6	33.8	1.9	33.3
Dry Beans	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.7	5.7	6.2	2.7	2.5	30.0	1.9	29.5
Safflower	2.4	1.5	1.0	0.7	1.5	1.9	2.5	4.8	8.7	7.7	4.4	2.5	39.6	1.9	39.1
Asparagus	2.4	1.5	1.0	0.7	1.5	1.9	2,2	1.0	3.5	7.7	6.4	4.7	34.5	2.4	34.5
Potatoes	2.4	1.5	1.0	0.7	1.5	1.9	2.2	1.7	4.3	7.4	5.5	2.8	32.9	1.9	32.4
Irrigated Grain	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	1.0	1.0	1.6	26.1	1.6	24.7
Vineyard	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.8	5.3	6.5	5.3	3.4	34.5	2.4	34.5
Rice	3.2	1.5	1.0	0.7	1.5	1.9	2.8	5.6	8.8	9.8	8.1	5.5	50.4	3.4	50.6
Sudan	2.4	1.5	1.0	0.7	2.0	4.3	5.7	4.8	6.9	7.7	4.9	4.7	46.6	2.4	46.6
Misc. Truck	2.4	1.5	1.0	0.7	1.5	1.9	3.2	4.6	6.7	7.4	5.2	3.7	39.8	1.9	39.3
Misc. Field	2.4	1.5	1.0	0.7	1.5	1.9	2.2	2.4	6.1	7.4	5.0	1.9	34.0	1.9	33.5
Double Cropped with Grain															
Sugar Beets	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	4.2	5.2	5.8	37.7	3.4	38.7
Field Corn	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	4.3	6.3	6.1	39.2	2.7	39.5
Grain Sorghum (Milo)	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	1.8	2.7	6.1	5.2	36.5	1.9	36.0
Sudan	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	3.6	7.7	4.9	4.7	41.6	1.9	41.1
Dry Beans	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	3.1	7.6	3.5	1.5	36.4	1.9	35.9
Tomatoes	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	2.3	6.6	6.0	5.2	40.8	1.9	40.3
Lettuce	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	4.1	7.4	5.3	4.9	42.4	2.4	42.4
Misc. Truck	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	2.3	6.6	6.0	5.2	40.8	2.4	40.8
Misc. Field	2.4	1.5	1.0	0.7	2.0	4.3	5.7	3.1	4.1	7.4	5.3	4.9	42.4	3.4	43.4
Fallow Lands 1/	2.4	1.5	1.0	0.7	1.4	1.0	1.0	1.0	1.0	1.0	1.0	1.0	14.0	1.0	12.6
Native Vegetation 2/	2.4	1.5	1.0	0.7	1.4	3.7	3.8	2.1	2.3	2.6	2.3	2.0	25.8	1.6	25.0
Riparian Veg. & Water Surface	4.6	2.4	1.4	0.8	1.9	4.5	7.4	6.6	9.7	11.8	9.7	7.0	67.8	4.3	67.5
Urban	1.6	0.8	0.6	0.7	1.0	1.0	1.9	2.4	2.4	2.5	2.4	1.9	19.2	1.6	19.2

1/ Applies also to nonirrigated grain.
2/ Applies also to nonirrigated orchards and vineyards

Metric conversion: inches times 25.4 equals millimetres.

EXHIBIT B

Good Neighbor Checklist

The Sacramento-San Joaquin Delta (Delta) is the home of numerous habitat restoration efforts. Many Delta farmers are concerned that habitat lands could harm nearby agriculture in various ways. They would like assurance that entities that establish and manage habitat projects will consult with their neighbors and find ways to avoid impacts and resolve problems if they arise.

Restoration project managers can use the following checklist to ensure that they comprehensively consider and examine the impacts of their project on neighbors, and vice versa. The checklist is based on a discussion paper, "Agricultural and Land Stewardship Strategies" (see https://agriculturallandstewardship.water.ca.gov), which identifies a menu of mitigation measures and enhancements for the Delta. The measures described in the discussion paper, called Strategies, are referenced in the checklist.

- ☐ Have project proponents consulted with all neighboring landowners and operators about the project and its potential impacts? (See Strategy E1.1, which recommends involvement of landowners in project planning.)
- ☐ Have project proponents designated a local contact person to meet with neighboring landowners and discuss any issues of concern? (See Strategy D5.1, which suggests establishment of a public advisor position to help the public work with government agencies.)
- ☐ Will the project need access through other properties? If so, have access agreements been obtained?
- ☐ Does the management plan for the project provide for an on-site patrol or manager to deter trespass and vandalism? (See Strategy A4.3, which suggests the hiring of game wardens, sheriff's deputies, or private security guards.)
- ☐ Will the project increase the presence of vegetation susceptible to fire? (If yes, see Strategy A4.3.)
- ☐ Will the project discontinue maintenance of flood control features, involve prolonged or repeated flooding of previously dry land, or affect wind fetch across waterways? (If yes, see Strategy A1, which discusses flood protection improvements, and Strategy E1.3.2, which discusses drainage and seepage.)
- ☐ As a result of the project, are species on the project site expected to increase markedly in abundance and move from the site to neighboring lands or waterways? If yes, which species? (And see Strategy A4.2, which suggests ways to protect landowners from liability under endangered species laws.)
- ☐ Is it reasonably possible that species in the project area could damage crops or promote the growth of weeds or diseases on neighboring farms? (If yes, see Strategy A3, which suggests ways to control weeds, and Strategy A4.1, which

suggests the use of buffer zones and mechanisms for compensation for crop damages.)

- Will the project disturb utilities, roads, bridges, or other infrastructure that serve agricultural uses? (If yes, see Strategy D3, which suggests improvements to transportation infrastructure.)
- Will the project fragment or isolate farmland? (If yes, see Strategy E1.1, which encourages collaborative project planning.)
- Do domestic or feral animals or livestock occur on lands neighboring the project? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)
- Do neighboring farms use chemicals as fertilizer, or to control weeds or crop pests? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)

EXHIBIT 12

UC Agriculture & Natural Resources
California Agriculture

Title
Yellow starthistle continues its spread in California

Permalink
https://escholarship.org/uc/item/55x5p3kw

Journal
California Agriculture, 60(2)

ISSN
2160-8091

Authors
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Publication Date
2006-04-01

Peer reviewed

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Yellow starthistle continues its spread in California

by Michael J. Pitcairn, Steve Schoenig, Rosie Yacoub *and* John Gendron

Yellow starthistle is an exotic invasive weed that is estimated to infest over 14 million acres in California and is considered the most common exotic weed statewide. We reviewed several previous studies and conducted a township survey to provide an up-to-date analysis of the weed's rapid spread throughout the state. A county-by-county comparison between 1985 and 2002 showed increases in yellow starthistle in all regions of the state except for northeast California and the southeast desert region. Currently, most infestations occur in Northern California, but future invasions and spread will likely occur in the coastal counties of Southern California.



Baldo Villegas/CDFA

Yellow starthistle is the fastest-moving and most-widespread invasive, nonnative plant in California history. Dale Woods of the California Department of Food and Agriculture and Bill Bruckart of the U.S. Department of Agriculture examine the weed in Placer County.

Yellow starthistle is an exotic, noxious weed commonly found in rangelands and along roadsides and walking trails throughout California. Approximately 1-inch-long spines extend from the flower heads in a starlike pattern, giving rise to its common name of "starthistle." These spines are a bane to hikers and discourage feeding by grazing animals. Although not toxic to most animals, yellow starthistle (*Centaurea solstitialis* L. [Asteraceae]) is poisonous to horses and can cause brain lesions that may eventually kill them (Cordy 1978). Yellow starthistle favors disturbed soils but is also capable of invading undisturbed areas. Once this weed gains a foothold, it can build up dense populations that displace native and other desirable vegetation. Yellow starthistle is native to the Mediterranean climates of southern Europe and northern Africa and was first recorded in California near Oakland (Alameda County) in 1869. It is now considered the most common weed in the state.

Yellow starthistle was likely introduced many times to California as a contaminant of alfalfa seed (DiTomaso and Gerlach 2000). In the late 1800s, alfalfa seed from Europe, Asia and South America was imported for planting in the Sacramento Valley, and early records show that yellow starthistle was a frequent contaminant in these shipments. By 1917, this weed was common along roads, trails, ditches and railroad tracks throughout the Sacramento Valley (DiTomaso and Gerlach 2000). Yellow starthistle's primary means of spread is through human activity. The weed's seed can be transported over long distances by automobiles and earth-moving equipment, and in contaminated soil, crop seed and hay. More locally, the seed can be carried on animal fur and hiking boots and clothing, and by moving water. Wind does not appear to be an effective dispersal method.

Previous infestation estimates

Since the late 1950s, three estimates of the number of acres infested by yellow starthistle in California have been undertaken (Maddox and Mayfield 1985). The first, by the California Department of Food and Agriculture (CDFA), used responses from a questionnaire sent to county agricultural commissioners in 1958; the infested acreage of yellow starthistle was estimated at approximately 1.2 million acres (486,000 hectares). A similar survey undertaken by CDFA in 1965 found an estimated 1.9 million infested acres (769,000 hectares).

Donald Maddox and Aubrey Mayfield performed the third estimate 20 years later, in 1985. They also distributed questionnaires to the county agricultural commissioners but included UC Cooperative Extension farm advisors and other interested parties as well. Maddox and Mayfield estimated the number of acres infested with yellow starthistle at approximately 7.9 million acres (3.2 million hectares), a four-fold increase from 1965.

Unlike the previous two surveys, Maddox and Mayfield (1985) also reported the infested acreage by county and identified those with high and low infestation levels. High infestation counties had at least 1,000 acres (405 hectares) of yellow starthistle. In 1985, 38 of California's 58 coun-



Baldo Villegas/CDFA

A native plant of southern Europe and northern Africa, yellow starthistle was first recorded in California near Oakland in 1869.

Starthistle abundance guidelines

The following descriptions were provided to cooperators in the township survey to provide guidance in scoring yellow starthistle abundance.

Low:

- Only a single plant was found in the township.
- The only plants found were scattered plants and confined to the roadsides.
- Plants were scattered throughout the township, but did not occur in high densities.
- No dense patches or a few small, dense patches (< 10 acres) were observed.

High:

- Plants occurred primarily along roadsides, and quite dense for several miles.
- Plants not confined to roadsides, but observed throughout neighboring fields.
- Dense patches of plants > 10 acres found in at least three sections.
- Everywhere you looked you saw yellow starthistle plants.

ties had high infestation levels, with Lake County the highest, followed by Siskiyou, Humboldt and Trinity counties. Six counties reported no infestations: Alpine, Imperial, Inyo, Mono, Orange and San Francisco. In addition, Maddox and Mayfield grouped the county estimates into seven regions that represented the state's major drainage areas. The Sacramento and North Coast drainages had the highest infestation acreage, representing over 76% of the total reported acreage of yellow starthistle for the state.

Maddox and Mayfield's survey showed that the invasion and spread of yellow starthistle in California differed regionally. Northern California had more areas with high infestation levels and Southern California had fewer invaded areas, especially in the South Coast and San Joaquin drainages. This difference was attributed to the Northern California infestations having been in place longer than those in Southern California. Other regions with low infestation levels, such as the higher elevations of the Sierra Nevada and the Sonora and Mojave deserts, were believed to have climates that limit population growth and resist invasion by yellow starthistle.

Knowing the distribution of an invasive weed is of direct importance to its management. If an uninfested area is climatically unsuitable for yellow starthistle, then control efforts may not be necessary. However, if an area susceptible to yellow starthistle has not yet been infested, it might be feasible to control this noxious weed before it becomes abundant and impractical to manage. Studies have shown that controlling exotic weeds at the early stages of invasion is the most successful and cost-effective strategy (Randall 1996; Rejmanek and Pitcairn 2002).

Planning and prioritizing control measures at the regional level requires detailed knowledge of the target weed's distribution. For example, the U.S. Department of Agriculture and CDFA are implementing a statewide distribution effort of several biological control insects for yellow starthistle. For this effort to be successful, it is critical to know where yellow starthistle occurs so that all infestations are targeted for releases (Villegas 2001a, 2001b; Woods and Villegas 2005).

Surveying occurrence by township

To provide a more detailed and more recent assessment of the spread of yellow



Joe DiTomaso

Human activity, such as the use of automobiles and agricultural equipment, is the primary means of dispersal for yellow starthistle seeds. While nontoxic to most animals, it causes neurological diseases in horses. High densities crowd out native vegetation, discourage grazing and annoy hikers.

starthistle statewide, we performed a survey of its occurrence by township. A legal township in the Federal Public Lands Survey is a 6-mile-by-6-mile square (9.6-kilometers-by-9.6-kilometers). Early land surveyors throughout much of California established townships in the late 1800s. We purchased county maps and used markers to highlight the grid of township borders printed on them. For areas where townships were not established, such as many of the early Spanish land grants, we used markers to extend the grid into those areas.

These marked-up county maps were distributed to CDFA's Weed and Vertebrate Program biologists, who coordinate the eradication of noxious weeds throughout the state. We asked that each township be given a score of "0" for no yellow starthistle plants, "1" for low abundance and "2" for high abundance. Guidelines were provided as to what constituted low and high abundance (see box, page 84). Some program biologists completed the maps themselves, while others distributed them to the county agricultural commissioners in their districts. The township grid survey was performed in 1996 and 1997. All information collected during the survey was transferred into a geographic information system (GIS) database and a preliminary map of yellow starthistle in California was produced (Pitcairn et al. 1998).

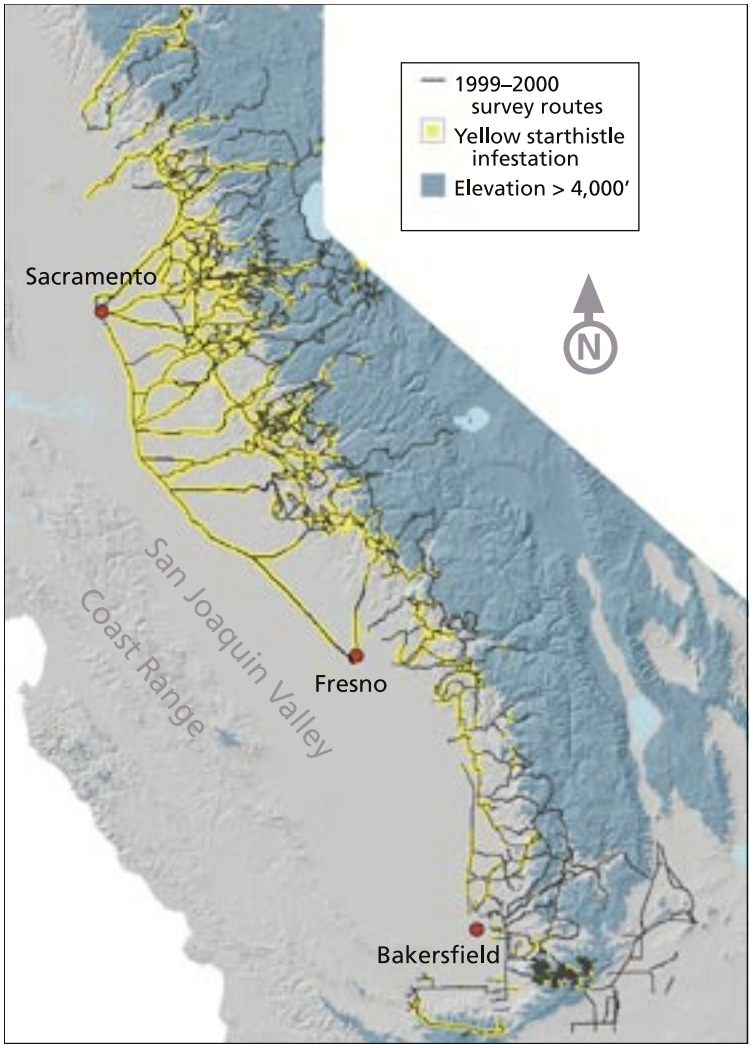

Fig. 1. Surveys of roads in the Sierra Nevada in 1999 and 2000 showed yellow starthistle to be less common at elevations above 4,000 feet (1,220 meters).

Sierra Nevada and Kern County. In compiling the township grid data, we learned that knowledge of the occurrence of yellow starthistle was particularly weak or missing in the mid-elevations of the Sierra Nevada and throughout Kern County. Both areas are important transitions from the Central Valley to the mountains in the east and the desert in the southeast, respectively. Before a final map of yellow starthistle in California was produced, we examined these two areas more closely. Information on the occurrence of yellow starthistle in Kern County was provided by the agricultural commissioner's office, which performed a local noxious weed survey in 2000.

In cooperation with the California Department of Transportation, in 1999 we surveyed for yellow starthistle along 14 major roads crossing the Sierra Nevada as well as along many of the smaller roads in between them. The objective was to identify how far yellow starthistle had spread into the higher elevations. If control efforts were focused on local eradication of new, incipient populations, large tracts of important public and private land might be protected from invasion. In addition, the infested acreage along the advancing front of the invasion might be relatively small and control costs low, especially compared to the value of the area to be protected.

The survey was broken into three phases: a general survey of the highway roadsides, a survey of areas beyond the right-of-way to determine how far yellow starthistle extended away from the roadside, and a resurvey of the upper elevations to determine if plants that germinated later in the season were missed during the survey's first phase. Surveyors used global positioning systems (GPS) to mark yellow starthistle locations, and all data were entered into a GIS database.

In 2000, we coordinated a survey over the same geographic area, taking advantage of the recently formed Weed Management Areas to acquire contacts from many different private and public landowners throughout the region. Weed Management Areas are local coalitions of public and private landowners that work on invasive weeds. They typically include representatives from state and federal agencies with land in the area, land managers from local park districts, large private landowners and concerned citizens. We incorporated

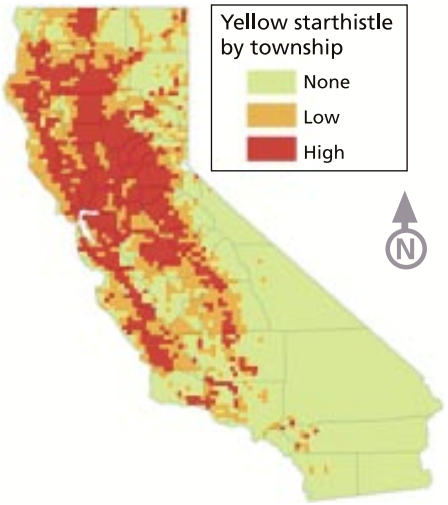

Fig. 2. Occurrence of yellow starthistle by township, incorporating information from all surveys through 2002.

into our database any information on areas surveyed for yellow starthistle or incidental finds collected by cooperators. This included GPS positions, GIS-digitized locations, road descriptions and paper maps. Additionally, we resurveyed some of the highways that were surveyed in 1999 and many of the smaller mountain roads, again using GPS units to record locations.

The results of these two road surveys showed an edge to the spread of yellow starthistle into the Sierra Nevada (fig. 1). When mapped with elevation contours, yellow starthistle was generally not common above elevations of 4,000 feet (1,220 meters). While major highways in the northern Sierra Nevada (such as Interstate 5 and Highway 50) had infestations well above this elevation, yellow starthistle was much less frequent or absent above 4,000 feet (1,220 meters) in the central and southern portion of the mountain range. In addition, while yellow starthistle was common along some roads in the Tehachapi mountains, almost none was observed on the eastern side of mountains in the Mojave Desert.

Modoc County, statewide surveys. Two more yellow starthistle surveys also became available and were incorporated into our township grid database. First, Modoc County performed a noxious weed survey in 2002, and this information was used to update the township grid data they

TABLE 1. Yellow starthistle infestation totals reported by county agricultural commissioners, 2002

County	Total county acres*	1985 gross†	2002 gross	Increase	Portion county infested	2002 net	Net/gross ratio
		..... acres		%	%	acres	% cover
Alameda	528,270	20,000	200,000	900	38	15,000	7.5
Alpine	465,030	0	250	—	< 1	11	4.4
Amador	384,810	243,000	243,000	0	63	33,000	13.6
Butte	1,065,490	463,000	463,000	0	43	50,000	10.8
Calaveras	663,290	100,000	400,000	300	60	150,000	37.5
Colusa	739,740	246,000	265,000	8	36	50,000	18.9
Contra Costa	510,680	470,400	310,000	–34	61	44,000	14.2
Del Norte	641,920	4	1,000	24,900	< 1	1	0.1
El Dorado	1,155,040	5,000	650,000	12,900	56	129,000	19.8
Fresno	3,838,820	3,000	925,000	30,733	24	303,000	32.8
Glenn	844,160	10,000	400,000	3,900	47	175,000	43.8
Humboldt	2,303,690	686,000	250,000	–64	11	50,000	20.0
Imperial	2,942,340	0	0	0	0	0	0.0
Inyo	6,462,640	0	10	—	< 1	2	20.0
Kern	5,229,000	100	4,500	4,400	< 1	2,500	55.6
Kings	918,790	10	120	1,100	< 1	100	83.3
Lake	848,960	800,000	500,000	–38	59	176,000	35.2
Lassen	3,001,780	500	1,000	100	< 1	500	50.0
Los Angeles	2,610,730	2	415	20,650	< 1	125	30.1
Madera	1,374,160	300	10,000	3,233	< 1	5,000	50.0
Marin	376,300	2,000	2,200	10	< 1	1,500	68.2
Mariposa	938,690	200,000	250,000	25	27	200,000	80.0
Mendocino	2,246,840	250,000	1,000,000	300	45	400,000	40.0
Merced	1,284,930	1,000	600,000	59,900	47	120,000	20.0
Modoc	2,777,870	120	500	317	< 1	210	42.0
Mono	1,985,950	0	1	—	< 1	1	100.0
Monterey	2,127,430	6,000	1,650,000	27,400	78	56,000	3.4
Napa	510,010	242,560	242,560	0	48	85,120	35.1
Nevada	635,010	200,000	248,000	24	39	75,000	30.2
Orange	502,440	0	0	0	0	0	0.0
Placer	964,140	274,000	360,000	31	37	145,000	40.3
Plumas	1,675,780	800	13,000	1,525	< 1	3,300	25.4
Riverside	4,635,540	251+	2,080	729	< 1	920	44.2
Sacramento	649,780	320,000	320,000	0	49	25,000	7.8
San Benito	894,150	72,000	80,000	11	9	8,000	10.0
San Bernardino	12,905,960	2,890	1,500	–48	< 1	58	3.9
San Diego	2,739,560	15	26	73	< 1	8	30.8
San Francisco	58,300	0	1,000	—	2	12	1.2
San Joaquin‡	919,180	72,000	333,143	363	36	38,883	11.7
San Luis Obispo	2,128,800	10,000	60,000	500	3	15,000	25.0
San Mateo§¶	339,690	27	5,000	18,419	1	5,000	100.0
Santa Barbara	1,756,580	3,000	5,720	91	< 1	3,000	52.4
Santa Clara	842,160	5,000	7,307	46	< 1	7,040	96.3
Santa Cruz	281,360	75	250	233	< 1	100	40.0
Shasta	2,464,140	400,000+	500,000	25	20	333,000	66.6
Sierra	613,500	5	364	7,180	< 1	73	20.1
Siskiyou	4,043,710	768,000	1,010,000	32	25	252,500	25.0
Solano#	558,210	20,000+	95,794	379	17	24,906	26.0
Sonoma	1,022,460	100,000	100,000	0	10	10,000	10.0
Stanislaus	973,580	227,000	227,000	0	23	45,050	19.8
Sutter	388,480	200,000	199,324	0	51	65,450	32.8
Tehama	1,904,640	40,000	789,267	1,873	41	137,934	17.5
Trinity	2,062,500	612,672	200,000	–67	10	50,000	25.0
Tulare	3,100,710	10,000	20,000	100	< 1	6,000	30.0
Tuolumne§	1,467,320	212,818	40,000	–81	3	40,000	100.0
Ventura	1,192,680	5	250,000	4,999,900	21	100,000	40.0
Yolo	661,760	198,600	660,760	233	100	165,440	25.0
Yuba	409,020	407,680	407,680	0	100	80,000	19.6
Total	101,563,500	7,905,834	14,305,771	81	14	3,682,744	25.7

* Source: Hornbeck et al. 1983.

† Source: Maddox and Mayfield 1985.

‡ No estimate submitted; gross and net values were estimated as the average of values reported by Sacramento and Stanislaus counties.

§ Only net acreage provided.

¶ Value provided by San Mateo Weed Management Area.

Only gross acreage provided; net acreage was estimated as 26% of gross acreage (based on the average ratio between total net and gross acreage for the other counties reporting both values).



TABLE 2. Comparison of yellow starthistle infestations for major California drainage areas, 1985 and 2002

Drainage area	Gross acreage		% of total		Net acreage		Net/gross ratio
	1985*	2002	1985	2002	2002	% of total	
1. Northeast interior basins	58,219	1,751	0.7	< 0.1	722	< 0.1	41.2
2. Sacramento drainage	3,235,035	5,872,189	40.9	41.0	1,635,103	44.4	27.8
3. North Coast drainage	2,792,186	2,805,760	35.3	19.6	849,121	23.1	30.3
4. Central Coast drainage	355,042	2,313,557	4.5	16.2	150,152	4.1	6.5
5. San Joaquin drainage	1,458,300	3,052,763	18.4	21.3	943,533	25.6	30.9
6. Southeast desert basins	2,796	10	< 0.1	< 0.1	2	< 0.1	20.0
7. South Coast drainage	4,256	259,741	< 0.1	1.8	104,111	2.8	40.1
Total	7,907,819	14,305,771	100.0	100.0	3,682,744	100.0	

*Source: Maddox and Mayfield 1985.

had submitted in 1997. Second, CDFA conducted a statewide survey in 2001 and 2002 of biological control agents released against yellow starthistle (Pitcairn et al. 2003). This survey consisted of collecting yellow starthistle plants from 421 locations throughout California and examining them for the presence of four insects known to attack the seed heads. We overlaid the yellow starthistle collection locations on the township map, and then updated the map accordingly.

Final map. The information from all surveys through 2002 was compiled into a final map of yellow starthistle occurrence by township (fig. 2). Of the 6,389 townships statewide, 3,010 had yellow starthistle (1,441 had low abundance and 1,569 had high abundance). These infested townships account for approximately 47% of the surface area of California. The high-abundance townships occurred primarily in the Sacramento Valley and Sierra Nevada foothills, but were also reported for several coastal valleys from San Luis Obispo County to Humboldt County. The northeast interior and desert basins had few infestations of yellow starthistle.

Number of infested acres

The township grid map provides our best estimate of the extent to which yellow starthistle has spread, but provides no information on the amount of actual acres infested. To address this question, in 2002 we repeated the questionnaire survey of infested acres performed by Maddox and Mayfield (1985). In contrast to the previous three questionnaires, we requested two estimates of yellow starthistle infestations: gross acreage and net acreage. Gross acreage is the amount of land over which yellow starthistle populations are distributed. This is how the acreage of plant infestations is usually estimated, and how the results from the previous three surveys were reported.

Net acreage is the amount of land actually covered by the yellow starthistle plant canopy. For example, if one 10-acre (4-hectare) plot had 100 yellow starthistle plants while another 10-acre plot had 10,000 plants, the gross acreage in both cases is still 10 acres (4 hectares). However, the net acreage for the plot with 100 plants may be only 1 acre (0.4 hectares), while the net acreage for the plot with 10,000 plants may be 6 acres (2.4 hectares). The ratio of net acres to gross acres multiplied by 100 provides an estimate of the percentage cover of the infestation.

The total gross acreage of yellow starthistle in California is now estimated at 14.3 million acres (5.8 million hectares), an increase of over 80% from 1985 (table 1). Monterey County had the highest reported gross acres of yellow starthistle in the state, at 1.65 million acres (668,000 hectares). This was followed by Siskiyou County with just over 1 million acres (405,000 hectares), Mendocino County with 1 million acres (405,000 hectares) and Fresno County with 925,000 acres (374,000 hectares). In addition, four of the six counties previously reporting no yellow starthistle reported some infestations in 2002; only Orange and Imperial counties still reported none in 2002.

Eight counties reported no change since 1985 in the number of gross acres infested with yellow starthistle, and six counties reported a decrease in infested acres. All other counties reported an increase in infested gross acreage. The largest increase was reported by Monterey County, which jumped from only 6,000 acres (2,430 hectares) in 1985 to 1.65 million acres (668,000 hectares) in 2002. The largest proportional increase was reported for Ventura County, which jumped from just 5 acres (2 hectares) in 1985 to 250,000 acres (101,000 hectares).

Per Maddox and Mayfield (1985), we grouped the county infestation acreages by region (table 2). Although our grouping boundaries were not identical to those used by Maddox and Mayfield, they are similar. The differences are due to our grouping of counties as a whole instead of partitioning the estimates according to drainage area. The exception was the reported acreage for Riverside and San Bernardino counties, which occurred entirely within the South Coast drainage area; consequently, estimates from these counties were combined with the South Coast counties.

Our 2002 survey showed that the Sacramento Valley continued to have the largest amount of yellow starthistle gross acreage, with over 5.8 million acres (2.3 million hectares). The San Joaquin Valley followed with just over 3 million acres (1.2 million hectares), then the North Coast drainage with 2.8 million acres (1.1 million hectares) and the Central Coast drainage with 2.3 million acres (0.9 million hectares). These four regions represent over 98% of the total yellow starthistle gross acreage statewide.

Comparing the proportional amounts of the total yellow starthistle infestation located within each region for 1985 and 2002 showed little change except for the Central Coast drainage, which increased from 4.5% to 16.2% of the total gross acreage, and the North Coast drainage, which decreased from 35.3% to 19.6% of the total gross acreage (table 2). Interestingly, the amount of canopy cover of yellow starthistle (as estimated by the ratio between net and gross acreages) was similar among regions (rang-

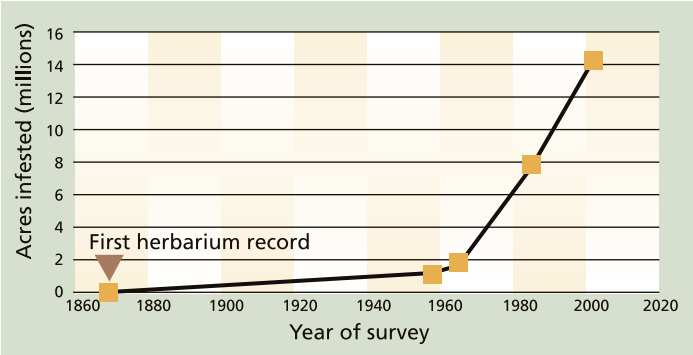

Fig. 3. Number of acres infested by yellow starthistle by year of survey. Sources: Maddox and Mayfield 1985, this report (2002).

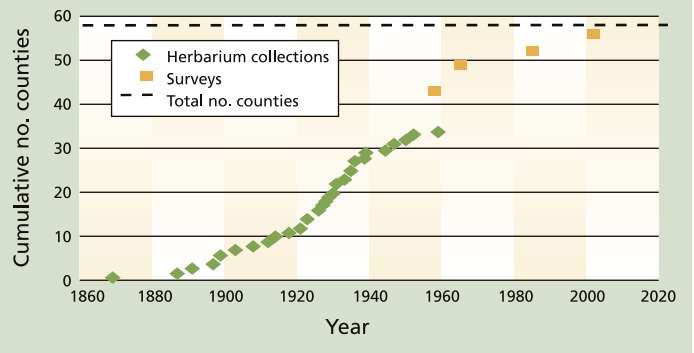

Fig. 4. Cumulative number of counties with yellow starthistle from 1869 through 2002. Data from the herbarium collections compiled by Doug Barbe, CDFA botanist (retired), for 1869 through 1960 (Calflora 2005). Survey data is from questionnaires from 1959 through 1985 (Maddox and Mayfield 1985) and this report (2002).

ing from 20% to 41%) except for the Central Coast drainage, which reported an estimated canopy cover of 6.5%. This suggests that, although the gross acreage was high, yellow starthistle cover was actually lower in the Central Coast drainage than elsewhere.

It must be emphasized that our estimates of yellow starthistle acreage are subjective and rely on the judgment of the county biologists. However, an acre-by-acre survey would be economically unfeasible. County biologists are trained to identify yellow starthistle and have good firsthand knowledge of the infestations in their county, so a subjective estimate may be our best estimate of infested acreage for an exotic weed that occurs over millions of acres.

Township levels vs. infested acres

The county survey of infested acres and the abundance of yellow starthistle by township were performed separately. However, we expected that the results of the two surveys were correlated, so to quantify this we summed the amount of acres identified as low or high in the township survey and compared the totals for each county with their estimate of infested acres. There was a significant correlation between the two data sets ($r = 0.61$, $P < 0.05$) when we assumed that the high-abundance townships were 45% infested with yellow starthistle (10,400 out of 23,040 acres [4,211 out of 9,328 hectares]) and the low-abundance townships were 17% infested (4,000 out of 23,040 acres [1,619 out of 9,328 hectares]). This suggests that the township abundance survey and the infested acres survey both yielded similar patterns of high and low abundance for yellow starthistle.

History of starthistle's spread

The invasion of California by yellow starthistle shows two phases of spread: a long initial period of slower spread prior to 1960 and a period of rapid spread after 1960 (fig. 3). An initial lag phase has been observed for other exotic weeds and is thought to be due to the weed's genetic adjustment to the new environment and the initiation of enough new founder populations to promote rapid spread (Weber 1998). Some insight into the early invasion dynamics of yellow starthistle may be obtained from the examination of early herbarium records. Doug Barbe, CDFA botanist (retired), visited the main herbaria throughout California and compiled a list of the locations and years of collection for yellow starthistle specimens collected through 1959. A total of 58 localities were obtained and the data were posted on the Internet by Fred Hrusa, the current CDFA botanist (Calflora 2005).

We used these records to examine the patterns of first yellow starthistle occurrence by county and the expansion of the weed's range throughout California (fig. 4). In addition to the herbarium data, we included the numbers of counties reporting infestations in the four surveys between 1959 and 2002. The data shows a logistic curve with the highest rate of increase between 1920 and 1940. There was a decline in new county collections after 1940, when yellow starthistle was no longer considered unusual. Once a species is widely recognized as a common weed, the collection of herbarium specimens often declines. However, the addition of the data from the county surveys after 1958 suggests a steady increase in spread from 1920 through 1965.

It appears that during the lag phase of the invasion, yellow starthistle gradually increased in abundance until around 1920, when the rate of spread increased. The earliest herbarium collections occurred within the Sacramento River and North Coast drainage areas (Calflora 2005), but beginning in the 1920s yellow starthistle was collected for the first time in San Bernardino and Santa Barbara counties in Southern California. This was a significant expansion of range.

Gerlach (1997) suggested that invasion of California by yellow starthistle occurred in a multiple-step process. Prior to 1900, yellow starthistle was likely introduced as a contaminant of alfalfa seed brought from Chile. The original source of alfalfa in Chile was Spain, so the yellow starthistle that was initially introduced to California may have been of Spanish origin. After 1900, California received contaminated alfalfa seed directly from several locations throughout Europe and Asia, including Spain, Italy, France, Turkey and "Turkestan" (an area consisting of parts of Turkmenistan, Uzbekistan and Kazakhstan) (Gerlach 1997). This suggests that different biotypes of yellow starthistle may have been introduced during this period.

Individual introductions of a species are only a sample of the genetic diversity of the original source popula-

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Prior to 1960, yellow starthistle's rate of spread through California was about 13,500 acres annually; between 1965 and 2002 the rate escalated to more than 334,000 acres annually. *Above,* tall yellow starthistle plants in a pasture near Quincy.



Fig. 5. Historical distribution of yellow starthistle in California, 1941. Source: Robbins et al. 1941.

tion, and the lack of genetic diversity may limit a weed's ability to adjust and overcome biotic and abiotic barriers to establishment in its new habitat. The occurrence of multiple introductions and the subsequent hybridization of plants from formerly separated source populations may provide the necessary genetic material to allow a species to become successful in its new environment (Ellstrand and Schierenbeck 2000). The occurrence of multiple introductions of yellow starthistle into California suggests that local hybridization was possible, but its role in the invasion biology of this weed has not been examined.

Gerlach (1997) suggested that a second invasion began in the 1930s or 1940s, when yellow starthistle became associated with the grazing system being developed for the foothill grasslands. This second invasion was facilitated by changes in cropping practices from 1920 to 1940. Prior to 1920, early reports of yellow starthistle were associated with the irrigated alfalfa fields and dry-land crops (wheat and barley) located near the Sacramento River and its tributaries (Gerlach 1997). Later, with motorized vehicles becoming more common, the cropping systems and harvesting equipment began to move away from the watercourses.

Prior to the 20th century, agricultural production was concentrated near the Sacramento and San Joaquin rivers. Later, with the expansion of the state's irrigation system and the increased use of motorized vehicles, farming expanded away from the river system and into the foothills. The development of new roads into the foothills and the movement of large numbers of grazing animals between the valley and foothills provided an efficient method for yellow starthistle to spread into new areas.

The increase in rate of first occurrence by county (fig. 4) after 1920 is consistent with Gerlach's hypothesis. The movement of yellow starthistle into the foothill grazing system and assistance in its dispersal by the movement of infested agricultural products, animals and machinery, may have been the stimulus that allowed yellow starthistle to move into the second phase of its invasion statewide.

After 1960, the rate of spread of yellow starthistle increased dramatically. The slope of the linear regression of the amount of infested acres between 1965 and 2002 shows that the spread rate was 334,377 acres (135,400 hectares) per year (fig. 3). In contrast, prior to 1960 the rate of spread averaged only 13,500 acres (5,500 hectares) per year. A spread rate of 334,377 acres per year is quite high compared to other exotic invasive plants, as most are reported to spread at rates less than 250,000 acres (100,000 hectares) per year (Weber 1998; Smith et al. 1999). Moreover, since 1960 the rate of spread of yellow starthistle in California has been steady, almost linear, and there is no indication of it slowing down. Eventually, however, the rate of spread will decrease as maximum coverage is approached and more aggressive management programs are employed.

The expansion of yellow starthistle throughout California appears to have occurred in two ways: a steady diffusion away from existing population centers, and a disjunctive establishment of multiple satellite populations that were originally separated by great distances but eventually expanded and coalesced. Robbins et al. (1941) produced an early distribution map of yellow starthistle in California (fig. 5) that showed a high concentration of the weed within the Sacramento Valley; several small, scattered populations throughout the remainder of Northern California; and a few small populations in the San Joaquin Valley and the coastal counties of Southern California. This map, along with the early herbarium records, suggests that the initial population center for yellow starthistle was the Sacramento River drainage area. This area continues to have the highest number of infested acres today.


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A statewide township survey conducted in 2002 identified more than 14 million gross acres infested with yellow starthistle, nearly double the level of a 1985 survey. *Above,* U.S. Department of Agriculture scientist Sharon Anderson collects leaf samples along an infested trail in Fresno County.

From 1985 to 2002, increases of infested acres occurred in all areas of the state except the Interior Great Basin and the desert regions. The increases in Southern California likely resulted from new founder populations as well as from the expansion of small existing populations, and these areas showed the highest proportional increases of this weed. However, yellow starthistle infestations in the Sacramento Valley continued to increase, indicating a filling in of the gaps in this area.

Future increases in abundance

Because this weed has a strong affinity for roadsides and can be transported on machinery and in feed and hay, it is likely that human activity accelerated the scattering of new founder populations and contributed to its high rate of spread. It is not certain how far east and southeast yellow starthistle will spread in the future because environmental factors that may limit its distribution (such as low annual rainfall) are not yet known. However, we anticipate yellow starthistle continuing to increase its density and distribution in both Northern and Southern California, with the highest rates of increase in the southern coastal counties.

Future increases in yellow starthistle abundance may be significant for land managers of areas not currently infested. To stop the spread, new infestations should be eradicated when populations are small and easy to control, taking into account biological control efforts already under way.

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References

Calflora. 2005. The Calflora Database, Berkeley, CA. www.calflora.org/index0.html (accessed March 25, 2005).

Cordy DR. 1978. Centaurea species and equine nigropallidal encephalomalacia. In: Keeler RF, Van Kampen KR, James LF (eds.). *Effects of Poisonous Plants on Livestock*. Academic Pr. p 327–36.

DiTomaso JM, Gerlach JD. 2000. *Centaruea solstitialis* L. In: Bossard CC, Randall JM, Hoshovsky M (eds.). *Invasive Plants of California's Wildlands*. Berkeley, CA: UC Pr. p 101–6.

Ellstrand NC, Schierenbeck, KA. 2000. Hybridization as a stimulus for the evolution of invasiveness in plants? Proc Nat Acad Sci 97(13):7043–50.

Gerlach JD. 1997. How the west was lost: Reconstructing the invasion dynamics of yellow star-thistle and other plant invaders of western rangelands and natural areas. In: Kelly M, Wagner E, Werner P (eds.). Proc California Exotic Pest Plant Council Symposium, Vol 3. p 67–72.

Hornbeck D, Kane P, Fuller D. 1983. *California Patterns: A Geographical and Historical Atlas*. Palo Alto, CA: Mayfield Publ. 117 p.

Maddox DM, Mayfield A. 1985. Yellow starthistle infestations on the increase. Cal Ag 39(6):10–2.

Pitcairn MJ, O'Connell RA, Gendron JM. 1998. Yellow starthistle: Survey of statewide distribution. In: Woods DM (ed.). Biological Control Program Annual Summary, 1997. California Department of Food and Agriculture, Plant Health and Pest Prevention Services, Sacramento, CA. p 64–6.

Pitcairn MJ, Villegas B, Woods DM, et al. 2003. Statewide survey of yellow starthistle biological control agents. In: Woods DM (ed.). Biological Control Program Annual Summary, 2002. California Department of Food and Agriculture, Plant Health and Pest Prevention Services, Sacramento, CA. p 45–9.

Randall JM. 1996. Weed control for the preservation of biological diversity. Weed Technol 10:370–83.

Rejmanek M, Pitcairn MJ. 2002. When is eradication of exotic pest plants a realistic goal? In: Veitch CR, Clout MN (eds.). *Turning the Tide: the Eradication of Invasive Species*. IUCN SSC Invasive Species Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. p 249—53.

Robbins WW, Bellue MK, Ball WS. 1941. *Weeds of California* (1st ed.). California State Department of Agriculture, Sacramento, CA. p 395.

Smith HA, Johnson WS, Shonkwiler JS, Swanson SR. 1999. The implications of variable or constant expansion rates in invasive weed infestations. Weed Sci 47:62–6.

Villegas B. 2001a. Releases of the flower weevil, *Larinus curtus,* for the biological control of yellow starthistle in California in 2000. In: Woods DM (ed.). Biological Control Program Annual Summary, 2000. California Department of Food and Agriculture, Plant Health and Pest Prevention Services, Sacramento, CA. p 47.

Villegas B. 2001b. Releases of the hairy weevil, *Eustenopus villosus,* in California during 2000. In: Woods DM (ed.). Biological Control Program Annual Summary, 2000. California Department of Food and Agriculture, Plant Health and Pest Prevention Services, Sacramento, CA. p 48–9.

Weber E. 1998. The dynamics of plant invasions: A case study of three exotic goldenrod species *(Solidago* L.) in Europe. J Biogeogr 25:147–54.

Woods DM, Villegas B. 2005. Field releases of the rust, *Puccinia jaceae* var. *solstitialis,* in California. In: Woods DM (ed.). Biological Control Program Annual Summary, 2004. California Department of Food and Agriculture, Plant Health and Pest Prevention Services, Sacramento, CA. p 25–6.

EXHIBIT 13

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BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING IN THE MATTER OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLAMATION REQUEST FOR A CHANGE IN POINT OF DIVERSION FOR CALIFORNIA WATER FIX	**TESTIMONY OF ERIK RINGELBERG**

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I, Erik Ringelberg, do hereby declare:

I. INTRODUCTION

I am an environmental scientist with technical and managerial experience in developing, planning, and permitting large projects, assessing their environmental impacts, and, where necessary, developing mitigation measures. I have applied scientific experience in the assessment of water quality in both the field and in the laboratory, and experience managing multi-disciplinary teams in the assessment of ecological baseline conditions and assessing the results of managed hydrologic regimes leading to water quality impacts.

As an environmental scientist, I have completed analyses of the Bay Delta Conservation Plan (BDCP) and its various permutations since 2008. Over those eight years, I have been asked to provide oral and written comments by the Local Agencies of the North Delta with particular emphasis on the technical considerations of project features that would impact water quality, terrestrial and aquatic ecology, and the rural agricultural community. Prior to those efforts, I provided support to the Pyramid Lake Paiute Tribe on the Truckee River Operating Agreement and its management of Pyramid Lake habitat and water quality. That work included managing a sampling team and a water quality laboratory that completed algal chlorophyll, nutrient, and other water quality analyses to assess the condition of the lake and the Truckee River.

My educational background and other qualifications are summarized in the Statement of Qualifications submitted concurrently herewith. (SJC-003)

II. OVERVIEW – MICROCYSTIS IN THE DELTA

My testimony is intended to provide scientific analysis and conclusions about the likely project impacts on toxic algal growth, colony formation, and toxic byproduct formation because of the proposed diversions on the Sacramento River near Clarksburg. The proposed project influences flow and water quality within Sacramento San Joaquin Delta as a result of this diversion, and those factors further influence the formation of Harmful Algal Blooms (“HABs” or CyanoHABs).

Cyanobacteria and Harmful Algal Blooms

Summary

I was asked to assess the proposed California Water Fix Petition for Change before the State Water Resources Control Board (SWRCB) to determine from a scientific perspective whether the project, as proposed by the Petitioners, would be likely to affect the conditions that promote the incidence of harmful algal blooms and, if so, to identify those likely effects. I was asked, also, to: (1) review the adequacy of the analysis, if any, of HABs presented in the Petition, (2) explain the conditions that promote the development of HABs and the effects of HABs on legal users of water in the Delta.

Upon review of the Petition (SWRCB-1, and the associated errata, SWRCB-2), there are no analyses of any kind analyzing the project's potential to create or exacerbate the formation of HABs or their toxic byproducts. During my review of the relevant portions of the direct testimony in support of this project, I did not hear analysis of any kind associated with HABs and their toxic byproducts. Furthermore, there were no experts on HABs were provided in support of the project.

There is information provided on one genus of HABs (*Microcystis*) in Exhibits SWRCB-3, SWRCB-4, and SWRCB-5, despite molecular biologists identifying the HABS in the Delta (and elsewhere) could contain or be caused by multiple genera, and identifying that genus being less dominant in the Delta, potentially being replaced by the toxic *Aphanizomenon flosaquae*. (SJC-045, Kurobe et al. 2013) I have analyzed information provided in Exhibits SWRCB-3, SWRCB-4, and SWRCB-5 in detail as a part of my comments on the project previously. (Exhibit SCWRB-3 RESIRC 2622 Pg. 14-20)

For a variety of reasons described in my prior analysis, and repeated for context in this analysis, the Petitioners' prior analyses fail to adequately describe the likely project impacts on the ecological drivers for HAB formation created or exacerbated by the project, and further fail to provide scientific substantiation that the project will not create HABs and their toxins.

The Project documentation states: "…beneficial uses in the Delta will not be negatively impacted by operations with the new point of diversion." (SWRCB-1, Pg. 19) The scientific

question of how the project could affect the environment is not evident because of the inadequacies in analysis and water quality modeling of the proposed project. Because of the lack of supporting information provided by the Petitioners, I looked at relevant information available from other sources that could be used as surrogates for the proposed action and extrapolated from existing conditions that were the most similar to project operations. Contrary to the project's analysis in SWRCB-3, there are several scales of models available for HAB formation, including for the Sacramento-San Joaquin Delta (Delta). There is a detailed Delta food web model, as well as predictive models used for the Potomac and Lake Eire[1]. (SJC-046, Durand, 2008; SJC-047, Tango 2009) The project failed to apply any of those models to this project. Finally, since there was no HAB modeling provided for me to review any technical basis of their conclusion of no injury, I examined how the proposed project impacts could be assessed by the last remaining metric, the Basin Plan itself. The following is an analysis of the Project's potential impacts on these beneficial uses:

> State law defines beneficial uses of California's waters that may be protected against quality degradation to include (and not be limited to) "...domestic; municipal; agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves" (Water Code Section 13050(f)).

The beneficial uses relevant to project impacts to water quality are identified in the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Basin Plan) as follows:

> Municipal and Domestic Supply; Recreation-Contact; Agriculture- Irrigation and Stock Watering, and including although not expanded upon in detail in this analysis, Freshwater Habitat- Warm and Cold, and Wildlife.

[1] http://lakeeriealgae.com/forecast/

(SWRCB-27.)

There is simply no scientific debate that HABs and their toxic byproducts are by definition injurious to legal users of waters applying their water for beneficial uses. The toxins harm and can kill people, pets, stock animals, wildlife, and can impair other agricultural uses. As explained in greater detail below, I have concluded that the proposed project diversion in the North Delta under certain project scenarios will establish essentially the equivalent of drought conditions, and their associated lower flows, in the Delta by removing significant flow of the Sacramento River during ecologically critical periods (summer and early fall) for algal bloom formation. (DWR-515 and DWR 5 errata, Pg 25-6). Moreover, because of the current drought conditions, spring is now an important period for bloom formation. (SJC-048, Glibert et al. 2014)

From the limited summary flow data provided in these two sources, it appears that the flows immediately downstream of the intakes would be altered in the following manner, at 5,000 cfs, 900 cfs would be diverted, leaving 4,100 cfs in the river. At 15,000 cfs, 3,000 cfs would be diverted, leaving 12,000 cfs in the river. At 22,000 cfs, 9,000 cfs would be diverted, leaving 13,000 cfs in the river. These flow rules result in a flow reduction of 18% to 41%. Under these rules, the flow would for the vast majority of the time would be constrained from 4,100 cfs to 13,000 cfs, removing most of the flow variability (except in flood) and regulating the flow.

These flows are directly equivalent to the range of flows at Freeport during critically dry year (mean 9,345 cfs 1922) to a dry year (mean 16,003 cfs 1989). (SJC-049, ICF 2016, Pg. 2-3). In plain language, the project rules create a drought equivalent condition on the Sacramento River. Notwithstanding those rules, the scenarios that were provided as illustration of the project modeling analysis for 1978, which was also classified as a dry year, is modeled with a flow in the river of 14,000 cfs, and a 6,000 cfs diversion, leaving 8,000 cfs in the river with a 43% flow reduction. The same modeling shows that even in an above normal year (1993), at a flow of 11,000 cfs, 8,000 cfs is diverted, leaving 3,000 cfs in the river, a reduction of 73% (DWR 5 errata, Pg 25-6). These rules and their associated modeling illustrate that the project will reduce flows to the same as occur in critically dry and dry years. The ecological

effects will be the same as what occurs in equivalent drought periods, but, potentially, even worse, since the frequency of these periods is likely to increase in comparison to recent history.

The project's impacts associated with, and related to, algae in general and cyanobacteria specifically, leading to the formation of concentrations of these organisms (blooms [mats or scum]), include: lower flows compared to the same period in the Sacramento River below the intakes, with the resulting lower dilution potential, reduced assimilative capacity, and longer residence times, amplification of the flow split from Delta Cross-channel (lowering flows further in the Sacramento River sloughs and Cache Slough complex), and increased temperatures.

The project operational control of flows, and the removal of flow within the North Delta is not the only project operation that can induce or maintain HABs. The project analysis includes a brief and non-specific analysis for potential impacts associated with riparian and tidal habitat creation, providing locally increased nutrients. (DWR-3; RDEIR, App. A, p. 28-16 (Environmental Justice).) Where there is any project analysis regarding HABs, the project impacts are largely ignored, and, instead, what limited analysis exists is solely and incorrectly focused on the nutrient data, and their relationship to the blooms of a single species, *Microcystis aeruginosa*. (SCWRB-3 RESIRC 2622 Pg. 14-20)

The degree of impact on human health and drinking water supplies from the project's impacts on blue-green algae is not adequately assessed or mitigated in the material submitted in support of the Petition. The testimony and supporting material submitted in support of the Petition all but ignores the project diversion's relationship to flow, nutrients and their associated environmental impacts. The limited analysis instead looks at a single dimension of algal dynamics, nutrient availability and ratio, and states that the data for nutrients are equivocal. Juxtaposing the current analysis with the CVP/SWP Contractors' 2010 comments on Sacramento Regional County Sanitation District's wastewater discharges, the data on algal bloom relationships appear to have gone from certain to uncertain when the Tunnels are the

source of the impact. (SJC-050, Alameda, 2010. See also DWR-3, RDEIR/S Section 8.1.3.18 Microcystis (p. 8-45 lines 15-42 and p. 8-46, lines 1-22))

II. CYANOBACTERIAL ECOLOGY AND PUBLIC HEALTH THREATS

Cyanobacteria or blue-green algae are a 'simple' form of microscopic photosynthetic bacteria that lives in water. While they are simple structurally, Cyanobacteria are widely distributed in aquatic and terrestrial environments, globally important primary producers for the global nitrogen oxygen and carbon budgets. It is generally accepted that the chloroplasts of true algae and plants and are derived from a cyanobacterial ancestor. (SJC-051, Tomitani et al. 2006)

They are typically green, from the chlorophyll, but they also can make a number of pigment chemicals, which have different colors. An algal bloom forms when the numbers of algal cells increase rapidly to reach concentrations dense enough to be visible. The bloom typically looks like a colored cloud in the water and can form very thick layers of scum. Many genera of algae form blooms, some are important for the ecology of the system, and not all algal blooms are toxic, even if the species can create toxicity. The toxin itself is not visible and can exist long after the cell is dead. As noted, the toxic blooms are called "Harmful Algal Blooms" and can be found in many environments from lakes to the ocean.

As was first documented in the Sacramento-San Joaquin River Delta in 1999, blooms of cyanobacteria have spread for miles throughout the Delta during periods of warmer temperatures and low flows (SJC-052, Berg and Sutula, 2015). This threat of increasing algal blooms and the formation of algal toxins 'appears to increase' as the drought goes on (SJC-052, Berg and Sutula, 2015).

Phytoplankton, the entire aquatic microbial 'plant' community, have been extensively studied in the Delta and elsewhere. An existing transition point or shift in dominance from benthic diatoms to phytoplankton has been noted below the I-80 Bridge, as well as the Stockton Deep Water Ship Channel. (SJC-053, Kimball, 2011; SJC-054, Brunell, Litton and Borglin, 2008; SJC-055, Müller-Solger, Jassby, and Müller, 2002. Pg.1474). These ecological shifts on both the Sacramento River and the San Joaquin River, respectively, are associated

with a number of physical factors, including strong flows above I-80 and Mossdale, and reduced flows and tidal mixing below those locations. These shifts are the discernable point where higher flow, dominant riverine processes transition to slower, tidal systems with naturally longer residence times, and differing water quality and temperature regimes. Without modeling, it is difficult to say if the project will make the upstream transition between the benthic diatom and the phytoplankton community more abrupt, or move it upriver, or create some new unknown dynamic. In any case, the natural hydrologic conditions would be amplified below the new point of diversion, as identified by the project- river stages, and other project changes to the environment that will occur, each of which can be more favorable to the formation of HABs than the current conditions.

Within the phytoplankton community, the dynamics between phyla become important in terms of which predominate under which conditions. This is why it is difficult to assert a specific outcome for a particular environmental change or series of changes without modeling. The model identifies under which conditions one or the other phyla predominate. That dynamic interaction is quantifiable through a series of correlations to documented HABs, and if calibrated iteratively can become a relatively precise, *predictive* model.

Cyanobacterial blooms have been extensively studied in the lab, field trials, and even in whole lake manipulations in Canada. These experimental studies show that if phytoplankton is entrained in the turbulent flow and redistributed vertically over the entire depth, green algae and diatoms outcompete (colonial) cyanobacteria due to a higher growth rate and reduced sedimentation losses. The advantage of buoyant cyanobacteria to float up to the illuminated upper layers is eradicated in a well-mixed system. (SJC-056, Visser, 2015) Lower flows also increase blooms because lower flows can reduce water column mixing. (SJC-052 Berg, 2015) Said another way, increased flows can control conditions cyanobacterial blooms both mechanically by breaking up the bloom, and also through ecological, competitive controls.

Cyanobacteria have growth rate increase of 100 to 400 percent every 10 degree C rise in temperature. (SJC-052, Berg and Sutula, 2015, p. 32.) As with most microorganisms, they have a logarithmic response to the appropriate ecological conditions, responding very rapidly

to what can appear to be subtle differences in factors such as temperature or sunlight. (See Figures 1, 2, and 3 attached hereto) A couple of degrees of increased temperature can lead to HABs in just a few days. Higher temperatures also prompt higher levels of toxins. (SJC-057 Brutemark, 2015.) Increased salinity levels (up to 10 parts per trillion) do not significantly harm these organisms, as they survive in brackish water. (SJC-052 Berg, 2015.) Blooms of cyanobacteria also reduce the dissolved oxygen content in a water body, and block sunlight needed by other living organisms. (SJC-052 Berg, 2015.) For this reason, cyanobacteria's role was investigated as a potential correlate with the pelagic organism decline in the Delta. (SJC-058, Lehman, 2005.)

Cyanobacteria present public health issues because of the potent toxins found in many different genera of cyanobacteria cause symptoms in both animals and humans, ranging from vomiting, rashes, headaches, and diarrhea to liver failure, and even death. (SJC-059 Office of Environmental Health Hazard Assessment, 2009; SJC-060 U.S. EPA, 2015.) The International Agency for Research on Cancer lists the toxin found in cyanobacteria as possibly carcinogenic to humans. (SJC-061, Cogliano, 2010.) Similar to mercury and other bioaccumulative toxins, cyanobacteria toxins are known to build up in the bodies of fish and shellfish; it also can contaminate food crops when present in irrigation water. (SJC-061, Cogliano, 2010, p. 357-358.)

The presence of cyanobacteria toxins, notably microcystins, can shut down drinking water supplies. Nationally, there have been "do not drink or boil" advisory for their water when a cyanobacterial bloom near Toledo's drinking water intake on Lake Erie caused microcystin to spike in samples in 2014. (SJC-060, U.S. EPA, 2015, p. 14.)

The "Do not boil" advisory is an important consideration, because (as distinct from responses to many other dangerous bacterial species, such as fecal coliforms) boiling microcystin contaminated water will not render the contaminant harmless. A species related to the cyanobacteria that contaminated Ohio drinking water has been detected in the Delta, *Microcystis aeruginosa.* (SJC-045 Kurobe, 2013.) Traditional methods of killing algae, such as algaecide, can actually increase the presence of the cyanobacteria toxin, which releases upon

the death of the organism. (SJC-060, U.S. EPA, 2015, p. 41.) Conventional water treatment systems do not remove the toxins; therefore, U.S. EPA recommends that drinking water systems affected by a cyanobacteria bloom change the location of their intakes, purchase well water from a neighbor, or add expensive additional treatments such as reverse osmosis. (SJC-060, U.S. EPA, 2015, pp. 41-43.)

III. HARMFUL ALGAL BLOOMS IN THE DELTA, CURRENTLY

As described, the current drought conditions provide context for observing the impacts of the project; these are the effects of reduced freshwater flows from the Sacramento River, leading to resulting increased residence times and localized increased water temperatures. These are the conditions that lead to HAB formation in the Delta. (SJC-058, Lehman, 2005.)

The serious and increasing incidence of HABs in San Joaquin County, and State and local government's awareness of, and efforts to respond to the hazards HABs pose in San Joaquin County are amply illustrated in the Testimony of Linda Turkatte, submitted concurrently herewith. (See Exh. SJC-002.)

Even Sacramento had a recent (October 5, 2015) death of a dog in the Sacramento River at a public beach directly attributed to cyanobacteria.[2] Per the Sacramento Bee article, the Sacramento County environmental health division chief said he expects more blue-green algae events if the state's four-year drought continues: "That's because droughts create more pockets of slow-moving warm water in rivers, a situation that triggers more algal blooms." The identical conditions will be created or exacerbated by the proposed project.

The testimony and other material submitted in support of the Petition fails to consider the readily-available literature provided by the CalEPA's Office of Environmental Health Hazard Assessment ("OEEHA"), which documents these issues, which directly relate back to the defined beneficial uses, in great detail:

> Many cyanobacteria species produce a group of toxins known as microcystins, some of which are toxic;

[2] http://www.sacbee.com/news/local/environment/article38250372.html

> Upon ingestion, toxic microcystins are actively absorbed by fish, birds and mammals;
>
> People swimming, waterskiing, or boating in contaminated water can be exposed to microcytins;
>
> Microcystins may also accumulate in fish that are caught and eaten by people;
>
> Finally, pets and livestock have died after drinking water contaminated with microcystins.[3]

Moreover:

> Microcystins are toxic to fish at concentrations as low as a few micrograms per liter (µg/L) or possibly even fractional µg/L. Finally, Blooms of cyanobacterial species that produce microcystins and/or anatoxin-a have coincided with the deaths of ducks, gulls, songbirds, pheasants and hawks, as well as several other bird species. The severity of such bird kills have ranged from a few individuals to several thousand birds per incident.

(*Ibid.*)

The OEEHA report identifies that it is not just one genus, *Microcystis*, but several, that create the toxins. People, agricultural and domestic animals, birds and fish are at direct and acute risk. The risk to fish is exceptionally high. And, the report further explains that conditions that are not classically considered favorable for bloom formation can still lead to toxicity sufficient to kill even mammals.

The project will cause changes to water operations and creation of project-required tidal and floodplain restoration areas that change water residence times within Delta channels, and increases in Delta water temperatures. "The data do not represent the length of time that water in the various subregions spends in the Delta in total, but do provide a useful parameter with which to compare generally how long algae would have to grow in the various subregions of the Delta." (DWR-3, RDEIR/S, Section 8.3.1.7, p. 8-82, p. 31-43.)

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[3] http://oehha.ca.gov/ecotox/documents/Microcystin031209.pdf

In the RDEIR/S, much is made regarding Redfield ratios associated with historic nutrient levels, but there is no evidence provided that nutrients are limiting, indeed research demonstrates the opposite is likely, the nutrients are at more than sufficient levels for algal blooms and one or more factors, namely light deficiency and velocity-induced mixing are controlling near the proposed intakes. (SJC-053, Kimball, 2011; SJC-054, Brunell, Litton and Borglin, 2008; SJC-055, Jassby, and Müller, 2002.) Water clarity, temperature and nutrients that support blue-green algal growth needs and HAB formation in the Delta and its waterways are already sufficient to support the toxic blooms since they have already occurred in both places.

IV. IMPACTS OF THE PROPOSED WATERFIX PROJECT ON CONDITIONS CONDUCIVE TO FORMATION OF HARMFUL ALGAL BLOOMS.

Based on the flow description and operational rules provided in SWRCB-3, and the failure to present any scientific supporting information to the contrary, the proposed changes in the point of diversion will have obvious consequences for water quality, quantity and more subtle, yet equally profound effects on the ecology of the Delta. Because the Delta and its tributaries and sloughs are subject to significant tidal influence from the Pacific Ocean and through the San Francisco Bay, they are also subject to multiple physical processes and thus ecological processes ranging from river-like to lake-like (fluvial to lacustrine), twice a day. This hydrologic condition of tides slowing the rate of downstream transport, is exacerbated by the Project's removal of significant fractions of flow, which change the hydraulic head of the river (advection) and increase the residence time downstream of the intakes, and within each of those proximate sloughs. Some of these potential project impacts have already been identified by federal scientists:

> "Uncertainty about New Facilities and Habitats Decades of hydrodynamics monitoring, modeling, and special studies indicate that restoration or changes in water conveyance in one area can substantially affect basic hydro-dynamic processes and transport in others. Many changes are proposed for the Sacramento–San Joaquin River Delta to meet the State's goals of "providing a more reliable water supply for California and

protecting, restoring, and enhancing the delta ecosystem" (Delta Stewardship Council, 2013). Documenting how these changes affect flows in the delta is important. The proposed flooding of Sherman Island, for example, could affect hydrodynamics and transport processes, including salinity intrusion, throughout the delta. Withdrawing water from the system into an isolated water-conveyance facility, such as the currently proposed twin tunnels, would also alter transport throughout the delta. If built, net flows throughout the north and western Sacramento–San Joaquin River Delta would be proportionately reduced by the amount withdrawn into the conveyance facility, increasing the influence of the tides throughout the delta. If the conveyance facility is built, the north-to-south draw of water across the delta that has existed for decades would likely be reduced as a result of compensatory reductions in pumping from the south delta, creating much longer average residence times. Longer residence times are associated with higher rates of algal growth, which could fuel eutrophication in some regions, including increased blooms of nuisance algae, such as Microcystis, which is toxic to humans and other organisms (Lehman and others, 2013). In the coming decades, the flow-station network can provide data that address uncertainty concerning the location of proposed water-conveyance facilities and that, after they are built, document the effects of these new water-conveyance facilities, management actions, and habitat-restoration efforts."

(SJC-063, USGS Fact Sheet 2015-3061. 2016)

Yet, despite what seem obvious to ecologists, aquatic chemists, and geomorphologists, the project documentation submitted by Petitioners fails to take the aquatic environmental changes created by the proposed project and their likely consequences into account.

For example, the conditions in the Sacramento River created by the proposed project operations are the very same conditions -- reduced flow, longer retention times, and likely localized higher temperatures -- identified in the basic ecology discussion provided above known to promote cyanobacterial blooms. Furthermore, flow reduction also directly affects velocity, which maintains particles in suspension, leading to "drop out" of sediment, and this

loss of sediment related turbidity, which is further compounded by the project's removal of sediment at the intakes, and flow reversals. (SJC-054, Brunell, Litton, and Borglin, 2008, Pg.2-3, 12)

The significant reduction of sediment, thus influencing turbidity, results in greater sunlight penetration of the water column. This light is likely to support phytoplankton, which get their energy from sunlight, and is understood to be one of the key controlling factors for HAB formation in the Delta.

Potential Impacts of Climate Change on HABs in the Delta

The drought has demonstrated the link between lower flows and HAB formation within the Delta. This is not unexpected, as science has well identified that under appropriate nutrient conditions, lower flows and longer retention time are directly associated with HAB formation.

The uncertainties that climate change can create does not necessarily mean that climate change by itself will induce more HABs. For example, increased precipitation and greater flushing flows could occur under scenarios for the Delta. (SJC-064, Cloern et al. 2014) Increased temperature is of course a driver, but significant improvements in water quality through nutrient control have been and continue to be implemented by the SWRCB and the CVRWQCB. These controls if done strategically may countervail the HAB temperature response to some degree.

Given the wide range of uncertainty regarding the ultimate climate change trajectory, and the temporal difference between when the project is proposed and the more significant impacts of that change in the Delta, the project should use or develop a model for HABs and their formation processes in the Delta, and then provide model support to demonstrate how it will not induce HABs through its operations over the next 20 years.

The project's operational effects of locally increasing water temperature, reducing flows into the Delta to levels similar to known conditions that create HAB formations in the Delta from the Sacramento River would worsen the HABs problems in the Delta. Moreover, project induced increased dominance of cyanobacterial blooms can significantly disrupt the aquatic

food chain (zooplankton) reducing both diversity and food quality of these resources for fish and piscivorous wildlife. (SJC-065, Reichwaldt, Song, and Ghadouani, 2013.)

In any case, the Petitioners are obligated to demonstrate scientifically why the project would not induce or sustain these HABs, and to describe the effects of these induced HABs on the beneficial uses of water for both short-term impacts and potential climate change scenarios. Petitioners case in chief fails to do so, and indicates that water uses will in fact be injured by HABs should the Petition be granted.

IV. CONCLUSION

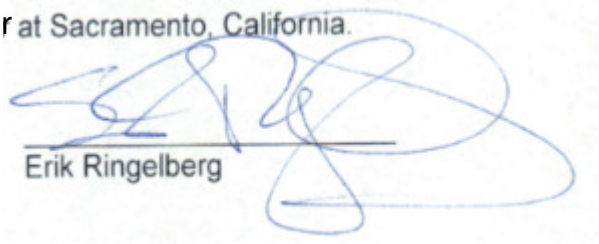
The project has direct impacts on flows by removing significant portions of Sacramento flow, the primary freshwater source of the Delta. The combined project operations associated with this diversion also directly manipulates the source waters through dam releases, and controls the remaining (bypass) flows within the Delta through operation of the Delta Cross Channel, which directs the flows to the east; and, then through operations of the South Delta pumps, which control regional circulation. The new intakes will also remove sediment, which allows for more light to enter the water column and exacerbates algal growth.

As most Delta agriculture, and many municipalities are reliant on pumping directly from rivers and sloughs, HABs and their toxic microcystins can lead to many problems ranging from illness to mortality as a result of direct and indirect environmental conditions exacerbated or created by the project both in the near-term and cumulatively. Removing significant fractions of the flow of the Sacramento River and concentrating that effect in a river corridor profoundly changes the downstream channel flow (velocity). The flow-related dilution and water column mixing, as well as the induction of flow reversals which serve to lengthen residence time, are further exacerbating conditions that lead to HAB formation and maintenance. These project-caused ecological conditions can amplify natural conditions that are suitable for HABs and create the tipping point for bloom expression.

The Petition fails to demonstrate how the project will protect beneficial uses, or protect

legal users of the water from HABs created or made more made more likely to occur across a variety of water years by the project.

Executed on the 1st Day of September at Sacramento, California.



Erik Ringelberg

CITED REFERENCES

Alameda County Water District, Alameda County Flood Control and Water Conservation District, Zone 7, Contra Costa Water District, Metropolitan Water District of Southern California, Santa Clara Valley Water District, State Water Contractors (Alameda). 2010. Comments on Drinking Water Supply and Public Health Issues Concerning the Sacramento Regional Wastewater Treatment Plant NPDES Permit Renewal. Letter to Ms. Kathy Harder, Central Valley Region Regional Water Quality Control Board. See pg 57 footnote for averages.

Berg, M. and M. Sutula. 2015. *Factors Affecting Growth of Cyanobacteria With Special Emphasis on the Sacramento-San Joaquin Delta.* Central Valley Regional Water Quality Control Board: Southern California Coastal Water Research Project. Technical Report No. XXX (DRAFT).

Brunell, M. S., G.M. Litton and S. Borglin. 2008. An Analysis Of Grazing And Phytoplankton Communities In The Lower San Joaquin River Above The Stockton Deep Water Ship Channel. San Joaquin Valley Drainage Authority, San Joaquin River, Up-Stream DO TMDL Project, ERP - 02D - P63 Task: 9

Brutemark, A. E.-Ö. 2015. Growth, toxicity and oxidative stress of a cultured cyanobacterium (*Dolichospermum* sp.) under different CO2/pH and temperature conditions. *Phycological Research*, 63: 56–63.

Cloern. JE.., Knowles N., Brown L.R., Cayan D., Dettinger M.D., et al. 2013. Projected Evolution of California's San Francisco Bay-Delta-River System in a Century of Climate Change. PLoS ONE 6(9): e24465. doi:10.1371/journal.pone.0024465

Coetsee, R. 2015. Delta water weed problems called the worst in years . *Contra Costa Times* 20 January 2015. http://www.contracostatimes.com/breaking-news/ci_27358409/delta-water-weed-problems-called-worst-years

Cogliano, V. J. 2010. Volume 94: Ingested Nitrate and Nitrite, and Cyanobacterial Peptide Toxins. *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans* (p. 422). Lyon, France: World Health Organization.

Cohen, A. N. and Moyle, P. B. 2004. Summary of data and analyses indicating that exotic species have impaired the beneficial uses of certain California waters. http://www.sfei.org/sites/default/files/biblio_files/2004-ImpairedCalWaters382.pdf

Department of Boating and Waterways. 2002. *Environmental Impact Report Excerpt*. 9 July 2002. http://www.dbw.ca.gov/PDF/Egeria/WHSciProbsExcerpts.pdf

Durand, J. 2008. Delta Foodweb Conceptual Model. Sacramento (CA): Delta Regional Ecosystem Restoration Implementation Plan.

Glibert, P.M. et al. 2014. Major – but rare – spring blooms in 2014 in San Francisco Bay Delta, California, a result of the long-term drought, increased residence time, and altered nutrient loads and forms. / Journal of Experimental Marine Biology and Ecology 460 (2014) 8–18

Kassim, Z., Akbar J., Lim K. C., Nur F. Z. and Nur H. A. 2014. Sustainable Technique for Selected Live Feed Culture in: "Sustainable Aquaculture Techniques", book edited by Martha Patricia Hernandez- Vergara and Carlos Ivan Perez-Rostro, ISBN 978-953-51-1224-2, (Figure. Cellular Growth at Different Nutrient Levels)

Kimball, J. W. 2011. Freshwater Ecosystems. In Biology Pages. http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/F/Freshwater.html

Kurobe, T. E. 2013. Identification of Harmful Cyanobacteria in the Sacramento-San Joaquin Delta and Clear Lake, California by DNA Barcoding. *SpringerPlus 2*, 491.

Lehman, P. W., G. Boyer, C. Hall, S. Waller, and K. Gehrts. 2005a. *Microcystis biomass and toxicity.* Sacramento: Interagency Ecological Program Pelagic Organism Decline Work Group.

Lehman, P. W., G. Boyer, C. Hall, S. Waller, and K. Gehrts. 2005. Distribution and Toxicity of a New Colonial *Microcystis aeruginosa* Bloom in the San Francisco Bay Estuary, California. *Hydrobiologia* 541:87–99.

Lehman, P. W., G. Boyer, M. Satchwell, and S. Waller. 2008a. The Influence of Environmental Conditions on the Seasonal Variation of Microcystis Cell Density and Microcystins Concentration in San Francisco Estuary. *Hydrobiologia* 600(1):187–204.

Lopez, C.B., Jewett, E.B., Dortch, Q., Walton, B.T., Hudnell, H.K. 2008. Scientific Assessment of Freshwater Harmful Algal Blooms. Interagency Working Group on Harmful Algal Blooms, Hypoxia, and Human Health of the Joint Subcommittee on Ocean Science and Technology. Washington, DC.

Müller-Solger, A.B., A.D. Jassby, D.C. Müller. 2002. Nutritional Quality of Food Resources for Zooplankton (Daphnia) in a Tidal Freshwater System (Sacramento-San Joaquin River Delta): Limnology and Oceanography, Vol. 47, No. 5 (Sep., 2002), pp. 1468-1476.

Office of Environmental Health Hazard Assessment. 2009. *Microcystis: Toxic Blue-Green Algae.* http://oehha.ca.gov/ecotox/pdf/microfactsheet122408.pdf deadlink

Pal S. W., N. K. Singh and K. Azam. 2013. Evaluation of Relationship between Light Intensity (Lux) and Growth of *Chaetoceros muelleri*. School of Marine Studies, Faculty of Science, Technology and Environment, University of the South Pacific, Fiji. (Figure Microalgae response to light.)

RWQCB [California Central Valley Regional Water Quality Control Board] 2006.The Water Qality Control Plan (Basin Plan) for the California Regional \ Water Quality Control Board Central Valley Region. Fourth Edition. Rev Apr. 2006. The Sacramento River Basin and the San Joaquin River Basin(,) California.

Reichwaldt E.S., H.Song, A. Ghadouani. 2013. Effects of the Distribution of a Toxic Microcystis Bloom on the Small Scale Patchiness of Zooplankton http://dx.doi.org/10.1371/journal.pone.0066674

Sabalow, R. 2015. Unusual Delta Algae Bloom Worries Researchers. *Sacramento Bee*, pp. http://www.sacbee.com/news/state/california/water-and-drought/delta/article32394438.html.

Tomitani A., A.H. Knoll, C. M. Cavanaugh, and T. Ohno. 2006. The evolutionary diversification of cyanobacteria: Molecular–phylogenetic and paleontological perspectives. Proceedings of the National Academy of Sciences. 5442–5447, doi: 10.1073/pnas.0600999103.

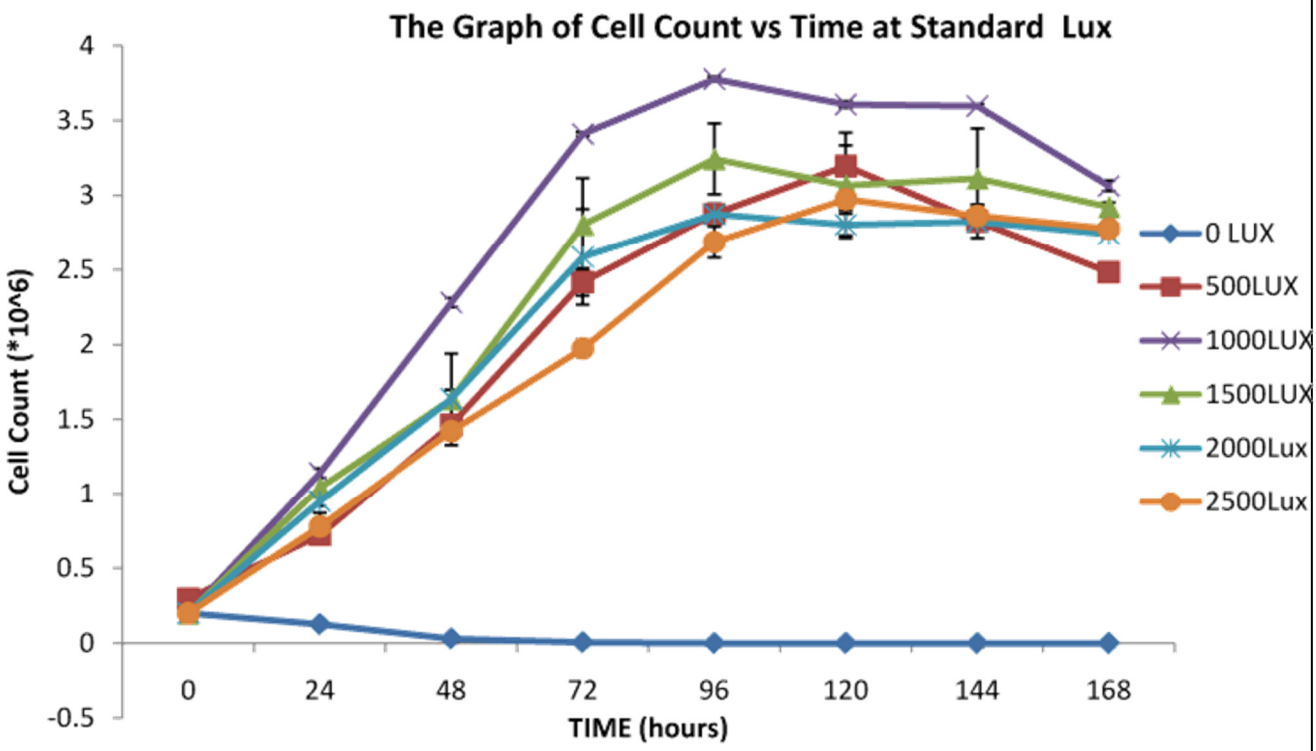
U.S. EPA. (2015). *Drinking Water Health Advisory for the Cyanobacterial Microcystin Toxins.* Washington, DC: U.S. Environmental Protection Agency.

U.S. Geologic Survey [USGS] 2016. Innovation in Monitoring: The U.S. Geological Survey Sacramento–San Joaquin River Delta, California, Flow-Station Network. Fact Sheet 2015-3061.

Visser, P.M., B.W, Ibelings, M., Bormans, and J. Huisman. 2015. Aquatic Ecology doi:10.1007/s10452-015-9537-0

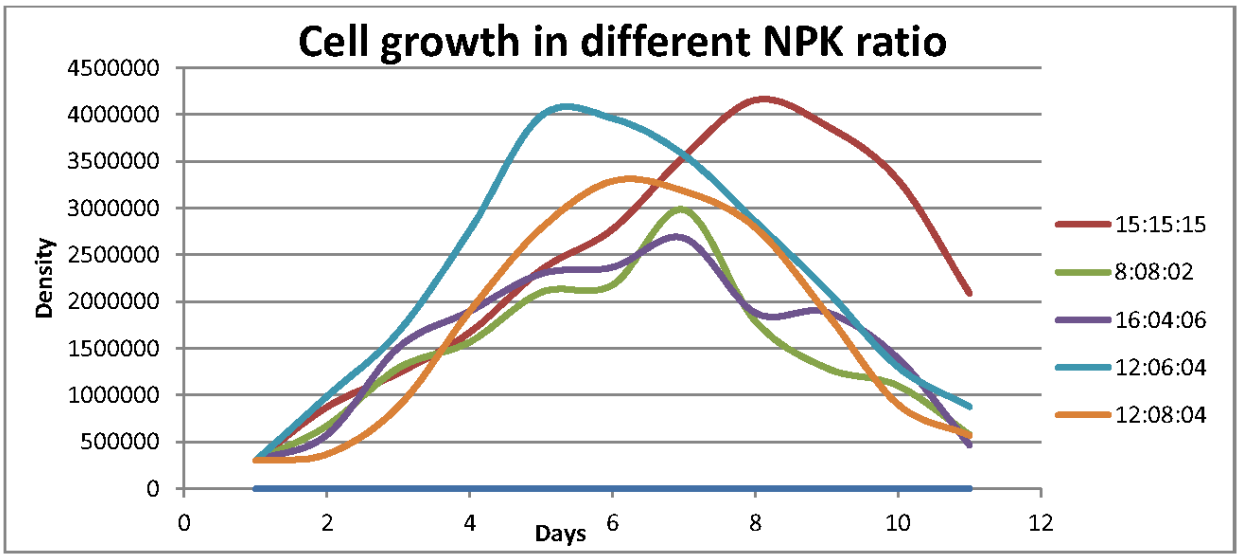
Attached Figures

Figure 1. Chaetoceros Cell Counts at Varying Light Levels



SJC-066 Pal S. W., N. K. Singh and K. Azam. 2013. Evaluation of Relationship between Light Intensity (Lux) and Growth of *Chaetoceros muelleri*. School of Marine Studies, Faculty of Science, Technology and Environment, University of the South Pacific, Fiji. (Figure Microalgae response to light.)

Figure 2. Chlorella Growth Rate at Varying Nutrient Ratios



SJC- 067 Kassim, Z., Akbar J., Lim K. C., Nur F. Z. and Nur H. A. 2014. Sustainable Technique forSelected Live Feed Culture in: "Sustainable Aquaculture Techniques", book edited by Martha Patricia Hernandez- Vergara and Carlos Ivan Perez-Rostro, ISBN 978-953-51-1224-2, (Figure. Cellular Growth at Different Nutrient Levels)

Figure 3.

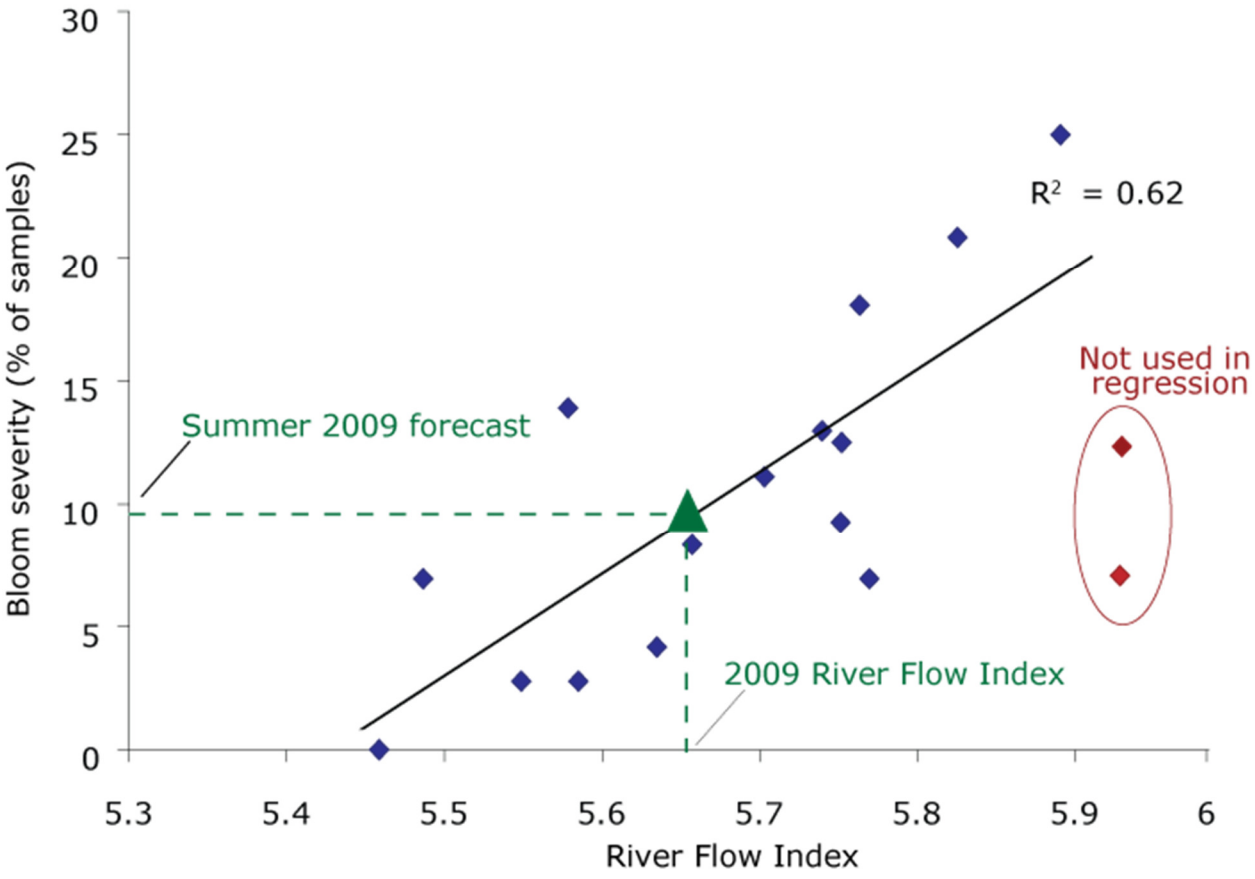


Figure 1. Regression relationship between river flow index at Point of Rocks, Potomac River, MD and Bloom Severity Index as % of samples in a summer season where bloom levels of *Microcystis* were detected. 2008 Summer Forecast is shown here.

X-axis: River Flow Index = Log_{10}(Cumulative 17 month flow in cubic feet/(1* 10^{-6}))
Y-axis: Bloom Severity Index = % Summer Potomac samples at bloom level

SJC-047 Tango, P. 2009. HAB. USGS. (Microcystis) Growth Model, Potomac Algal Bloom http://ian.umces.edu/ecocheck/forecast/chesapeake-bay/2009/indicators/microcystis#_Methodology

EXHIBIT 14

Blue-Green Algae (Cyanobacteria) Blooms

Last Update: September 18, 2013

Activities at the local, state, national and international level demonstrate an increasing interest in health concerns related to blue-green algae (cyanobacteria) and harmful algal blooms. In response, the Environmental Management Branch is providing information and links (at bottom of page) to other sites that will be helpful to the public and to local, regional, and state public health and environmental health officials.

» Click here for the July 2010 update of the Draft Voluntary Statewide Guidance for Blue-Green Algae in Recreational Water Bodies (PDF).

General Information

What are blue-green algae blooms?

» Blue-green algae (cyanobacteria) are any of a number of species of microscopic bacteria that are photosynthetic. They may exist as single cells or groups of cells. They occur naturally in surface waters.

» When conditions are optimal, including light and temperature, levels of nutrients (*i.e.,* phosphorous and nitrogen, and the ratio of the two), and lack of water turbulence, blue-green algae can quickly multiply into a bloom.

» Blue-green algae blooms are likely to occur more often in warmer months.

What is the concern about blue-green algae blooms?

» When some blooms occur in water bodies, exposure to the blue-green algae and their toxins can pose risks to humans, pets, livestock and wildlife. Exposure may occur by ingestion, dermal contact, and aspiration or inhalation.

» Risks to people may occur when recreating in water in which a blue-green algae bloom is present, or from the use of drinking water that uses a surface water source in which a blue-green algae bloom is present.

What are the possible health effects related to blue-green algae blooms?

» Exposure to blue-green algae can cause rashes, skin and eye irritation, allergic reactions, gastrointestinal upset, and other effects. At high levels, exposure can result in serious illness or death.

» Depending on the particular cyanobacterium, and the amount to which one is exposed, blue-green algae have the potential to cause a variety of adverse health effects, including liver toxicity (e.g., *Microcystis aeruginosa*) and neurotoxicity (*e.g., Anabaena circinalis*). Microcystin toxins may also promote tumor growth.

» Destruction of cyanobacteria cells may release the toxins into surrounding waters, so care must be taken in dealing with blue-green algae blooms.

Are these effects just theoretical?

» No. Several dog deaths have been reported following the dogs' exposure to blue-green algae in Humboldt County, as mentioned in this press release (PDF)

» *Microcystis* has been implicated in the deaths of central California southern sea otters, as discussed in this 2010 papert.

» Worldwide animal poisonings and adverse human health effects have been reported [see links below, especially this from WHO (PDF)].

Are there any guidelines or risk evaluations available?

» The WHO guideline for the toxin microcystin LR in drinking water is 1 microgram per liter (µg/L). WHO references are listed below.

» US EPA's National Center for Environmental Assessment has prepared draft toxicological reviews of several cyanobacterial toxins, anatoxin-a, cylindrospermin, and microcystins (LR, RR, YR, and LA).

» Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA) has prepared a draft toxicological summary and suggested action levels for six cyanotoxins.

Where have blooms occurred recently in California?

Last modified on: 3/10/2015 2:06 PM

- Blue-green algal blooms have been reported for a number of water bodies, including: Klamath River (PDF), Siskiyou County | Big Lagoon and Eel River, Humboldt County | Clear Lake, Lake County | Lake Isabella, Kern County | Crowley Lake, Mono County | Lake Elsinore, Riverside County | San Francisco Bay Delta | Stockton Channel, San Joaquin County | Pinto Lake, Santa Cruz County

- In August 2009 the North Coast Regional Water Quality Control Board issued a press release about toxic blue-green algae for parts of the Klamath, Eel (South Fork) and Van Duzen Rivers in northern California (PDF).

Drinking Water

On July 1, 2014, the Drinking Water Program and the Environmental Laboratory Accreditation Program moved from CDPH to the State Water Resources Control Board (SWRCB). Find out more at http://www.waterboards.ca.gov/drinking_water/programs/index.shtml.

What is the best way to minimize risks from blue green algae in drinking water?

- Avoid drinking untreated surface water. This will protect you not only from blue-green algae, but from *Giardia*, *Cryptosporidium*, and a host of other microbes.

What about drinking water from public water systems?

- Water systems generally go to great lengths to keep blue-green algae from growing in their surface water supplies, in order to avoid taste and odor problems that would concern their customers. For example, some blue-green algae produce geosmin and MIB (2-methylisoborneol); their earthy, musty odors can be sensed at very low concentrations (on the order of nanograms per liter). The usual good management practices to control taste and odor help reduce the likelihood of toxic blue-green algal blooms.

- When toxic blue-green algae blooms occur, water systems need to utilize a strategy to treat the blooms that does not merely kill the algae, since rupturing (or lysing) the blue-green algal cells can release their toxins, and treatment may not be entirely effective in removing toxins.

What is the regulatory status of blue-green algae in drinking water?

- There aren't any drinking water standards specifically for blue-green algae, but "blue green algae (cyanobacteria), other freshwater algae, and their toxins" were included on the second federal Drinking Water Contaminant Candidate List (CCL2). EPA uses the CCL to prioritize research and data collection efforts to help determine whether a specific contaminant ought to be regulated.

Recreational Water

More about CDPH's recreational health programs is here.

What is the best way to minimize risks from blue green algae in recreational water?

- Avoid body contact with blue-green algal blooms. This includes swimming, wading, water-skiing.

- Children especially should avoid contact. Their small body weight means their exposures to blue green algae will be higher than adults, given the same volume of water intake.

- Local health and environmental agencies are encouraged to and generally do post recreational areas with signs and brochures to inform the public of the presence of blue-green algae blooms. Some examples of information from various states are presented below.

What about fish caught in water experiencing a blue-green algae bloom?

- If one is going to consume fish, it's best to remove the internal organs, which would likely contain more of the algae/toxin.

- There have been some reports of blue-green algae toxin in fish tissues [for example, see the SWRCB's 2008 report on cyanotoxin in yellow perch and shellfish in the Klamath River (PDF)]. However, anadromous fish that are migrating into a water body with a bloom may not have had an opportunity to concentrate much of the toxin.

What about pets?

- Keep pets out of water with blue-green algae blooms.

- Dog deaths have been reported, some apparently related to ingestion associated with licking algae from their fur after wading/swimming in water with blue-green algae blooms.

What is the regulatory status of blue-green algae in recreational water?

- There aren't any state or federal standards for blue-green algae in recreational water.

- California has developed draft voluntary guidance for recreational water bodies -- the latest draft (July 2010) is here (PDF).
- CDPH discusses blue-green algae in its guidance for freshwater beaches.
- The WHO has developed guidelines (PDF) for recreation, which are summarized in this table (PDF).

References

WHO, 1999. Toxic Cyanobacteria in Water: A Guide to their Public Health Consequences, Monitoring and Management. World Health Organization, Geneva

WHO, 2003. Guidelines for Safe Recreational Water Environments, Vol. 1, Coastal and Fresh Water, World Health Organization, Geneva.

WHO, 2004. Microcystin LR (PDF), from Chemical Fact Sheets, Guidelines for Drinking Water (PDF), World Health Organization, Geneva.

More Information

What are other states doing about blue-green algae?

Some other states provide informational materials about blue-green algae and/or other algal blooms, including the following:

Florida | Indiana | Maine | Maryland | Massachusetts | Michigan (PDF) | Minnesota | Nebraska | New Hampshire | New York | North Carolina | Ohio | Oregon | Texas | Vermont | Washington | Wisconsin

Where Can I Learn More?

Blue-Green Algae Tri Fold Brochure

Guidance on blue-green algae in recreational water bodies (PDF, New Window)
State-wide guidance from SWRCB, CDPH, and OEHHA, dated July 2010.

SWRCB's blue-green algae page
Information from the State Water Resource Control Board.

OEHHA's information on microcystins
Includes a report on toxicity and effects, with special reference to fish, wildlife, and livestock; a factsheet; and list of references.

OEHHA's draft toxicologic summary for cyanobacteria
Includes actions levels to reduce potential adverse health effects for six cyanobacteria.

CDC's blue-green algae web site
The Centers for Disease Control and Prevention's information on blue-green algae.

NOAA's Harmful Algae Page
The National Oceanic and Atmospheric Administration's information on harmful algal blooms.

NCEA's toxicological reviews of several cyanobacterial toxins
Evaluations by the National Center for Environmental Assessment.

The WHO's Toxic Cyanobacteria in Water Guidance
The World Heath Organization's Guide to BGA's Public Health Consequences, Monitoring and Management.

Introduction to the ISOC-HAB
US EPA's information about the International Symposium on Cyanobacterial Harmful Algal Blooms.

ISOC-HAB Proceedings (PDF, 11.2MB, New Window)
Proceedings from the 2005 symposium, published in 2007.

US EPA's Cyanobacterial Harmful Algal Blooms (CyanoHABs) Information

USGS Kansas Algal Toxins Research Team
BGA Blooms: Tastes, Odors, and Toxins; plus links to more

Other Cyanobacteria Sites

Cyanosite
A webserver for cyanobacterial research (Purdue University).

Introduction to Cyanobacteria
Information from UC Berkeley's Museum of Paleontology.

NALMS' Blue-Green Algae Pages
The North American Lake Management Society's blue-green algae information.

Toxic algal blooms – A sign of rivers under stress
Material from the Australian Academy of Science.

Blue-Green Algae (Cyanobacteria) in Inland Waters:
Assessment and Control of Risks to Public Health (Scottish Executive Health Department).

Current approaches to cyanotoxin risk assessment, risk management, and regulations (PDF, 2.47MB, New Window)
A summary of interanational activities, from the Federal Environmental Agency, Germany.

Laboratories

Commercial Laboratories
In response to inquiries about laboratories that can assist local agencies in the identification of blue-green algae and monitoring for algal cells and toxins, CDPH offers the following:

GreenWater Laboratories/Cyanolab
Palakta, Florida: 1-877-869-2542 (toll free), or (386) 328-0882.

California Animal Health & Food Safety Laboratory System
University of California, Davis: (530) 752-8700 — analysis for microcystins and anatoxin-a in animal stomach contents, and other animal-related analyses.

Abraxis
Warminster, Pennsylvania: (215) 357-3911 — test kits.

Beacon Anayltical Systems, Inc.
Portland, Maine: (207) 761-2199 — test kits.

Envirologix
Portland, Maine: (866) 408-4597 or (207) 797-0300 — test kits.

information.

USGS Podcast: Slimy Summer Swimming: Harmful Algal Blooms in Lakes, Rivers and Streams

Prior Correspondence from DDWEM (now State Water Board)

To public water systems (PWS) (PDF, New Window)
DDWEM's (now State Water Board) letter to PWS with surface water sources of drinking water.

To local primacy agencies (LPAs) (PDF, New Window)
DDWEM's (now State Water Board) letter to LPAs that regulate PWS with surface water sources.

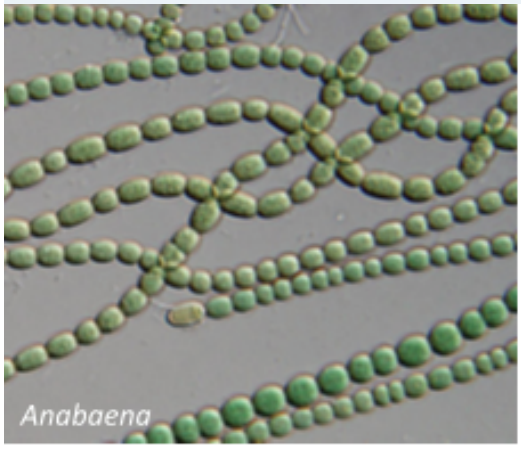
To county officials (PDF, New Window)
DDWEM's (now State Water Board) letter to county health officers and environmental health directors.

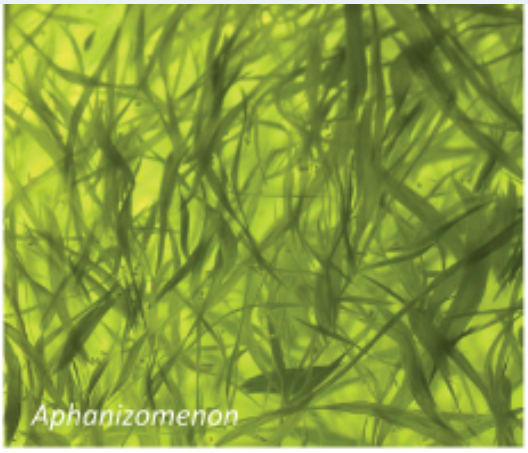
EXHIBIT 15

DWR-703

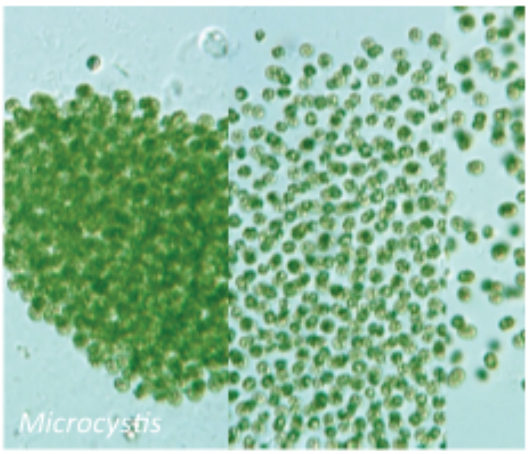
Factors Affecting Growth of Cyanobacteria

With Special Emphasis on the Sacramento-San Joaquin Delta









Mine Berg
Martha Sutula

Southern California Coastal Water Research Project

SCCWRP Technical Report 869

Factors Affecting the Growth of Cyanobacteria with Special Emphasis on the Sacramento-San Joaquin Delta

Prepared for:
The Central Valley Regional Water Quality Control Board
and
The California Environmental Protection Agency
State Water Resources Control Board
(Agreement Number 12-135-250)

Mine Berg
Applied Marine Sciences

Martha Sutula
Southern California Coastal Water Research Project

August 2015
Technical Report 869

ACKNOWLEDGEMENTS

The authors of this document wish to thank the members of the Cyanobacteria Technical Advisory Group for their excellent review and discussion of this topic. This report was produced under California State Water Board contract to the Southern California Coastal Water Research Project (Agreement Number 12-135-250).

This report should be cited as:
Berg M and Sutula M. 2015. Factors affecting the growth of cyanobacteria with special emphasis on the Sacramento-San Joaquin Delta. Southern California Coastal Water Research Project Technical Report 869 August 2015.

EXECUTIVE SUMMARY

A world-wide increase in the incidence of toxin-producing, harmful cyanobacterial blooms (cyanoHABs) over the last two decades has prompted a great deal of research into the triggers of their excessive growth. Massive surface blooms are known to decrease light penetration through the water, cause depletion of dissolved oxygen following bacterial mineralization of blooms, and cause mortality of aquatic life following ingestion of prey with high concentrations of toxins. Additionally, humans coming in contact with the water may develop digestive and skin diseases, and it may affect the drinking water supply.

The Central Valley Regional Water Quality Control Board (Water Board) is developing a science plan to scope the science needed to support decisions on policies governing nutrient management in the Delta. Blooms of cyanoHABs are one of three areas, identified by the Water Board, that represent pathways of potential impairment that could be linked to nutrients. The Water Board commissioned a literature review of the factors that may be contributing to the presence of cyanoHABs in the Delta. The literature review had three major objectives:

1) Provide a basic review of biological and ecological factors that influence the prevalence of cyanobacteria and the production of cyanotoxins;
2) Summarize observations of cyanobacterial blooms and associated toxins in the Delta;
3) Synthesize literature to provide an understanding of what ecological factors, including nutrients, may be at play in promoting cyanobacterial blooms in the Delta.

This review had four major findings:

#1. Five principal drivers emerged as important determinant of cyanobacterial blooms in a review of the global literature on factors influencing cyanobacteria blooms and toxin production. These include: 1) Water temperature, 2) Water column irradiance and water clarity, 3) Stratified water column coupled with long residence times, 4) Availability of N and P in non-limiting amounts; scientific consensus is lacking on the importance of N: P ratios as a driver for cyanoHABs, and 5) Salinity regime.

#2. Existing information is insufficient to fully characterize the threat of CyanoHABs to Delta ecosystem services because cyanoHABs are not routinely monitored. Based on existing data, the current risk to Delta aquatic health is of concern and merits a more thorough investigation. This observation is based total microcystin levels found in Delta fish tissues that are within the range of sublethal effects to fish as recently reviewed by the California Office of Environmental Health Hazards (OEHHA 2009), and dissolved toxin concentrations that occasionally exceed both the OEHHA action level and the World Health Organization (WHO) guideline of 1000 ng L^{-1} in certain "hotspots" of the Delta.

#3. Comprehensive understanding of the role of nutrients vis-à-vis other environmental factors in influencing cyanoHAB presence in the Delta is severely hampered by the lack of a routine monitoring program. Drawing on available information on the five factors influencing cyanoHABs, we can conclude the following:

- Temperature and irradiance appear to exert key roles in the regulation of the onset of blooms. Cyanobacteria require temperatures above 20°C for growth rates to be competitive with eukaryotic phytoplankton taxa, and above 25°C for growth rates to be competitive with diatoms. In addition, they require relatively high irradiances to grow at maximal growth rates.
- It appears that N and P are available in non-limiting amounts in the Delta; moreover, concentrations, or ratios, do not change sufficiently from year–to–year in order to explain year–to–year variation *Microcystis* biomass or occurrence. Therefore the initiation of *Microcystis* or other cyanoHAB blooms are probably not associated with changes in nutrient concentrations or their ratios in the Delta. However, as with all phytoplankton blooms, once initiated, cyanoHABs cannot persist without an ample supply of nutrients.
- Salinity is controlling the oceanward extent of cyanobacteria blooms in the Delta, but salinity gradients do not explain the spatial distribution of cyanoHABs in the Delta. Notably, salinity regime is not a barrier to toxin transport, as cyanotoxins have been detected in SF Bay.
- Turbidity, low temperatures, and higher flows during most of the year are likely restricting cyanobacteria blooms to the July-August time period.

#4. Climate change and anthropogenic activity associated with land use changes have the potential to alter cyanoHAB prevalence in the future. Climate change will likely result in warmer temperatures and increased drought, the latter of which could result in reduced flows, increased residence time and water column stability leading to higher light availability in the Delta. Both temperature and reduced flows would presumably result in a greater prevalence of cyanoHABs. It's noteworthy that phytoplankton biomass and primary productivity are depressed relative to available nutrients in the Delta, so it's unclear what the effect of modifying nutrient loads will have on frequency and intensity of cyanoHAB occurrence in the future.
Given these findings, two major science recommendations are proposed:

R1: Implement Routine Monitoring of CyanoHABs. DWR is currently conducting a monitoring program which routinely samples many of the variables of interest known to influence cyanoHABs. Comprehensive cyanoHAB monitoring should be added as a component to this program. To begin, a work plan should be developed which specifically scopes the needed changes in the program to comprehensively monitor cyanoHABs. This report details specific components that should be considered in this workplan. The workplan should also consider monitoring needed to develop and calibrate an ecosystem model to further investigate controls

on primary productivity and phytoplankton assemblage (see R2 below). The workplan should be peer-reviewed by subject matter experts. After an initial period of 3-5 years, the monitoring data should be used to comprehensively report on the status and trends of cyanoHABs and the factors that favor bloom occurrence in the Delta.

R2: Develop an Ecosystem Model of Phytoplankton Primary Productivity and HABs Occurrence to further Inform Future Risk and Hypotheses on Factors Controlling CyanoHABs. Because nutrients are not currently limiting cyanobacterial blooms, it is critical that an improved understanding is gained of the factors that are controlling phytoplankton primary productivity in the Delta, since increased phytoplankton growth could lead to increased risk of cyanoHAB blooms. To inform management action moving into the future, an ecosystem model of phytoplankton primary productivity and HABs occurrence should be developed. This model should have the capability to provide information on primary productivity and biomass as well as planktonic food quality and transfer of carbon to higher trophic levels. To step into model development, three actions should be taken: 1) examine existing models already available to determine suitability for this task, 2) utilize existing data to explore, to the extent possible, the relationships between chlorophyll a, phytoplankton composition, climate variables *et al.* factors. This analyses should inform hypotheses that can be tested through model development as well as potential future scenarios, and 3) a work plan should be developed that lays out the modeling strategy, model data requirements, and implementation strategy.

TABLE OF CONTENTS

Acknowledgements ..... **i**

Executive Summary ..... **iii**

List of Tables ..... **vii**

List of Figures ..... **viii**

1. Introduction, Purpose and Organization of the Review **1**

1.1 Background and Context *1*

1.2 Goal and Organization of Cyanobacterial Literature Review *3*

2. Basic Biology and Ecology of Cyanobacteria **4**

2.1 Overview *4*

2.2 General Characteristics *5*

2.2.1 Classification, Distribution and Akinete Production 5

2.2.2 Light Harvesting, Photosynthesis and Carbon Fixation 7

2.2.3 Buoyancy Regulation 8

2.2.4 Nitrogen Metabolism 9

2.2.5 Cellular Nitrogen:Phosphorus (N:P) Requirement 13

2.2.6 Toxin Production 15

3. Factors Influencing Cyanobacterial Blooms and Toxin Production **21**

3.1 Salinity *21*

3.2 Nutrient Concentrations and Ratios *22*

3.2.1 Influence of N and P Loadings and Concentrations in Stimulating Cyanobacterial Growth 22

3.2.2 Influence of Changes in N:P Ratios on Stimulation or Limitation of Cyanobacterial Growth 23

3.2.3 Influence of Type of N on Growth of Cyanobacteria 26

3.3 Irradiance and Water Clarity *27*

3.4 Factors Impacting Toxin Production and Degradation *29*

3.4.1 Toxin Production 29

3.4.2 Toxin Degradation 30

3.5 Temperature *31*

3.6 Stratification and Residence Time *32*

3.6.1 Stratification 32

3.6.2 Residence Time 33

3.7 Other Factors *33*

4. Prevalence of CyanoHABs and Potential for Effects on Ecosystem Services in the Delta....34

4.1 Ecosystem Services....34

4.2 Prevalence and Trends of CyanoHABs in the Delta....35

4.2.1 Spatial Distribution of Microcystis throughout the Delta....35

4.2.2 Interannual variability in Microcystis biomass in the Delta....37

4.2.3 Microcystin toxin concentrations in the Delta and San Francisco Bay....39

4.2.4 Potential for CyanoHAB Risk to Delta Beneficial Uses....41

4.2.5 Summary of Potential for Adverse Effects on Delta Beneficial Uses....42

5.0 Synthesis of Factors Influencing CyanoHABs presence and Toxin Production in the Delta....43

5.1 Present and Future Factors associated with cyanoHAB prevalence in the Delta....43

5.1.1 Flow and mixing....43

5.1.2 Temperature....44

5.1.3 Water Clarity....46

5.1.4 Nutrient Concentrations....46

5.2 Summary....47

6.0 Recommendations....50

R1: Implement Routine Monitoring of CyanoHABs....50

R2: Develop an Ecosystem Model of Phytoplankton Primary Productivity and HAB Occurrences to further Inform Future Risk and Hypotheses on Factors Controlling CyanoHABs....51

7.0 Literature Cited....52

Appendix A....75

Appendix B....80

Appendix C....97

LIST OF TABLES

Table 2.1. Cyanobacterial groupings based on morphological traits. Adapted from Rippka *et al.* 1979..... 5

Table 2.2.Toxins produced by cyanobacteria. Based on data from Cox *et al.* 2005, Sivonen and Borner 2008, Cheung *et al.* 2013. 16

Table 2.3. Common cyanobacterial toxins. ND: Not determined.....18

Table 4.1. Action levels developed by OEHHA (2009) for human health exposure to cyanotoxins compared with the WHO guidance level for microcystins and the EPA 10-day average exposure threshold.....42

Table 5.1. Summary of general physiological drivers of cyanobacterial growth, how they are manifested in population growth and competition with diatoms, and how they compare with environmental drivers observed to be operating in the Delta.....49

LIST OF FIGURES

Figure 1.1. The Sacramento-San Joaquin Delta Region..... 2

Figure 2.1. Akinetes of a) Anabaena cylindrica culture grown in medium without nitrogen; A=akinete; H=heterocyst; V=vegetative cell (picture from Tomatini *et al*. 2006), b) Anabaena lemmermanni, and c) Cylindrospermopsis raciborskii in lake sediments under light microscopy and hybridized with probe under fluorescence microscopy; scale bar is 10µm (pictures from Ramm *et al*. 2012)..... 7

Figure 2.2. Cellular N:P ratios (mole:mole) in different phytoplankton taxa. Dashed red line indicates the average phytoplankton cellular N:P ratio of 16, also called the Redfield ratio. Data from Hillebrand *et al.* 2013. 14

Figure 3.1. Conceptual model of factors affecting cyanobacteria blooms including warmer water, drought and decreased flow, decreased mixing, increased residence time, and increased N and P inputs from agricultural, industrial and urban sources. From Paerl *et al*. 2011. 21

Figure 3.2. Conceptual diagram of interaction of nutrient inputs, cycling processes, and limitation of primary production along the freshwater to marine continuum. From Pearl *et al.* 2014b. 23

Figure 3.3. Difference in growth rates of *Cylindrospermopsin raciborskii* when growth on NO_3^- (red bars) versus NH_4^+ (blue bars) for eigth different strains. Data from Saker and Neilan 2001 and Stucken *et al.* 2014. 27

Figure 3.4. Photosynthesis as a function of irradiance in three cyanoHAB species. Data from Wu *et al.* 2009. 28

Figure 3.5. Concentration of dissolved microcystin-LR equivalents in bioassays as a function of time after addition of purified microcystin (top panel) or lysed bloom material (bottom 3 panels) to lake water containing natural microbial assemblages. Shaded area corresponds with time period of degradation of 95% of original microcystin concentration. Data from Christoffersen *et al.* 2002..... 31

Figure 3.6. Changes in growth rate with temperature for diatoms (red ± 0.35 d^{-1}, T_{opt}= 20 ± 1.8 °C), Chlorophytes (green ± 0.21 d^{-1}, T_{opt}= 29 ± 3.8), Cyanobacteria (cyan ± 0.13 d^{-1}, T_{opt}=29 ± 4.5) and dinoflagellates (orange ± 0.1 d^{-1}, T_{opt}= 21 ± 2.8). Data from Kudo *et al.* 2000, Butterwick *et al.* 2005, Yamamoto and Nakahara 2005, Boyd *et al.* 2013, Lurling *et al.* 2013. 32

Figure 4.1. The Sacramento-San Joaquin Delta Region. Red bubbles mark locations with greatest Microcystis-associated surface Chl a concentrations (largest bubble=0.55 µg Chl a L^{-1}). Data from Lehman *et al.* 2005. 36

Figure 4.2. Interannual changes in surface Chl a due to abundance of Microcystis colonies. Means and standard deviations of 9 different stations in the San Joaquin River (Antioch (D12), Jersey Point (D16), Frank's Tract (D19), Potato Point (D26), Prisoners Point (D29), San Joaquin River at Turner Cut, Sand Mound Slough, Mildred Island, and Old River at Rancho del Rio (D28). Data from Lehman *et al.* 2005, 2013. 37

Figure 4.3. Comparison of environmental variables and Chl a in Clear Lake (Cyan) and the Delta (orange) using in-patch grab samples during the summer months of 2011. (A) Temperature, (B) Secchi disk depth, (C) Chl a. Data from Mioni *et al.* 2012. 38

Figure 4.4. Percent toxin-producing strains in Microcystis assemblage at stations AT, Antioch (D12); BI, Brannan Island (D23); MI, Mildred Island; and OR, Old River at Rancho del Rio (D28). Data from Baxa *et al.* 2010.....39

Figure 4.5. Microcystin toxin concentrations determined with grab samples (blue/cyan) and with SPATT resin (red/orange) at three stations in Clear Lake, during and after a Microcystis bloom, and at one station (D12, Antioch) in the Delta. Data from Mioni *et al.* 2012. 40

Figure 5.1. Variation in flow at Brandt Bridge in the Delta (years 2009 and 2012) illustrating the low- and reverse-flow window in July-August (shaded grey). Data and plot from Spier *et al.* 2013.....44

Figure 5.2. Deviation from the annual mean of maximum water temperatures at Stockton in the Central Delta. Grey shaded area indicates period from 1999 onwards with increased positive temperature deviations. Data from Brooks *et al.* 2011.....45

1. INTRODUCTION, PURPOSE AND ORGANIZATION OF THE REVIEW

1.1 Background and Context

The Sacramento–San Joaquin River Delta, is an inland river delta and estuary approximately 1300 square miles in size, found in Northern California. Formed at the western edge of the Central Valley by the confluence of the Sacramento and San Joaquin Rivers, the Delta is a key component of the State's water resource infrastructure and a region that is rapidly urbanizing, yet serves as critical habitat or fish, birds and wildlife. Water from the 45,000 square mile Delta watershed fuels both local and statewide economies, including important agricultural commodities. The Delta is widely recognized as in "crisis" because of human effects on the environment and competing demands for the Delta's resources. The consequences of these competing demands include point and non-point discharges, habitat fragmentation and loss, modified flow regimes, introduction of non-native species, all of which combine to threaten ecosystem health, including the continued decline of threatened and endangered species

In 2009 the California legislature passed the Delta Reform Act creating the Delta Stewardship Council. The mission of the Council is to implement the coequal goals of the Reform Act and provide a more reliable water supply for California while protecting, restoring, and enhancing the Delta ecosystem. The Council wrote and adopted a Delta Plan in 2013 to implement these goals. Chapter 6 of the Delta Plan deals with water quality and contains recommendations to implement the coequal goals of the Delta Reform Act. Recommendation # 8 states, in part, "…the State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards (Water Board) should prepare and begin implementation of a study plan for the development of objectives for nutrients in the Delta … by January 1, 2014. Studies needed for development of Delta… nutrient objectives should be completed by January 1, 2016. The Water Boards should adopt and begin implementation of nutrient objectives, either narrative or numeric, where appropriate, in the Delta by January 1, 2018. Potential nutrient related problems identified in the Delta Plan for evaluation are:

1) Decreases in algal abundance and shifts in algal species composition,
2) Increases in the abundance and distribution of macrophytes, including water hyacinth and Brazilian waterweed,
3) Increases in the magnitude and frequency of cyanobacterial blooms

To provide better scientific grounding for the study plan, the Water Board commissioned two literature reviews centered on these three potential areas of impairment. This document provides a synthesis of literature on cyanobacterial blooms in the Delta. Technical Adivory Group and Stakeholder comments on the review are provided in Appendices B and C, respectively.

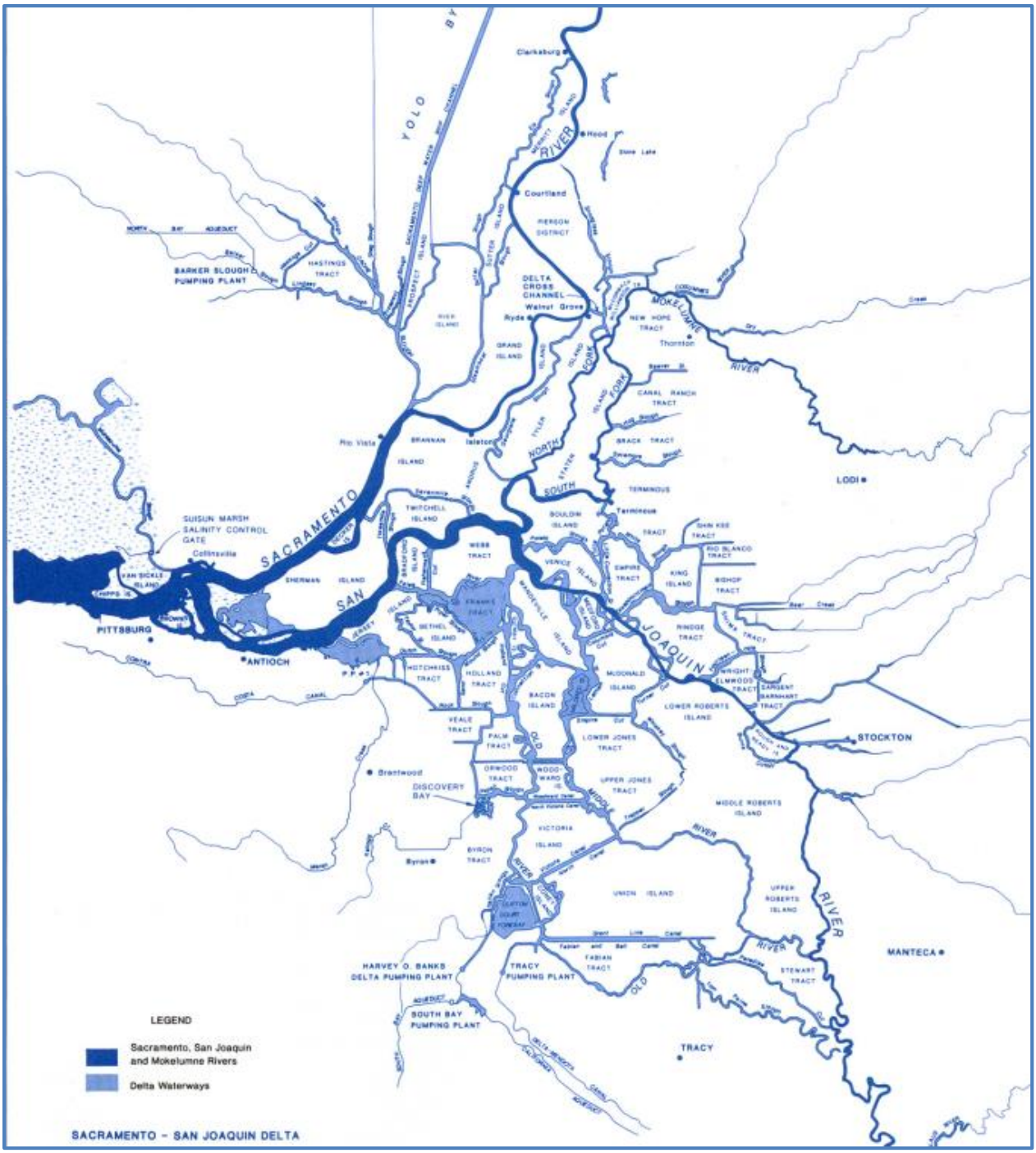


Figure 1.1. The Sacramento-San Joaquin Delta Region.

1.2 Goal and Organization of Cyanobacterial Literature Review

The goal of the cyanobacterial literature review is to synthesize available information to provide insight into cyanobacterial blooms in the Delta. The review had three major objectives:

1) Provide a basic review of biological and ecological factors that influence the prevalence of cyanobacteria and production of cyanotoxins;
2) Summarize observations of cyanobacteria blooms and associated toxins in the Delta;
3) Synthesize literature to provide an understanding of what ecological factors, including nutrients, may be at play in promoting cyanobacteria blooms in the Delta.

This review, and the recommended next steps, will contribute to a science plan to determine whether or how to proceed with the development of nutrient objectives for the Delta. The document is organized as follows:

Section 1: Introduction, Purpose and Organization of the Review

Section 2: Basic Biology and Ecology of Cyanobacteria

Section 3: Factors Influencing Cyanobacterial Blooms and Toxin Production

Section 4: Prevalence of CyanoHABs and Potential for Effects on Ecosystem Services in the Delta

Section 5: Synthesis of Factors Influencing CyanoHABs Presence and Toxin Production in the Delta

Section 6: Recommendations

Section 7: Literature Cited

2. Basic Biology and Ecology of Cyanobacteria

2.1 Overview

Cyanobacteria are a versatile group of bacteria that were the ancient colonizers of Earth and the photosynthetic ancestors of chloroplasts in eukaryotes such as plants and algae. As pioneers of photosynthesis, cyanobacteria were responsible for oxygenating Earth's atmosphere 2.5 billion years ago. In addition to being photosynthetic, cyanobacteria can differentiate into specialized cell types called heterocysts and fix nitrogen (N), exhibit gliding mobility, and tolerate a wide range of temperatures as evidenced by their ability to thrive in hot springs and ice-covered Antarctic lakes. Cyanobacteria also produce an array of bioactive compounds, some of which possess anti-microbial, anti-cancer and UV protectant properties. However, a subset of these bioactive compounds is highly toxic to humans and wildlife.

Blooms of cyanobacteria that produce these toxins, collectively known as harmful cyanobacterial algal blooms (cyanoHABs), has garnered a great deal of attention due to their increased occurrence in recent decades (Chorus and Bartram 1999, Carmichael 2008, Paerl and Huisman 2008, Hudnell 2010). The geographical distribution of these blooms has also increased with blooms appearing in areas previously unaffected (Lehman *et al.* 2005, Lopez *et al.* 2008). CyanoHABs can have major negative impacts on aquatic ecosystems. Toxins produced by cyanobacteria can lead to mortality in aquatic animals, waterfowl and domestic animals (Havens 2008, Miller *et al.* 2010). Moreover, toxins in drinking water supplies can pose a variety of adverse health effects and therefore require expensive treatment options such as filtration, disinfection, and adsorption with activated carbon (Cheung *et al.* 2013). In addition to the threat of toxins, oxygen depletion due to organic matter decomposition following the die-off of blooms can result in massive fish kills. CyanoHABs can also lead to revenue losses and impact local economies by reducing business in affected water bodies during the peak of tourism season. Considerable costs are associated with mitigation of blooms and lake restoration (Dodds *et al.* 2009).

The San Francisco Bay Delta is an area where cyanoHABs were previously undetected but have become commonplace since early 2000 (Lehman *et al.* 2005). In addition to providing a home for several species of pelagic fish and other wildlife, the Delta serves as a critical source of drinking water, and freshwater for irrigation of farms, to communities locally as well as farther south including the Los Angeles Metropolitan Water District. In concert with the occurrence of cyanoHABs, concentrations of the toxins they produce have been detected in the water and in higher trophic levels including zooplankton and fish (Lehman *et al.* 2010). The purpose of the following sections summarizes the basic biology of cyanobacteria beginning with classification, light harvesting, carbon metabolism, buoyancy regulation, nitrogen metabolism, cellular N:P ratios and toxin production, in order to build fundamental concepts that are later utilized in the review.

2.2 General Characteristics

2.2.1 Classification, Distribution and Akinete Production

Classification

Traditionally, morphological traits have been used to subdivide the cyanobacteria into five sub-groups (Rippka *et al.* 1979). The major division is between cyanobacteria that are single celled and/or colonial and those that grow filaments (Table 2.1). Each category contains a mixture of marine and freshwater species. In the former category are the Group I Croococcales including the freshwater *Microcystis* and *Synechocystis*, and the marine *Synechococcus* and *Prochlorococcus*. Group II Pleurocapsales include *Pleurocapsa* and *Xenococcus* (Table 2.1). The filamentous algae, Groups III, IV, and V, are further subdivided into the Oscillatoriales that produce only vegetative cells, including the freshwater planktonic *Planktothrix* species, the benthic *Oscillatoria* and *Lyngbya* species, as well as the marine *Trichodesmium* sp. (Table 2.1). Group IV, the Nostocales, contain filamentous algae that differentiate into heterocysts and fix N_2. This group includes *Aphanizomenon*, *Anabaena*, *Nostoc* and *Cylindrospermopsis* (Table 2.1). Additionally, the Nostocales is known for differentiation into resting cells called akinetes during unfavorable conditions. Group V, the Stigonematales include species with filaments that grow in complex branching patterns.

Table 2.1. Cyanobacterial groupings based on morphological traits. Adapted from Rippka *et al.* 1979.

<table>
<tr><td colspan="3">Croococcales
Unicellular, reproduce by binary fission
GROUP 1</td><td>Gloeothece (N) Synechococcus
Microcystis Synechocystis
Prochlorococcus
Prochloron</td></tr>
<tr><td colspan="3">Pleurocapsales
Unicellular, reproduce by multiple fission
GROUP 2</td><td>Pleurocapsa
Staniera (N)
Xenococcus (N)</td></tr>
<tr><td rowspan="3">Filamentous chain (trichome) forming; reproduce by random trichome breakage, hormogonia, germination of akinetes</td><td>Trichome composed of vegetative cells</td><td>Oscillatoriales
1 plane division
GROUP 3</td><td>Lyngbya (N)
Oscillatoria (N)
Phormidium
Prochlorothrix
Trichodesmium (N)</td></tr>
<tr><td rowspan="2">In the absence of fix d N, trichome contains heterocysts; some produce akinetes</td><td>Nostocales
1 plane division
GROUP 4</td><td>Aphanizomenon
Anabaena
Cylindrospermum
Nodularia
Nostoc</td></tr>
<tr><td>Stigonematales
Division in more than 1 plane
GROUP 5</td><td>Chlorogleopsis
Fisherella</td></tr>
</table>

It was originally thought that N_2 fixation primarily existed in the Nostocales which had the ability to differentiate into heterocyst cells. More recent investigations tracking the *nifD* and *nifH* gene diversity has uncovered that N_2 fixation occurs in a range of unicellular, non-filamentous cyanobacteria dispersed throughout the five original groups first proposed by Rippka *et al.* (1979). These species are indicated by an (N) after their name in Table 2.1. Depending on which functionality of the cyanobacteria is emphasized, recent gene-based groupings of cyanobacteria have created as many as ten different sub-categories (Turner *et al.* 1999, Tomatini *et al.* 2006). However, there appears to exist no general consensus over the best manner in which to categorize the cyanobacteria based on functionality and marker genes. Most cyanobacteria are planktonic and are dispersed throughout the five groups. The benthic cyanobacteria are found mainly in the Oscillatoriales subgroup. The toxic cyanoHAB-forming cyanobacteria are mostly freshwater planktonic species dispersed throughout groups I, III and IV and include the N_2 fixing genera *Anabaena*, *Aphanizomenon*, *Cylindrospermopsin*, and *Nodularia*; the benthic N_2 fixing genera *Lyngbya* and some *Oscillatoria*; and the non-N_2 fixing genera *Microcystis* and *Planktothrix* (Paerl and Paul 2012).

Akinete formation

Akinetes are the resting cells produced by the Nostocales in order to survive adverse environmental conditions such as cold and desiccation (Tomatini *et al.* 2006). Akinete cells maintain low levels of metabolic activity (Thiel and Wolk 1983, Sukenik *et al.* 2007), are dispersed in sediments (Baker 1999, Kim *et al.* 2005, Rucker *et al.* 2009), and are distinguishable from vegetative cells by their larger size (Figure 2.1). They germinate in response to improved environmental conditions such as light and temperature (Baker and Bellifemine 2000, Karlsson-Elfgren *et al.* 2004, Yoshimasa and Nakahara 2005, Kaplan-Levy *et al.* 2010) and provide an inoculum of Nostocales vegetative cells to the water column from the sediments where the akinete "seed bank" may remain viable for decades (Stockner and Lund 1970, Livingstone and Jaworski 1980). Therefore, eradication of Nostocales from a system once it has become "infected" is very difficult.

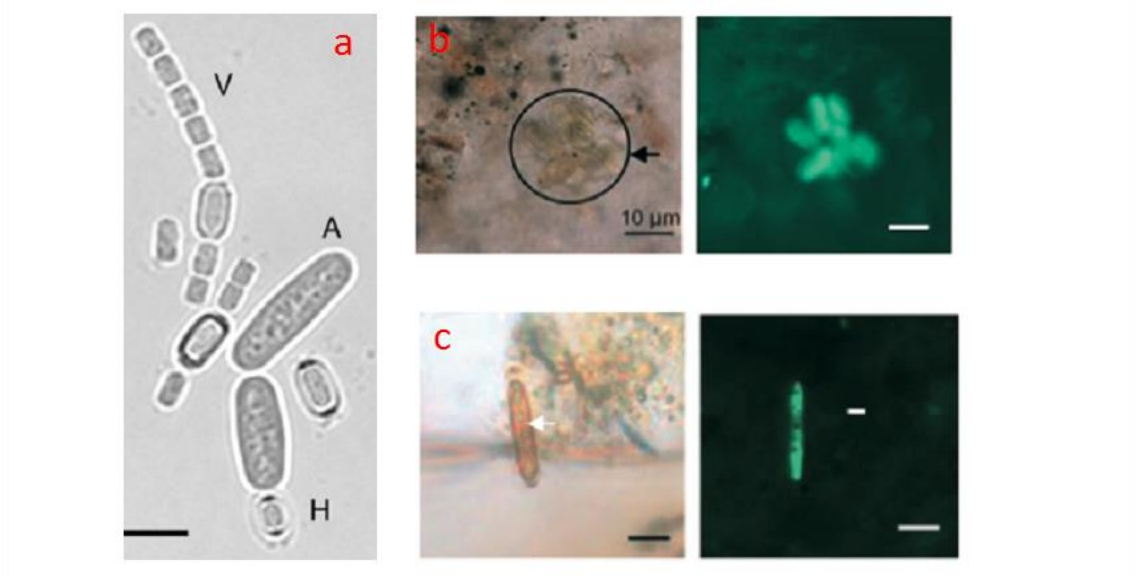


Figure 2.1. Akinetes of a) Anabaena cylindrica culture grown in medium without nitrogen; A=akinete; H=heterocyst; V=vegetative cell (picture from Tomatini *et al*. 2006), b) Anabaena lemmermanni, and c) Cylindrospermopsis raciborskii in lake sediments under light microscopy and hybridized with probe under fluorescence microscopy; scale bar is 10µm (pictures from Ramm *et al*. 2012).

2.2.2 Light Harvesting, Photosynthesis and Carbon Fixation

Cyanobacteria are distinct from all other algae in that most of them possess two light harvesting systems (as opposed to one). Maintaining two light harvesting system is costly in terms of protein and N requirements and manifests strongly in their cell biology. For example, the extra protein requirement means that cyanobacteria have a high tissue nitrogen:phosphorus (N:P) ratio and a high N requirement for growth (discussed below). Despite this, light harvesting is necessary in photosynthetic organisms to 1) collect light energy from the sun and 2) convert it to chemical energy in the form of electrons and ATP that can be used to power carbon fixation.

Light harvesting pigments and photosynthesis

Light harvesting is performed by chlorophyll *a* (Chl *a*) pigment molecules that are associated with two photosystems (PSI and PSII) that comprise the centers of the photosynthetic process which starts with the liberation of an electron from the splitting of water and ends with the production of ATP. Sitting in each of the photosystems is a specialized Chl *a* molecule that initiates the flow of electrons through the electron transport chain that eventually powers ATP synthesis. The other Chl *a* molecules, 40 and 90, together with 12 and 22 carotenoid pigment molecules, in PSI and PSII respectively, funnel light energy to the reaction core (DeRuyter and Fromme 2008). This complex of Chl *a* and carotenoid pigment molecules, coordinated by a large number of proteins, is very similar in its structure to the light-harvesting complex (LHC)

embedded into the thylakoid membranes of vascular plants and eukaryotic phytoplankton (Fromme *et al.* 2001, 2002).

What makes the cyanobacteria unique is that they have a second light harvesting antenna complex peripheral to the thylakoid membrane that is water soluble (e.g. not membrane bound). This pigment complex, comprised of pigmented proteins arranged in rods fanning out from a core attached to the thylakoid membrane, called the phycobilisome (PBS), is what gives cyanobacteria their name (Grossman *et al.* 1993, Grossman 2003). Similar to the carotenoid pigments mentioned above, the PBS chromophores absorb light inbetween the Chl *a* absorption peaks of 440nm and 670nm (Grossman *et al.* 1993). Interestingly, the PBS proteins are not exclusive to cyanobacteria; they also occur in photosynthetic eukaryotes.

Up to 50% of cyanobacterial cellular protein content is bound in the PBS complex taking a large proportion of the cell's resources, particularly its nitrogen (N) allocation. Therefore, under stress condition such as N starvation, the entire PBS can be degraded within a few hours and the N can become reused within the cell (Sauer *et al.* 1999). When conditions improve, the PBS will be re-synthesized and re-assembled (Collier and Grossman 1994, Grossman *et al.* 2001).

Carbon fixation

The ATP produced and the electrons liberated during photosynthesis are used to power the fixation of carbon into sugars in the Calvin Cycle. They are also used to reduce oxidized sources of N to ammonia during N assimilation (discussed below). The primary and rate-limiting enzyme in carbon fixation is Rubisco which catalyzes the first step in the Calvin Cycle. To deal with the rate-limiting nature of Rubisco, cyanobacteria have evolved specialized structures called carboxysomes. In addition to housing Rubisco, the carboxysomes contain a number of other enzymes that help concentrate CO_2 in its vicinity to speed its reaction rate (Kaplan and Reinhold 1999). Cyanobacteria fix carbon to provide the skeletons needed to assimilate N into amino acids and build protein and cellular biomass; fixed carbon can also be used to accumulate carbohydrate storage products (carbohydrate ballasting) in order to make the cell heavier during buoyancy regulation.

2.2.3 Buoyancy Regulation

One distinct advantage of many cyanobacterial genera such as *Microcystis*, *Planktothrix*, *Anabaena* and *Aphenizomenon* is their ability to regulate their buoyancy by a combination of producing gas vesicles and carbohydrate storage products (Oliver 1994, Beard *et al.* 1999, Brookes *et al.* 1999). The former renders them positively buoyant whereas the latter does the opposite (Walsby 1994, 2005). The carbohydrate storage products are derived from C-fixation and the amount produced varies depending on the species and on irradiance (Howard *et al.* 1996, Visser *et al.* 1997, Wallace and Hamilton 1999). At an irradiance that is specific to each species and strain, the amount of carbohydrate storage product will perfectly balance the upward lift

created by the gas vesicles and the cyanobacteria will become neutrally buoyant (Walsby *et al.* 2004). In addition to producing and storing the carbohydrates, cyanobacteria also consume the storage products to produce energy.

By regulating the amount of carbohydrate storage products consumed, cyanobacteria control their vertical position in the water column (Thomas and Walsby 1985, Konopka *et al.* 1987, Wallace and Hamilton 1999). Models demonstrate that filamentous cyanobacteria can sink or float at speeds up to 0.3 m per day in order to position them at a depth where irradiance is such that it maximizes their growth potential (Walsby 2005). These speeds are only achievable for filaments of a certain size and weight; picocyanobacteria and small filaments do not have enough momentum to respond by vertical repositioning to changes in irradiance (Walsby 2005). Of course, carbohydrate production, therefore buoyancy regulation, is affected by nutrient availability; nitrogen starved cells have excess carbohydrate stores and tend to lose buoyancy more easily than nutrient sufficient cells (Klemer *et al.* 1982, Brookes *et al.* 1999, Brookes and Ganf 2001).

2.2.4 Nitrogen Metabolism

Cyanobacteria use a wide variety of N sources for growth including ammonium (NH_4^+), nitrate (NO_3^-), nitrite (NO_2^-), urea, amino acids, cyanate, and several species are also capable of dinitrogen gas (N_2) fixation to satisfy their cellular N demand. Below we discuss the pathways of N transport, metabolism and assimilation, and their regulation.

Ammonium transport and assimilation of N into amino acids

Being a charged molecule, NH_4^+ cannot diffuse freely into the cell and has to be transported via active transport. Transport of NH_4^+ into cyanobacteria (as well as in eukaryotic algae) occurs via the Amt family of transporters. These transporters are either expressed constitutively or differentially depending on external N concentrations. At environmental concentrations, most of the NH_4^+ is transported into the cell via the high-affinity transporter Amt1 encoded by the gene *amt1* (Muro-Pastor *et al.* 2005).

Before it can be assimilated, all N sources, whether N_2, NO_3^- or organic N containing molecules, first have to be converted to NH_4^+. The NH_4^+ is then assimilated into amino nitrogen through the GS/GOGAT pathway. The primary NH_4^+ assimilating enzymes in cyanobacteria (as well as in vascular plants and eukaryotic algae) are glutamine synthetase (GS) and glutamate synthase (also called glutamine-2-oxogluterate-amido transferase, GOGAT) acting in concert to aminate 2-oxogluterate (2-OG). Photosystem I (PSI)-reduced ferredoxin (Fd_{red}) is typically used as a reductant in this reaction:

GS: Glutamate + NH_3 + ATP → Glutamine +ADP +P_i
GOGAT: Glutamine + 2-OG + 2[H] → 2 Glutamate
GS/GOGAT: 2-OG + NH_3 + ATP + 2[H] → Glutamate + ADP +P_i

An alternate route of NH_4^+ assimilation involves the enzyme glutamate dehydrogenase (GDH) but it's postulated that this occurs only during select conditions such as stationary growth:

GDH: 2-OG + NH_3 + 2[H] → Glutamate + H_2O

In all photosynthetic cells the link between the carbon (C) and N cycles in the cell occurs at the GS/GOGAT reactions because the two key ingredients in N assimilation is 1) 2-OG derived from carbon fixation, and 2) Fd_{red} derived from PSI. GOGAT (and also GDH) will not proceed without their presence, which avoids wasteful consumption of glutamine, and ensures that even in the presence of excess N, assimilation will not proceed unless an adequate supply of C skeletons is available (Flores and Herrero 2005, Muro-Pastor *et al.* 2005).

Nitrate transport and reduction to NH_4^+

As NO_3^- is also a charged molecule it's transported into the cell via active transport. Cyanobacteria use two different transport systems. Most freshwater species, including *Anabaena*, *Synechocystis* and *Gloebacter*, use the high affinity ATP-binding cassette (ABC) transporter NrtABCD (Flores *et al.* 2005). Most marine species (*Synechococcus* and others) take up NO_3^- and NO_2- via the major facilitator superfamily transporter NrtP, also a high-affinity transporter (Flores *et al.* 2005). Some species also have a NO_2^--specific transporter NIT (Maeda *et al.* 1998). Nitrate uptake is tightly regulated by the external concentration of NH_4^+; when NH_4^+ becomes available, cells cease NO_3^- uptake and switch to use NH_4^+ which is preferred. This process is regulated at the level of NO_3^- uptake (Flores and Herrero 1994). In addition, CO_2-fixation (regulated by irradiance) is required to maintain active NO_3^- uptake, a regulatory link that ensures that the product of NO_3^- reduction (ammonium) can be incorporated into carbon skeletons (Luque and Forchhammer 2008).

Reduction of NO_3^- to NH_4^+ is a two-step process catalyzed by the enzymes nitrate reductase (NR) and nitrite reductase (NiR). The power for the reduction reaction, in the form of 2 electrons for NR and 6 electrons for NiR, is provided by Fd_{red} via PSI providing a strong link between the light reactions and NO_3^- use by the cell (Flores *et al.* 2005).

In cyanobacteria, the genes encoding NR, narB, and Nir, nirA, and the NO_3^- transporter NrtP, are typically clustered in the same operon. An operon is a unit that tells the cells to transcribe a sequence of genes simultaneously. In cyanobacteria, the transcription of operons associated with N metabolism is tightly regulated by the transcription factor NtcA (discussed below).

The only cyanobacteria discovered to date that is not able to use NO_3^- is *Prochlorococcus* which lives in the open ocean. While it was initially thought that some species could assimilate NO_2^-, sequencing of their genomes demonstrates that they all lack the *nirA* genes and therefore cannot reduce NO_2^- (Garcia-Fernandez *et al.* 2004).

Urea transport and metabolism

Many, but not all, cyanobacteria can use urea as a source of N for growth. Because urea is not a charged molecule it diffuses freely into the cell; however, environmental concentration are not such that diffusion can supply the needed concentration of urea for the urease enzyme (based on its K_m). Both in freshwater and marine cyanobacteria, an ABC-type active transport system specific for urea has been identified (Valladares *et al.* 2002). The subunits of this transporter are encoded by the five genes urtA-E. In *Anabaena*, the urea transporter genes are in the same NtcA-activated promoter and subject to metabolic repression by NH_4^+ (Valladares *et al.* 2002).
Urea is metabolized to two molecules of NH_3 and CO_2 by the enzyme urease, also called urea amidohydrolase (Mobeley *et al.* 1995). The urease enzyme is well-conserved throughout the bacteria and eukaryotic organisms and consists of two small and one large subunit encoded by at least seven genes, three which encode the structural subunits (*ureA, ureB, ureC*) and the other four (*ureD, ureE, ureF, ureG*) encoding accessory polypeptides required for the assembly of the nickel metallocenter (Collier *et al.* 1999, Palinska *et al.* 2000).

Amino acid transport

All cyanobacteria tested to date have at least one transport system for amino acids. These transporters appear to have broad specificity (i.e. they can transport more than one type of amino acid) and different species have different combinations of transporters (Herrero and Flores 1990, Montesinos *et al.* 1997). For example, freshwater *Synechocystis* sp. has four different amino acid transporters, including the ABC transporter Nat for glutamine and histidine, the ABC transporter Bgt for basic amino acids, and two glutamate-specific transporters GHS and Gtr (Quintero *et al.* 2001). Once in the cell, cyanobacteria possess a variety of deaminase enzymes that can deaminate the amino acids to NH_3 which then enters the GS/GOGAT pathway.

Cyanate transport and metabolism

Cyanobacteria, including freshwater and marine species, can use cyanate (a toxin) as a N source for growth since they have the genes encoding a transporter (*cynA, cynB, cynC*) and the gene encoding the cyanase enzyme (*cynS*) which hydrolyzes cyanate to NH_3 and CO_2 (Kamennaya and Post 2011). In freshwater cyanobacteria, these genes are repressible by NH_4^+ suggesting that they are under NtcA regulation.

Nitrogen fixation

Arguably the most expensive (energetically speaking) source of N for cyanobacteria is molecular dinitrogen gas (N_2). Nitrogen fixation, the process of reducing N_2 to NH_3, is catalyzed by the nitrogenase enzyme. The nitrogenase has two subunits. The first is the dinitrogenase subunit which catalyzes the reduction of N_2 to NH_4^+, composed of the NifD and NifK polypeptides encoded by the *nifD* and *nifK* genes. The dinitrogenase contains an iron-molybdate active site and two iron-sulfur clusters. The second is the dinitrogenase reductase subunit (NifH polypeptide

encoded by the *nifH* gene) which contains a central iron-sulfur cluster whose function it is to donate electrons derived from ferredoxin to dinitrogenase. Reduction of N_2 to NH_3 requires 8 electrons and 15 molecules of ATP in the following reaction:

$$N_2 + 8[H] + 16ATP \rightarrow 2\ NH_3 + H_2 + 16ADP + 16P_i$$

It was recently discovered that under conditions of molybdate limitation, some *Anabaena* species express an alternative nitrogenase containing a vanadium-iron cofactor instead of the molybdate-iron cofactor (Thiel 1993, Boison *et al.* 2006). Both these variants require iron cofactors to function and N_2 fixation cannot proceed under iron-limiting conditions.

The nitrogenase enzyme is very sensitive to oxygen (O_2), and O_2 is evolved as a byproduct of the water-splitting reactions at photosystem II (PSII), requiring the nitrogenase enzyme to be kept separate from PSII. Accordingly, freshwater cyanobacteria have evolved heterocysts (Wolk *et al.* 1994). These are specialized cells where PSII is inactivated, the PBS antenna proteins are degraded, and energy to power the cell is derived from cyclic electron flow around PSI. Rates of respiration in these cells are also high to scavenge any O_2. The ATP and reductant needed for N_2 reduction is generated by carbohydrate metabolism inside the heterocyst. The carbohydrate is synthesized in the non-heterocyst, vegetative cells flanking the heterocyst and transported inside. In turn, NH_3 produced inside the heterocyst is exported to the vegetative cells in the form of amino acids (Wolk *et al.* 1994). However, many species of cyanobacteria that fix N_2 do not form heterocysts; these species either separate N_2 fixation from photosynthesis in time (e.g. by fixing N_2 at night such as *Lyngbya aestuarii* and *Crocosphaera watsonii*) or in different regions of filaments as is hypothesized to be the case for *Trichodesmium* sp. (Frederiksson and Bergman 1997).

Because nitrogen fixation is such an energy expensive process, from the formation of the heterocysts to the reduction of N_2, it is tightly regulated by NtcA and is only induced under N starvation and in the absence of any other fixed N source (Herrero *et al.* 2004).

Regulation of nitrogen metabolism

As evident from the preceeding sections, the transcription factor NtcA (encoded by the gene *ntcA*) regulates most of the cyanobacterial genes associated with nitrogen uptake and assimilation, and is therefore considered the master regulator of N metabolism (Herrero et al 2004). NtcA binds to and activates the operons for heterocyst differentiation, N_2 fixation, NO_3^- uptake and reduction, urea uptake and hydrolysis, and glutamine synthetase to mention a few. In other words, none of the genes related to N metabolism are transcribed and their enzymes synthesized unless NtcA binds to their promoter in the genome (Luque *et al.* 1994, Wei *et al.* 1994, Forchammer 2004, Luque and Forchammer 2008). The exception to this rule are some NH_4^+ transport proteins which are not under NtcA control and are transcribed constitutively, i.e.

always “on” (Herrero *et al.* 2001). NtcA also controls signaling proteins that fine-tune cellular activities in response to fluctuating C/N conditions (Herrero *et al.* 2001).

NtcA is under negative control by NH_4^+, meaning that when NH_4^+ is detectable by the cell, *ntcA* gene transcription is repressed (Herrero *et al.* 2001, Lindell and Post 2001). There is an inverse relationship between NH_4^+ concentration and *ntcA* expression in all cyanobacteria tested to date, with basal levels of *ntcA* expression observed in the presence of high external NH_4^+ concentrations and maximal levels of *ntcA* expression observed under N starvation (Frias *et al.* 1994, Lindell *et al.* 1998, Lee *et al.* 1999, Sauer *et al.* 1999, Lindell and Post, 2001). Ammonium regulates expression of *ntcA* via 2-OG which is synthesized in the Calvin cycle and consumed in the GS/GOGAT cycle. Thus 2-OG is at the crossroads between C and N metabolism and is ideally suited to “sense” NH_4^+ concentrations (Vazquez-Bermudez *et al.* 2002, Tanigawa *et al.* 2002, Forchammer 2004).

The repression of *ntcA* expression by NH_4^+ places NH_4^+ at the top of the hierarchy of N substrates utilized and assimilated by cyanobacteria. The order in which N substrates other than NH_4^+ is assimilated differs depending on species. For example, in N_2 fixing cyanobacteria, NH_4^+ represses both N_2 fixation and NO_3^- assimilation. Nitrate, in turn, represses N_2 fixation. Therefore N_2 fixation is at the bottom of the hierarchy in some cyanobacteria (Ramasubramanian *et al.* 1994). But in others such as marine *Trichodesmium* sp., NO_3^- does not repress N_2 fixation genes and the process of N_2 fixation is on a more even footing with NO_3^- assimilation (Post *et al.* 2012).

2.2.5 Cellular Nitrogen:Phosphorus (N:P) Requirement

In 1958 Redfield published his discovery that phytoplankton particulate matter was composed of N and P in a molar ratio of 16, similar to the ratio of dissolved N:P in the water (Redfield 1958). Redfield suggested that the ratio of dissolved N:P in the ocean was driven by the remineralization of phytoplankton particulate matter, a theory which has since taken hold (Falkowski 2000, Geider and LaRoche 2002). Given that the average N:P ratio was discovered to be 16 in phytoplankton, it was deduced that under nutrient limiting conditions phytoplankton would become limited by N at dissolved N:P less than 16 and limited by P at dissolved N:P ratios greater than 16.

Shortly after Redfield’s discovery of the universality of the N:P ratio of 16, investigators turned to phytoplankton cultures to examine how closely phytoplankton cellular N:P ratios varied around 16. Parsons *et al.* (1961) published the first investigation demonstrating variability in cellular N:P ratios depending on the phytoplankton species. Subsequent investigations noted that diatoms and dinoflagellates tended to have cellular N:P ratios below 16 whereas chlorophytes and cyanobacteria typically had ratios above 25 (Geider and LaRoche 2002; Ho *et al.* 2003; Quigg *et al.* 2003; Klausmeier *et al.* 2004; Hillebrand *et al.* 2013; Figure 2.2). This difference

among the taxa stems from slight variations in macromolecular composition of the phytoplankton, principally in their ratio of protein, the largest store of N in the cell, to nucleic acids, the largest store of P in the cell (Terry *et al.* 1985, Falkowski 2000, Elser *et al.* 2000, Geider and LaRoche 2002). As mentioned above in section 2.2.2, cyanobacteria have two light-harvesting complexes requiring a greater association of proteins with the light-harvesting pigments compared with eukaryotic cells which only have one light harvesting complex (Raven 1984, Geider and LaRoche 2002). The "excess" protein associated with the peripheral phycobilisomes substantially increase the cellular N:P ratios of cyanobacteria. Once it was realized that that there were significant departures in the cellular N:P ratio depending on taxa, it also became clear that the ratio of N:P uptake differed with respect to taxa and that this was a major basis of resource-based competition among taxa (Rhee 1978). That phytoplankton take up N:P in proportion to their tissue composition was subsequently confirmed in culture experiments (Droop 1974, Elrifi and Turpin 1985, Tett *et al.* 1985, Quigg *et al.* 2003, Leonardos and Geider 2004). In other words, phytoplankton do not take up nutrients according to the ratio that occurs in water, but rather the ratio dictated by the macromolecular composition of their tissues.

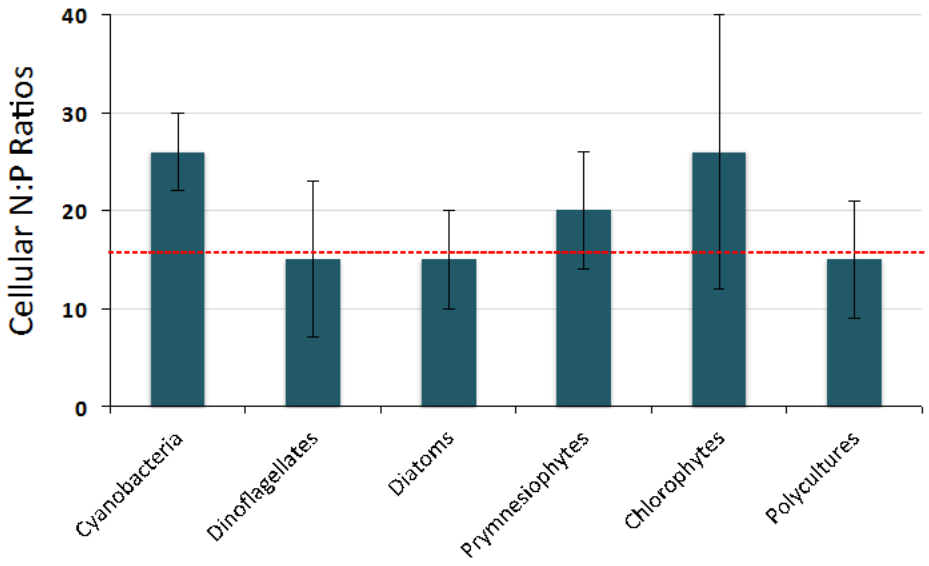


Figure 2.2. Cellular N:P ratios (mole:mole) in different phytoplankton taxa. Dashed red line indicates the average phytoplankton cellular N:P ratio of 16, also called the Redfield ratio. Data from Hillebrand *et al.* 2013.

Tissue N:P composition is not a fixed trait and phytoplankton are able to adjust it, within certain limits, in order to keep growing when environmental conditions change for the suboptimal. When limited for a nutrient, uptake of the non-limiting nutrient can proceed for a while skewing cellular ratios. But, severe limitation by one nutrient will eventually prevent the uptake of the other, non-limiting nutrient, even when the other is present in excess. This quirk of nature

constrains the extent to which cellular ratios vary (Droop 1974, Tett *et al.* 1985, Leonardos and Geider 2004, Hillebrand *et al.* 2013). For example, a summary of nearly 50 phytoplankton studies demonstrates that the N:P ratio of P-limited phytoplankton converge around 28 and the N:P ratio of N-limited phytoplankton converges around 16 (Hillebrand *et al.* 2013).

Irradiance may also change the cellular N:P ratio through its influence on the cellular protein content (LaRoche and Geider 2002). Pigments (Chl *a* and light harvesting antenna pigments) are bound in pigment-protein complexes rich in N that increase as irradiance decreases, and decrease under high light as cells reduce the size of the light harvesting complex to avoid photodamage (Wynne and Rhee 1986, Falkowski and LaRoche 1991, Nielsen 1992, Leonardos and Geider 2004). The irradiance-dependent change in N:P ratios is even more pronounced among cyanobacteria due to the greater association of protein with the phycobilisome than in the eukaryotic light harvesting complex (Raven 1984, Geider and LaRoche 2002).

In contrast with limiting nutrient concentrations or changes in irradiance, changes in the medium N:P ratio when nutrient concentrations are in excess of demand was found not to affect cellular N:P ratios in phytoplankton in early experiments (i.e. Tilman *et al.* 1982, Tett *et al.* 1985, Reynolds 1999, Roelke *et al.* 2003, Sunda and Hardison 2007) and has not been pursued by the scientific community.

2.2.6 Toxin Production

Cyanobacteria produce a large variety of toxins with a number of different actions in animals and humans leading to significant health risks and drinking water issues globally (c.f. Chorus and Bartram 1999, Chamichael 2008, Cheung *et al.* 2013). The toxin-producing cyanobacteria, and the suite of different toxins that each species produces, is discussed below.

Toxin-producing taxa

The cyanobacterial toxins were named according to the species that they were originally discovered in and isolated from. For example, microcystin was discovered in *Microcystis aeruginosa* and anatoxin was originally isolated from *Anabaena*. However, most cyanobacteria produce several different types of toxins, with the exception of nodularin which is only produced by *Nodularia spumigena.*

The toxin most widely produced by different cyanobacterial taxa is the recently discovered neurotoxin Beta-N-methylamino-L-alanine (BMAA, Cox *et al.* 2005). This is followed by the microcystins which are produced by nine different taxa (Table 2.2). Chief among the microsystin producing taxa are *Microcystis* (the toxin was originally isolated from *Microcystis aeruginosa*), followed by *Planktothrix* and *Anabaena*. Another widely distributed toxin is anatoxin-a, which is produced by eight different cyanobacterial taxa, principally *Anabaena*, the genus from which the toxin was originally isolated.

Table 2.2.Toxins produced by cyanobacteria. Based on data from Cox *et al.* 2005, Sivonen and Borner 2008, Cheung *et al.* 2013.

	Microcystin	Nodularin	Cylindro-spermopsin	Anatoxin-a	Anatoxina(S)	Saxitoxin	Dermatotoxin	BMAA
Microcystis	X							X
Planktothrix	X			X		X		X
Anabaena	X		X	X	X	X		X
Nostoc	X							X
Anabaenopsis	X							
Radiocystis	X							X
Synechococcus	X							X
Phormidium	X			X				X
Oscillatoria limosa	X			X				
Oscillatoria				X			X	
Nodularia		X						X
Cylindro-spermopsis			X			X		X
Aphanizo-menon			X	X		X		X
Raphidiopsis			X	X				X
Cylindro-spermum				X				X
Lyngbya						X	X	X
Shizothrix							X	
Umezakia natans			X					

Anabaena species, including *flos-aquae*/ *lemmermannii*/ *circinalis*, may be the most toxically versatile of all the cyanobacteria as they can produce all the toxins, including BMAA, microcystins, cylindrospermopsin, anatoxin-a, anatoxin-a(S) and saxitoxins, save nodularin (Table 2.2). Nodularin is only produced by *Nodularia spumigena*. Another versatile toxin producer is *Aphanizomenon flos-aquae* which produces BMAA, cylindrospermopsin, anatoxin-a and saxitoxins (Table 2.2). *Planktothrix* also produces four different toxins including BMAA, microcystins, anatoxin-a and saxitoxins. The cyanobacteria *Cylindrospermopsis raciborskii* from whence cylindrospermopsin was originally isolated also produces saxitoxins (Table 2.2). Benthic cyanobacteria are also versatile when it comes to toxin production. For example, *Oscillatoria limosa* can produce microcystins as well as anatoxin-a while *Lyngbya wollei* can produce saxitoxins and dermatotoxins (Table 2.2).

Toxin types and their biosynthetic pathways

The toxins produced by cyanobacteria can be divided into three main groups: hepatotoxins that damage the liver of the organisms ingesting them, neurotoxins that cause respiratory arrest, and dermatoxins that cause rashes and inflammations. Each is discussed separately below.

Hepatotoxins. The most well-known hepatotoxins are microcystins and nodularin which are serine/threonine protein phosphatase inhibitors (Table 2.3). A large variety of different microcystins (close to 80) have been identified, with the most toxic being microcystin-LR. These cyclic heptapeptides contain seven amino acids, including a unique beta amino acid ADDA (MacKintosh *et al.* 1990, Yoshizawa *et al.* 1990). In contrast with microcystins, only a few varieties of nodularin have been identified (Yoshizawa *et al.* 1990). The toxicity of cyanobacterial toxins is typically measured by injecting them into mice and calculating the lethal dosage to half the population (LD_{50}; Table 2.3).

Biosynthesis of the microcystis and nodularin peptides occurs by non-ribosomal peptide synthases (NRPS) and polyketide synthases (PKS) found mainly in bacteria (Welker and von Dohren 2006). Both of these enzyme classes are needed for both the microcystin and nodularin biosynthesis pathways which have been sequenced from a number of cyanobacterial species including *Microcystis, Planktothrix* and *Anabaena* (Borner and Dittman 2005). For example, the *mcyA*, *mcyB* and *mcyC* genes encode the NRPS that synthesize the pentapeptide portion of microcystins. The *mcyD*, *mcyE*, *mcyF* genes encode the PKS which synthesize the ADDA amino acid unique to microcystins. Finally, the *mcyF*, *mcyG*, *mcyH*, *mcyI*, *mcyJ* genes encode the proteins that tailor and transport specific microcystins (Table 2.3). Similarly, the *nda* gene cluster specific to nodularin encode the NRPS and PKS synthases as well as the tailoring and transport proteins (Table 2.3). Although not verified through functional investigations, the cylindrospermopsin gene cluster, encoding the genes *cyrA*, *cyrB*, *cyrC*, has recently been characterized in *Aphanizomenon flos-aquae* (Stuken and Jakobsen 2010).

Table 2.3. Common cyanobacterial toxins. ND: Not determined.

Toxin	Chemical Class	Action	Effect	LD_{50}	Reference	Gene Name	Gene Reference
Micro-cystins	Cyclic heptapeptides; 80 variants; microcystin-LR is most toxic	Serine/threonine protein phosphatase (1 and 2A) inhibitors	Hepatotoxin; damages liver	50 µg kg^{-1}	MacKintosh *et al.* 1990, Yoshizawa *et al.* 1990	*mcyA-I*	Tillett *et al.* 2000, Christiansen *et al.* 2003
Nodularin	Cyclic pentapeptide; only a few variants identified	Serine/threonine protein phosphatase 1 and 2A inhibitor	Hepatotoxin; damages liver	50 µg kg^{-1}	Yoshizawa *et al.* 1990	*ndaA-I*	Moffitt and Neilan 2004
Cylindro-spermopsin	Cyclic guanidine alkaloid	Protein synthesis inhibitor	Hepatotoxin/Cytotoxin; affects liver as well as kidney, spleen, thymus and heart	200 µg kg^{-1} at 6 days 2000 µg kg^{-1} at 24 hrs	Runnegar *et al.* 1994, Terao *et al.* 1994, Ohtani *et al.* 1992	*cyrA-C*	Stuken and Jakobsen 2010
Anatoxin-a	Alkaloid	Competitive inhibitor of acetyl choline	Neurotoxins: causes death by respiratory arrest	200-250 µg kg^{-1}	Devlin *et al.* 1977, Carmichael *et al.* 1990, Skulberg *et al.* 1992	*ana*	Mejean *et al.* 2010
Anatoxin-a(S)	Phosphate ester of cyclic N-hydroxyguanine	Anticholin-esterase	Neurotoxins: causes death by respiratory arrest	20 µg kg^{-1}	Carmichael *et al.* 1990	*ana*	Mejean *et al.* 2010
Saxitoxins	Carbamate alkaloids; the most potent are saxitoxins and neosaxitoxins	Sodium channels blocker	Neurotoxin	10 µg kg^{-1}	Sivonen and Jones 1999	*stxA-Z*	Kellmann *et al.* 2008
BMAA	Non-protein amino acid		Neurotoxin: linked with neuro-degenerative diseases (e.g. Parkinson's Dementia Complex)	ND	Cox *et al.* 2005	ND	
Dermato-toxins	Aplysiatoxins	Protein kinase C activators	Dermatotoxin: tumor promoters; dermatitis and oral/ gastrointestinal inflammations	ND	Mynderse *et al.* 1977, Fujiki *et al.* 1990	ND	

Neurototoxins. By far the most potent toxins are the neurotoxin saxitoxin that causes paralytic shellfish poisoning (PSP) syndrome and respiratory arrest in humans and animals. This neurotoxin is produced both by cyanobacteria and dinoflagellates and is an alkaloid that acts as a sodium channel blocker. Another alkaloid neurotoxin, anatoxin-a, competitively inhibits acetyl choline, and a variant, anatoxin-a(S), acts as an anti-cholinesterase (Devlin *et al.* 1977, Myderse *et al.* al 1977, Carmichael *et al.* 1990, Sivonen and Jones 1999). The LD_{50} of these toxins vary from 200-250 µg kg^{-1} in the case of anatoxin-a, 20 µg kg^{-1} in the case of anatoxin-a(S), to 10µg kg^{-1} in the case of saxitoxins (Table 3). The gene clusters encoding the saxitoxin biosynthesis and anatoxin biosynthesis pathways were very recently elucidated via functional homology and each contains 20 or more genes (Kellmann *et al.* 2008, Mejean *et al.* 2010). The recently discovered neurotoxin BMAA, a non-protein amino acid that is potentially linked to neurogenerative diseases such as Parkinson Dementia Complex (PDC), is produced in almost all cyanobacteria tested to date (Cox *et al.* 2005).

Dermatotoxins. Benthic cyanobacteria, including *Lyngbya*, *Oscillatoria* and *Schizothrix*, produce a number of different toxins including aplysiatoxins, debromoaplysiatoxins and lyngbyatoxin-a. These toxins are protein kinase C activators that cause dermatitis and oral and gastrointestinal inflammations, and can also promote tumor formation (Mynderse *et al.* 1977, Cardellina *et al.* 1979, Fujiki *et al.* 1990). The pathways and genes involved with the production of the dermatotoxins have yet to be elucidated.

Potential functions of toxin production

Interestingly, researchers have not been able to determine the purpose of toxin production in cyanobacteria, or under what conditions toxins are most likely to be produced (Sivonen and Borner 2008). Moreover, under environmental conditions cyanobacteria that produce toxins co-exist with cyanobacteria of the same genus that do not produce toxins; it's unclear whether the possession of, or lack of, the toxins confers an ecological advantage (Sivonen and Borner 2008, Baxa *et al.* 2010).

Despite these complications, several explanations for the potential function of toxin production exist. Originally it was thought that cyanotoxins acted as allelochemicals and that their secretion into the surrounding water would suppress the growth of competitors (Keating 1977, Keating 1978, Flores and Wolk 1986, Klein *et al.* 1995). But, when the distribution of toxins, such as microcystins, was compared between cells and the surrounding medium using immunodetection combined with electron microscopy, most of the toxin was found to be cell-bound (Rapala *et al.* 1997, Wiedner *et al.* 2003, Tonk *et al.* 2005, Gerbersdorf 2006). Because, live (i.e. non-lysed) cyanobacteria do not secrete the toxins they produce it is doubtful that they act as allelopathic chemicals. Consistent with this notion, most investigations that demonstrate allelopathic effects do so at concentrations of extracted toxins far above what is ecologically relevant, leading

investigators to conclude that the ability of cyanobacterial toxins to work as allelophathic chemicals appears unlikely (Babica *et al.* 2006, Berry *et al.* 2008, Holland and Kinnear 2013).

One explanation that is gaining ground is that the primary role of toxins is probably not to be toxic (Llewellyn 2006). Rather, investigators are hypothesizing that toxins may be produced to protect the cells from abiotic stresses. For example, microcystins are produced during all phases of growth but the greatest accumulation typically occurs under conditions that support optimal growth, including growing under optimal light levels (Sivonen and Jones 1999, Wiedner *et al.* 2003). Several lines of evidence point towards increases in irradiance as being a trigger for microcystin production. These include accumulation of intraceullular microcystin-LR with increased irradiance, the association of intracellular microcystins with the thylakoid membranes, and increased microcystis gene expression with increased irradiance (Kaebernick *et al.* 2000, Tonk *et al.* 2005, Borner and Dittman 2005, Gerbersdorf 2006). As such, it makes sense that microcystins are produced across a number of cyanobacterial taxa, such as *Microcystis*, *Anabaena*, and *Planktothrix*, that grow well in high-light environments (Paerl and Paul 2012).

Microcystins may also be implicated in preventing iron-stress by acting as siderophores to scavenge iron (Utkilen and Gjolme 1995, Lyck *et al.* 1996), an idea supported by the discovery that the iron-regulator factor Fur binds to the genes that produce microcystins in cyanobacteria (Martin-Luna *et al.* 2006). As such, microcystin production may provide an advantage to cyanobacteria in early stages of iron-limiting conditions (Alexova *et al.* 2011, Holland and Kinnear 2013) vis-à-vis eukaryotic competitors (Molot *et al.* 2014).

Another potential role for cyanotoxins is to act as a grazing deterrent (Burns 1987, Gilbert 1996). However, recent research using *Microcystis aeruginosa*, has demonstrated that it's not the toxic microcystins that deters Daphnia from grazing *M. aeruginosa* but other substances it produces. In other words, the substances causing toxicity and deterrence are not identical and the non-toxic substances may be much important in terms of grazing deterrence (Rohrlack *et al.* 1999, 2003).

While the toxic substances are by far the most well-known, there are hundreds of other, secondary metabolites similar in structure to the toxins that are produced by cyanobacteria. Just as the toxins, these cyclic or linear peptides may not be needed for growth but may serve protective functions. For example, the grazing deterrents discussed above belong to a class of depsipeptides called microviridins (originally isolated from *Microcystis viridis*) and has since their isolation been found in a range of cyanobacteria (Rohrlack *et al.* 2003). These secondary metabolites may also have important pharmacological applications. An alkaloid produced by *Nostoc*, called nostocarboline, is a cholinesterase inhibitor which has an effect comparable to galanthamine, a drug approved for Alzheimer's disease (Becher *et al.* 2005). Also isolated from *Nostoc* is a compound called cyanovirin-N which has antiviral activity and is under development as an antiviral agent against HIV (Boyd *et al.* 1997, Bolmstedt *et al.* 2001).

3. Factors Influencing Cyanobacterial Blooms and Toxin Production

The world-wide increase in the incidence of cyanoHABs such as the N_2 fixing genera *Anabaena*, *Aphanizomenon*, *Cylindrospermopsin*, and *Nodularia*; the benthic N_2 fixing genera *Lyngbya* and some *Oscillatoria*; and the non-N_2 fixing genera *Microcystis* and *Planktothrix* has prompted a great deal of research into the conditions that favor the growth of these species (Chorus and Bartram 1999; Carmichael 2008; Paerl and Huisman 2008; Hudnell 2008, 2010; O'Neill *et al.* 2012; Paerl and Paul 2012). These conditions typically include favorable salinity, ample supply of nutrients, calm water and stratified conditions, plenty of irradiance and warm water temperatures (Figure 3.1). In contrast, the most successful strategies to mitigate blooms of cyanoHABs include reducing the supply of nutrients, increasing the flow of water to promote mixing and destratify the water column (Figure 3.1). In the following sections, we will focus on the conditions that are favorable for the growth of the cyanoHAB genera.

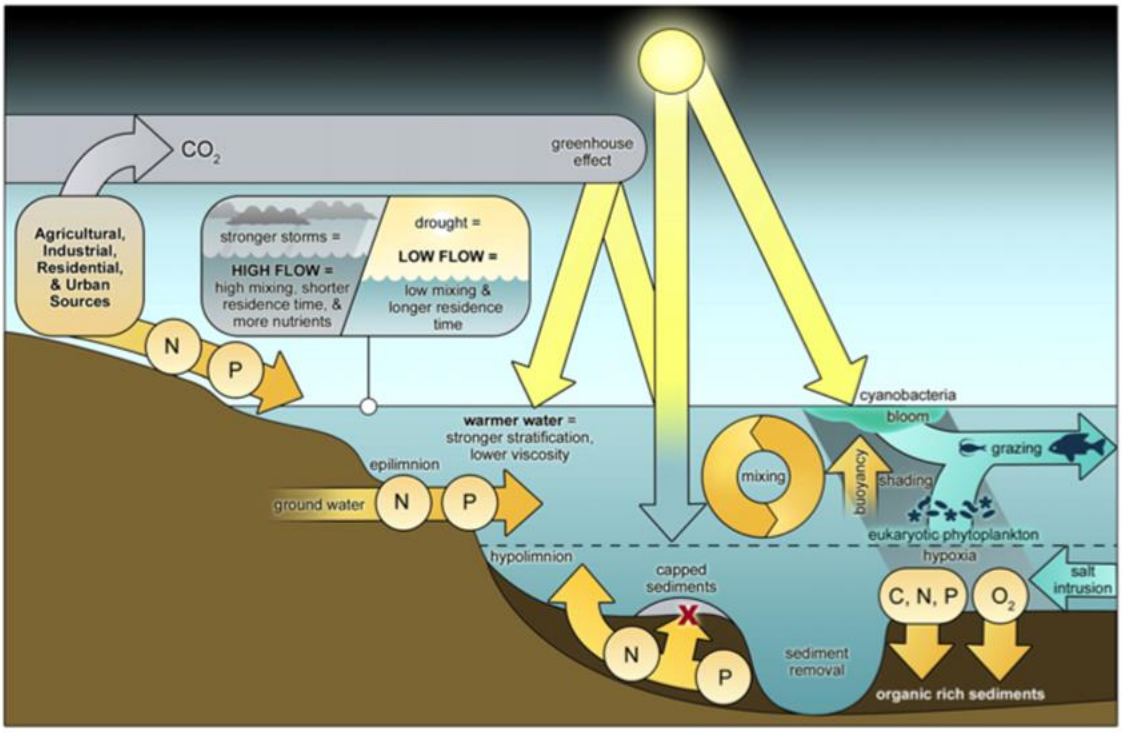


Figure 3.1. Conceptual model of factors affecting cyanobacteria blooms including warmer water, drought and decreased flow, decreased mixing, increased residence time, and increased N and P inputs from agricultural, industrial and urban sources. From Paerl *et al*. 2011.

3.1 Salinity

Most harmful algal bloom-forming and toxin-producing cyanobacteria (cyanoHABs) are freshwater species. In contrast, marine cyanobacteria such as *Prochlorococcus*, *Synechococcus* sp. and *Trichodesmium* sp. are not toxic and do not form cyanoHABs. However, laboratory investigations of freshwater cyanoHAB species demonstrate that these have quite wide salinity

tolerance ranges. For example, the least tolerant, *Cylindrospermopsis* only thrives up to 2.5 ppt salinity, but the most tolerant, *Anabaenopsis* and *Nodularia* spp., thrive at salinities from 5-20 ppt (Moisander *et al.* 2002). *Microcystis aeruginosa* tolerates up to 10 ppt salinity without a change in its growth rate compared to that on freshwater (Tonk *et al.* 2007). What these studies suggest is that given optimal growth conditions, these species could also bloom in brackish-water regions. Indeed, recent decades have witnessed a spread in the geographical extent of these species into the mesohaline (5-15 ppt) reaches of coastal systems (Paerl and Paul 2012). For example, blooms of *Microcystis aeruginosa* have occurred in the Baltic Sea (Maestrini *et al.* 1999) and the San Francisco Estuary (Lehman *et al.* 2013) suggesting 1) that factors other than salinity are regulating their geographical distribution and that 2) those factors are currently changing to allow cyanoHAB growth to occur in regions where they previously did not exist. In summary, salinity may not be the strongest "barrier" in terms of restricting the occurrence and geographical distribution of toxic cyanoHABs.

3.2 Nutrient Concentrations and Ratios

As with other photosynthetic phytoplankton, given optimal temperatures and irradiance, cyanobacterial biomass accumulation is directly proportional to the amount of nutrients (N and P) available in the water column. Therefore, strategies to reduce the accumulation of cyanoHAB biomass and severity of their blooms frequently focus on reductions of nutrient concentrations (Paerl 2008).

3.2.1 Influence of N and P Loadings and Concentrations in Stimulating Cyanobacterial Growth

Cyanobacterial growth in freshwater systems (rivers and lakes), which tend to become limited by P sooner than by N, is frequently linked with excessive P loading (Likens 1972, Schindler 1977, Edmondson and Lehman 1981, Elmgren and Larsson 2001, Paerl 2008, Schindler *et al.* 2008). In contrast with freshwater systems, estuarine and marine systems tend to be more sensitive to N loading (Figure 3.2), and eutrophication due to cyanobacterial growth is frequently linked with excessive N loading (Ryther and Dunstan 1971, Nixon 1986, Suikkanen *et al.* 2007, Paerl 2008, Conley *et al.* 2009, Ahn *et al.* 2011).

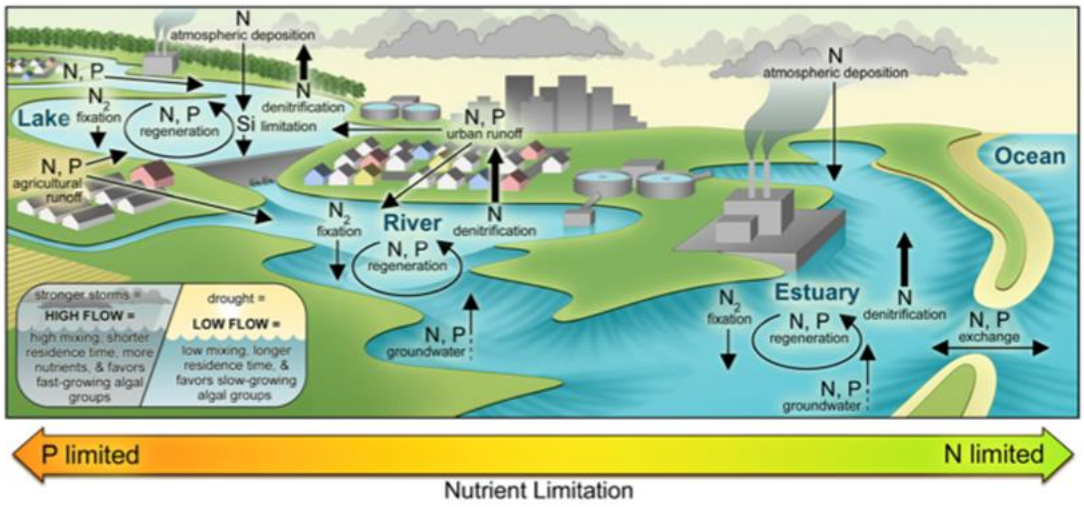


Figure 3.2. Conceptual diagram of interaction of nutrient inputs, cycling processes, and limitation of primary production along the freshwater to marine continuum. From Pearl *et al.* 2014b.

However, both non-point and point source nutrient contributions, such as agriculture and wastewater effluent, tend to increase N and P concentrations simultaneously (Paerl and Paul 2012, Paerl *et al.* 2014b). For example, human population growth-induced intensification of wastewater discharge and agriculture has led to hypereutrophication of China's third largest lake, Taihu (Qin *et al.* 2007). Increased nutrient loads, combined with low water column depth and increased water temperatures, has led to an explosive growth of cyanobacteria and a change in total phytoplankton community composition from being mainly diatom-dominated to being dominated by *Microcystis aeruginosa* (Qin *et al.* 2010, Paerl *et al.* 2014a). Bioassay experiments during summer months when cyanobacterial biomass is at its maximum, and nutrient concentrations at a minimum, demonstrate that N and P exert equal control over biomass accumulation in this system (Paerl *et al.* 2014a).

In general, dominance of both N_2-fixing and non-N_2 fixing cyanobacteria such as *Aphenizomenon flos aquae*, *Nodularia spumigena*, *Microcystis aeruginosa* and *Cylindrospermopsin raciborskii*, have increased world-wide in concert with increased loads of both N and P (Chapman and Schelske 1997, Jacoby *et al.* 2000, Gobler *et al.* 2007, Burford *et al.* 2006, Burford and O'Donahue 2006, Hong *et al.* 2006, Suikkanen *et al.* 2007, O'Neill *et al.* 2012).

3.2.2 Influence of Changes in N:P Ratios on Stimulation or Limitation of Cyanobacterial Growth

At low and intermediate nutrient loadings, reduction in only N or P may be sufficient to control blooms of cyanobacteria. But with elevated loadings of both N and P, reduction of only one type of nutrient can lead to an imbalance in the N:P ratio of the water column potentially leading to a

worsening of the cyanoHAB problem, or even lead to a eukaryotic HAB problem (Smith 1983; Paerl 2008; Pearl *et al.* 2011, 2014b).

Low nutrient concentrations

Pioneering studies by Smith (1983, 1990) predicted that phytoplankton community composition would be dominated by cyanobacteria when N:P ratios were < 15, and by eukaryotic phytoplankton when N:P ratios > 20. This was because many nuisance freshwater cyanobacteria that fix N_2 were hypothesized to thrive at very low ambient concentrations of fixed N, therefore at N:P < 15. In comparison, growth rates of eukaryotic phytoplankton that could not fix N_2 were predicted to slow down at N- limiting concentrations, resulting in eukaryotic species becoming outcompeted at N:P < 15. At N:P > 20, growth rates of eukaryotic phytoplankton would not be limited by N and therefore they could dominate phytoplankton community composition (Smith 1983, 1990). These predictions suggested that one could control growth of cyanobacteria by increasing the dissolved N:P ratio above 20. Consequently, many investigators who study lakes with low to intermediate nutrient loadings advocate for reductions in "P only" as a way to control cyanobacterial growth (Schindler 1977, Schindler *et al.* 2008). However, increasing the dissolved N:P ratio >15 becomes less important as a way to control cyanobacterial growth at high concentrations of nutrients, for a number of reasons, including: 1) nutrient concentrations are high relative to biomass and non-limting; 2) the prevalence of N_2 fixation in N_2-fixing cyanobacteria is not as great as initially hypothesized; 3) the cellular N:P ratio of cyanobacteria, and their N requirement, is high; 4) analysis of lake data by several investigators have demonstrated that absolute concentrations of N and P are more important in supporting blooms of N_2 fixing cyanobacteria rather than specific ratios of dissolved N:P.

High and non-limiting nutrient concentrations

In order for changes in nutrient ratios to affect phytoplankton growth, nutrient concentrations must be so low (relative to the phytoplankton biomass) that either P or N will eventually limit their growth rates. In the last decades, both N and P loadings have increased to the point that they exceed the assimilative capacity of the resident phytoplankton in many systems (Chapman and Schelske 1997, Jacoby *et al.* 2000, Burford *et al.* 2006, Burford and O'Donahue 2006, Hong *et al.* 2006, Gobler *et al.* 2007, Suikkanen *et al.* 2007, Paerl 2008, Paerl *et al.* 2011, Dolman *et al.* 2012, O'Neill *et al.* 2012, Paerl and Paul 2012, Paerl *et al.* 2014a). Therefore, changes in the N:P ratio have little effect on the growth of any of the phytoplankton taxa present in the water column (Paerl 2008, Davidson *et al.* 2012, but see also Glibert *et al.* 2011 with respect to diatoms).

Prevalence of N_2 fixation

An assumption that must be met in order that N_2 fixing cyanobacteria dominate the community at low N:P ratios (and N limiting conditions) is that they mostly use N_2 gas rather than fixed N for growth. However, investigations demonstrate that the proportion of the N demand of N_2

fixers that is met by N_2-fixation is typically less than 25% (Levine and Lewis 1987, Findlay *et al.* 1994, Laamanen and Kuosa 2005). For example, in Baltic Sea phytoplankton communities dominated by the N_2 fixers *Aphanizomenon flos aquae* and *Nodularia spumigena*, less than 20% of N utilization is due to N_2 fixation under N-limiting conditions (Sorensson and Sahlsten 1987; Berg *et al.* 2001, 2003; Laamanen and Kuosa 2005). As mentioned in section 2.2.4, N_2 fixation is repressed in the presence of NH_4^+; culture studies of the N_2 fixing cyanobacterium *Cylindrospermopsis raciborskii* demonstrate that N_2 fixation is shut down in the presence of NH_4^+ and that it's competitive for fixed N (Sprosser *et al.* 2003, Moisander *et al.* 2008). Based on a wide range of investigations, the assumption that most of the N demand of cyanobacteria is met by N_2 fixation does not hold.

Cellular N:P composition

As discussed above (Section 2.2.5), the cellular N:P requirement of cyanobacteria is greater than any other eukaryotic group due to the large protein demand of the peripheral light harvesting antennae. At N-limiting conditions, cyanobacteria would need to provide most, if not all, of their N demand by N_2 fixation in order to meet their high tissue N demand. This would lead to a sharp divide in the distribution of genera that fix N_2 from those that do not; the latter group would be much better suited to dominate high N:P ratio (>25) than low N:P ratio environments. On the flip side, many genera of eukaryotic phytoplankton, such as diatoms and dinoflagellates, have relatively high tissue P requirements and have cellular N:P ratios <16 (Geider and LaRoche 2002, Quigg *et al.* 2003, Hillebrand *et al.* 2013) rendering them better suited for environments with N:P <16 (Arrigo *et al.* 1999, Mills and Arrigo 2010). Based on their cellular N:P ratios, cyanobacteria are better suited to dominate high N:P ratio systems (>25) and some eukaryotes low N:P ratio systems (<16) which is opposite of the conclusions reached by Smith (1983).

Confounding factors

Because the height of a phytoplankton bloom, including blooms of N_2 fixers, frequently coincides with a depletion in N and N:P <15, it is often assumed that the major control on the cyanobacteria is the nutrient ratio, rather than the other way around. Additionally, there may be time lags between nutrient uptake and increased biomass such that a correlation between the two variables at a given point in time may not imply causality. Blooms of N_2 fixers also coincide with a warm, stratified water column coupled with adequate or high irradiance. Because all these parameters (warm water, high irradiance, stratification, depletion of N, overall increase in Chl *a*) occur in concert, it's difficult to separate out the impact of nutrients from other co-occurring environmental variables in order to quantify the most important effect on increases in cyanobacterial biomass. Investigations that separate out the effect of changes in absolute concentrations from ratios, find that changes in absolute concentrations of nutrients, or changes in total Chl *a* biomass, are more strongly related to changes in cyanobacterial biomass than changes in the ratio of N:P (Trimbee and Prepas 1987, Downing *et al.* 2001, Dolman *et al.* 2012).

Meta analyses of Lake Studies

Consistent with the problems of assigning shifts in phytoplankton community composition to changes in N:P ratios described above, Trimbee and Prepas (1987) and Downing *et al.* (2001) demonstrated that changes in cyanobacterial biomass was more strongly associated with changes in the absolute concentrations of N and P than with changes in the dissolved N:P ratio in 99 different freshwater systems. In a study of 102 lakes in Germany, Dolman *et al.* (2012) found that the more enriched in both N and P the lakes were, the greater was their total cyanobacterial biomass. The cyanobacterial taxa that responded most to nutrient enrichment included *Planktothrix agardhii*, *Microcystis* and *Anabaenopsis*. Moreover, differences between cyanobacterial taxa were not consistent with the hypothesis that N fixing taxa were favored in low N:P conditions as the greatest biomass of *Aphaenizomenon* and *Cylindrospermopsis raciborskii* were found lakes with the greatest N:P ratios (Dolman *et al.* 2012).

3.2.3 Influence of Type of N on Growth of Cyanobacteria

As previously mentioned, NtcA is central in cyanobacterial N regulation and is under negative control by NH_4^+ (Section 2.2.4). Other than NH_4^+-transporters, transcription of all N related enzymes requires binding of the NtcA transcription factor in order to be transcribed. Therefore, uptake and metabolism of sources other than NH_4^+ does not take place unless NH_4^+ is at limiting concentrations (Lindell and Post 2001, Lindell *et al.* 2005). In contrast, NH_4^+ transporters are constitutively expressed, or always "on", regardless of external concentration of NH_4^+ (Berg *et al.* 2011). In addition, the *amt1* NH_4^+ transporter gene is one of the most highly expressed in cyanobacterial genomes. In the marine cyanobacteria *Synechococcus* and *Prochlorococcus*, *amt1* is expressed on par with, or at a greater level, respectively, than the gene encoding the C-fixation enzyme Rubisco (Berg *et al.* 2011). Considering the countless other critical processes happening within cells, it is noteworthy that the protein responsible for NH_4^+ uptake is one of the most abundant proteins in cyanobacteria.

Given that NH_4^+ exerts such a strong control over the use of other N sources in cyanobacteria, is the preference for NH_4^+ reflected in different rates of growth on different N sources? There is no clear answer to this question. From a theoretical perspective it should not be the case because the magnitude of reductant and ATP needed for carbon fixation dwarfs the energetic costs of N assimilation, even assimilation of "expensive" sources such as NO_3^- or N_2 gas (Turpin 1991). The type of N should not affect the rate of growth other than under conditions of very low irradiance where assimilation of NO_3^- may compete with carbon fixation for reductant and ATP, thereby lowering the growth rate (Turpin 1991). Culture investigations appear to bear this out as faster rates of growth are typically not observed when cyanobacteria are grown on NH_4^+ versus NO_3^- (i.e. Berman and Chava 1999, Hawkins *et al.* 2001, Post *et al.* 2012, Saker and Neilan 2001, Solomon *et al.* 2010). Differences in growth rates when growing on NO_3^- versus on NH_4^+ are frequently detected for individual strains (i.e. Saker and Neilan 2001), but there is no pattern that can be generalized with respect to cyanobacteria as a whole. Even within the same species,

some strains may be growing faster on NH_4^+ and some on NO_3^-, but the difference with N source in most cases is smaller than the difference in growth rate among different strains (Figure 3.3). Therefore, observations of fast growth of cyanobacteria using NH_4^+ in the field are most likely due to 1) factors that promote fast growth of cyanobacteria generally (i.e. high temperature and high irradiance) combined with 2) high enough availability of NH_4^+ such that NtcA is repressed and only NH_4^+ is taken up and utilized by the cell.

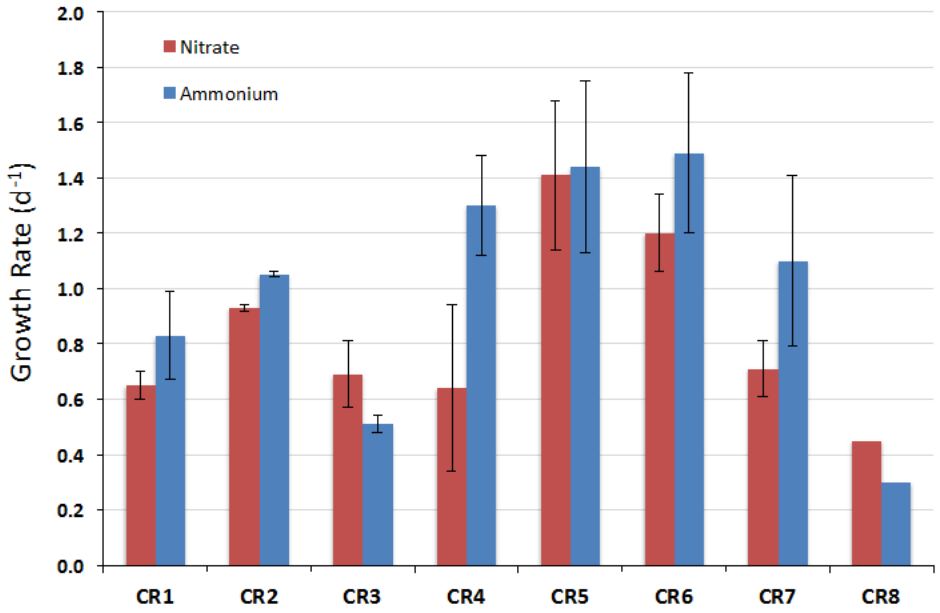


Figure 3.3. Difference in growth rates of *Cylindrospermopsin raciborskii* when growth on NO_3^- (red bars) versus NH_4^+ (blue bars) for eigth different strains. Data from Saker and Neilan 2001 and Stucken *et al.* 2014.

3.3 Irradiance and Water Clarity

Cyanobacteria have a distinct advantage with respect to other photosynthetic organisms in the amount of carotenoid pigments per cell volume (Section 2.2.2). These pigments serve a photoprotective function by dissipating excess light energy when required allowing cyanobacteria to be exposed to high irradiances without experiencing photoinhibition (Paerl *et al.* 1983, 1985). Recent investigations also demonstrate that the toxic peptides produced by cyanoHAB species accumulate in the thylakoid membranes potentially serving a role in photoprotection of the cells (Kaebernick *et al.* 2000, Borner and Dittman 2005, Gerbersdorf 2006). Interestingly, many cyanoHAB species are not strong competitors for light in a well-mixed environment due to their poor light absorption efficiency (Huisman *et al.* 1999, Reynolds 2006). Among the cyanoHAB species tested to date, *Microcystis* appears to possess the least efficient rate of photosynthesis for a given light intensity (Figure 3.4). The upshot of these traits

is that cyanobacteria grow ineffectively at low and mixed light, but very effectively when exposed to high light, particularly the toxic peptide-producing varieties (Huisman *et al.* 2004, Reynolds 2006, Carey *et al.* 2012).

Aided by their positive buoyancy, cyanobacteria such as *Microcystis*, can grow very close to the surface by tolerating irradiance levels that are inhibitory to other members of the phytoplankton community. As a result, these cyanobacteria can increase their cell densities past the point where they would ordinarily become light-limited by self-shading. Growing close to the surface can also help cyanobacteria avoid light limitation if there is a high concentration of suspended sediment matter in the water. In contrast, phytoplankton than are not positively buoyant can become shaded by the cyanobacteria growing at the surface (Carey *et al.* 2012).

In contrast with *Microcystis* and *Aphanizomenon*, other cyanoHAB species such as *Cylindrospermopsis raciborskii* and *Planktothrix* sp. are good competitors at low light. Cultures of *C. Raciboskii* can grow at optimal rates at very low irradiances (Briand *et al.* 2004, Dyble *et al.* 2006, Wu et al. 2009) and it grows well in deep water columns where it's exposed to fluctuating light levels as it mixes from the surface to the bottom (McGregor and Fabbro 2000, Burford and Donohue 2006, O'Brien *et al.* 2009). Not only is the rate of photosynthesis in *C. raciborskii* efficient at low irradiances, it's also efficient at high irradiances, making this a very versatile cyanoHAB species (Figure 3.4).

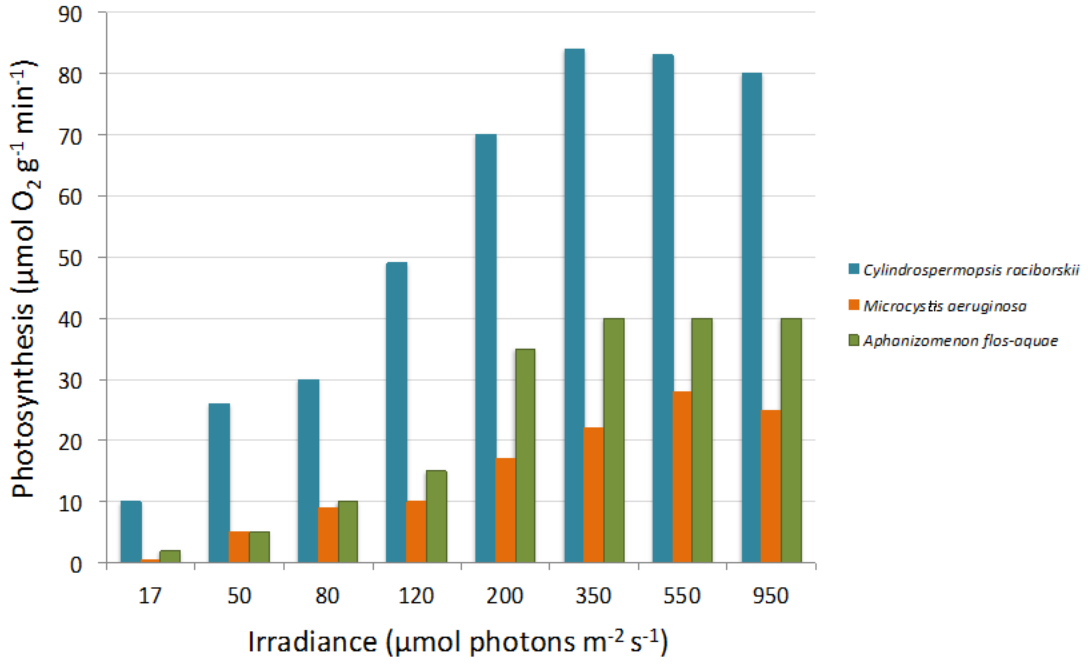


Figure 3.4. Photosynthesis as a function of irradiance in three cyanoHAB species. Data from Wu *et al.* 2009.

3.4 Factors Impacting Toxin Production and Degradation

While a large number of different toxins are produced by cyanoHAB species, the literature is heavily tilted towards investigations of factors impacting the production and degradation of microcystins. Therefore the information presented here is focused on microcystin-LR.

3.4.1 Toxin Production

Just as there is substantial discussion surrounding the purpose of toxin production in cyanobacteria, the conditions under which toxin production is enhanced is also vigorously debated. Previous studies have concluded that the greatest intracellular toxin concentrations are detected under favorable growth conditions, including high irradiance as discussed above, with maximal toxin production occurring at maximal rates of cell division and in late log phase (Watanabe and Oishi 1985, Orr and Jones 1998, Sivonen and Jones 1999, Van Der Westhuizen and Eloff 1985).

Investigations specifically focused on changes in nutrient concentrations and ratios, demonstrate that microcystin content reaches a maximum under maximum growth rates, regardless of medium N:P ratio, but that the microcystin content of the cells correlates with total cellular N and protein content (Lee *et al.* 2000, Vezie *et al.* 2002, Downing *et al.* 2005). These results make sense as the toxins, being peptides, require ample N in order to be synthesized. Consistent with this, total toxin production per cell decreases at N-limiting concentrations (Tonk *et al.* 2008).

Not only does toxin concentration per cell vary in strains that produce toxins (i.e. are toxigenic), but natural populations are typically comprised of a mix of toxigenic and non-toxigenic strains of the same species. It is also of interest to know whether the proportion of toxigenic:non-toxigenic strains within a population changes with nutrient concentrations or ratios. Laboratory culture investigations comparing growth of toxigenic and non-toxigenic strains of *Microcystis* demonstrated that toxigenic strains of *Microcystis* grew faster than non-toxigenic strains at N concentrations of 6000 µmoles L^{-1} and at N:P ratios >> 200 (Vezie *et al.* 2002). The reason for this is not clear, but could include microcystin conferring protection from NO_3^- toxicity in the toxin-producing strains at such unnaturally high concentrations of NO_3^-.

While results obtained with unnaturally high nutrient concentrations and ratios do not easily translate to natural systems, a nutrient enrichment bioassay investigation has demonstrated that toxigenic strains within a *Microcystis* population were promoted to a greater degree with N (and P) additions than non-toxigenic strains (Davis *et al.* 2010). However, the pattern of selective stimulation of toxigenic strains with increased nutrient concentrations is not evident in natural communities which typically exhibit a high degree of variability across small spatial scales in the proportion of toxigenic:non-toxigenic strains within a population. This variability appears not to be related to nutrient concentrations or ratios which do not exhibit the same spatial variability (Vezie *et al.* 1998, Baxa *et al.* 2010, Mbedi *et al.* 2005, Dolman *et al.* 2012).

3.4.2 Toxin Degradation

Together with labile dissolved organic carbon, toxins are rapidly degraded by the natural microbial community following sedimentation (and subsequent release of cellular material) of a cyanobacterial bloom (Jones *et al.* 1994, Rapala *et al.* 2005). In addition to non-specific degradation by the whole community, specific degradation of toxin peptides occurs due to bacteria belonging to the *Sphingomonadaceae* family (Bourne *et al.* 1996, 2001), and other more recently discovered families (Rapala *et al.* 2005, Yang *et al.* 2014). Bacteria that degrade microcystins may also degrade nodularin (Rapala *et al.* 2005). The predominance of these specialized bacteria in the microbial community may determine the length of time it takes (i.e. lag period) before bacterial degradation of toxins takes place. For example, Rapala *et al.* (1994) found the lag time decreased in waters with previous cyanobacterial blooms, compared with no previous cyanobacterial blooms, presumably due to a greater proportion of toxin-degradading bacteria in the former environment. Once degradation of toxin commences, it proceeds rapidly and toxin concentrations typically decrease in an exponential fashion (Figure 3.5), with a loss rate of 0.5 to 1 d^{-1}, corresponding to a half-life of only one day (Christoffersen *et al.* 2002, Jones and Orr 1994). While 95% of the toxins may be degraded within the first 3 days, a more recalcitrant fraction may remain for 20 days or more (Jones and Orr 1994). Other sinks for microcystin-LR include UV degradation (Tsuji *et al.* 1995), and adsorbtion onto clay particles (Morris *et al.* 2000). In the absence of bacteria, clay particles and UV light, microcystins are very stable in the environment and degrade slowly. At temperatures below 40°C the half-life of microcystin toxin increases to 10 weeks; this conservative estimate is used by the Office of Environmental Health Hazard Assessment to determine the risk of the toxin to wildlife (OEHHA 2009). Because there probably exists a great deal of variation in the relative importance of biological, chemical and physical processes in the degradation of microcystins depending on location, accounts in the literature regarding the half-life and recalcitrance of cyanoHAB toxins tend to be conflicting (i.e. Jones and Orr 1994, Gibble and Kudela 2014). Added to this uncertainty is the difference in toxin concentrations obtained using different methods of measurements (See Section 4.2.3 below).

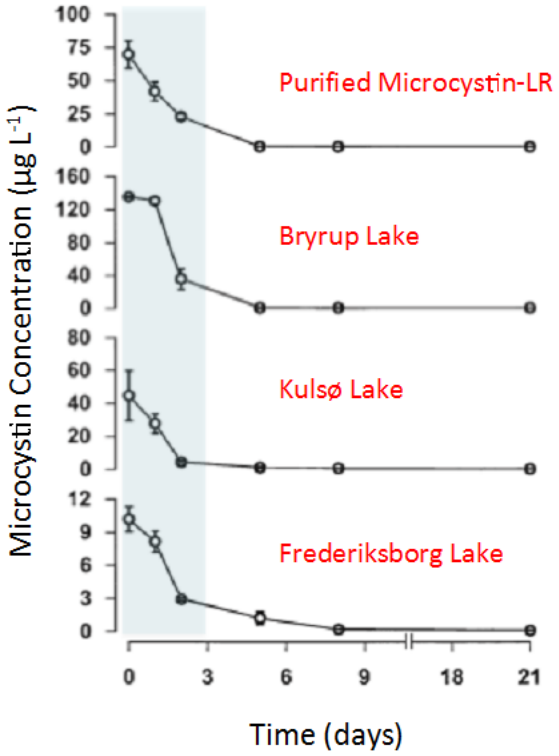


Figure 3.5. Concentration of dissolved microcystin-LR equivalents in bioassays as a function of time after addition of purified microcystin (top panel) or lysed bloom material (bottom 3 panels) to lake water containing natural microbial assemblages. Shaded area corresponds with time period of degradation of 95% of original microcystin concentration. Data from Christoffersen *et al.* 2002.

3.5 Temperature

Perhaps one of the most important factors in controlling the growth rate of cyanobacteria is temperature (Robarts and Zohary 1987, Butterwick *et al.* 2005, Reynolds 2006, Paerl and Huisman 2008). Cyanobacteria isolated from temperate latitudes (i.e. excluding polar regions) typically have temperature growth optima between 25 and 35°C (Reynolds 2006, Lurling *et al.* 2013). For example, in a survey of eight cyanobacteria the growth optima of two *Microcystis aeruginosa* strains were 30-32.5°C and that of *Aphanizomenon gracile* was 32.5°C. Lower growth temperature optima were observed in *Cynlindrospermopsis raciborskii* and *Planktothrix agardhii*, both at 27.5°C while *Anabaena* sp had an optimum of 25°C (Lurling *et al.* 2013). The optima of these freshwater HAB-forming cyanobacteria are greater than for marine cyanobacteria which typically have growth temperature optima ranging from 20-27.5°C (Breitbarth *et al.* 2007, Boyd *et al.* 2013).

Compared with other phytoplankton taxa, cyanobacteria typically demonstrate lower growth rates at colder temperatures and higher growth rates at higher temperatures. For example, diatoms typically have a 6-fold higher growth rate at 15°C, 3-fold higher growth rate at 20°C and

a similar growth rate at 25°C, compared with cyanobacteria (Figure 3.6). Growth rates of dinoflagellates typically peak at 25°C. Above 25°C both chlorophytes and cyanobacteria have faster growth rates than diatoms and dinoflagellates (Figure 3.6). The difference in the optimum growth temperatures of the various phytoplankton taxa is hypothesized to become increasingly important in determining phytoplankton community composition as global temperatures continue to increase above 20°C (Lehman *et al.* 2005, Paerl and Huisman 2008). For example, the acceleration of growth rate with a 10°C increase in temperature (Q_{10}) commonly varies from 1-4 for cyanobacteria and 1-3 for chlorophytes (Reynolds 2006). However, it varies from 4-9 for *M. aeruginosa*, the highest recorded for any phytoplankton (prokaryotic or eukaryotic) species (Reynolds 2006). These data suggest that in a mixed phytoplankton assemblage, all else being equal, cyanobacteria will be able to grow faster and outcompete other phytoplankton taxa as the temperature increases. With continued climate change and global warming, there's an increased risk that cyanoHABs will become increasingly competitive vis-à-vis diatoms which often dominate community composition in temperate regions.

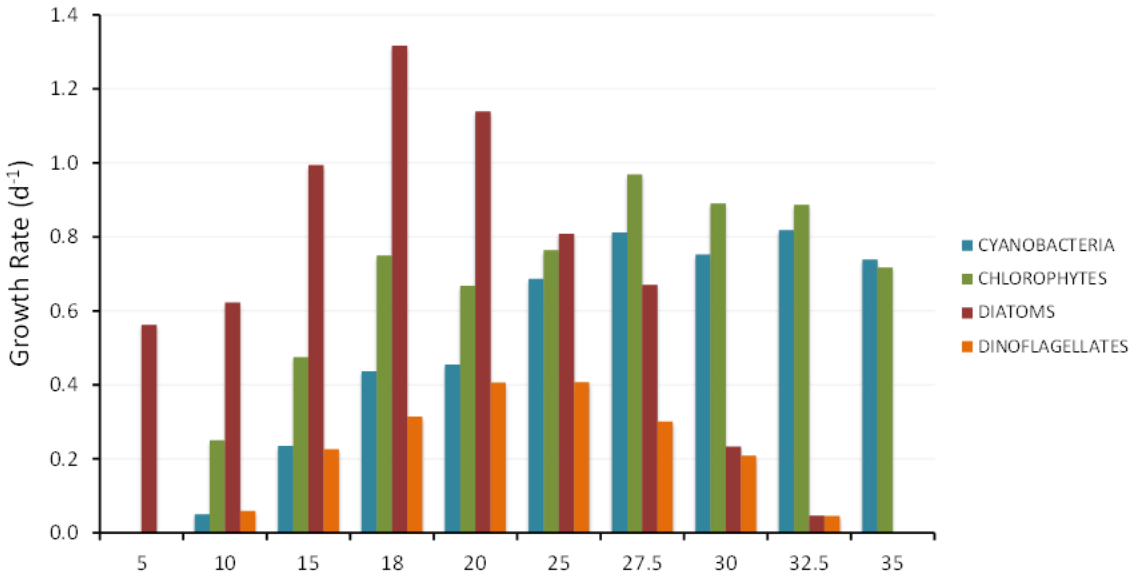


Figure 3.6. Changes in growth rate with temperature for diatoms (red ± 0.35 d^{-1}, T_{opt}= 20 ± 1.8 °C), Chlorophytes (green ± 0.21 d^{-1}, T_{opt}= 29 ± 3.8), Cyanobacteria (cyan ± 0.13 d^{-1}, T_{opt}=29 ± 4.5) and dinoflagellates (orange ± 0.1 d^{-1}, T_{opt}= 21 ± 2.8). Data from Kudo *et al.* 2000, Butterwick *et al.* 2005, Yamamoto and Nakahara 2005, Boyd *et al.* 2013, Lurling *et al.* 2013.

3.6 Stratification and Residence Time

3.6.1 Stratification

CyanoHAB blooms tend to occur during times of calm, stratified water columns (Huber *et al.* 2012). The degree of statification and water column stability increases with increased temperature, therefore stratification and temperature are closely linked (Paerl and Huisman

2008). The reasons that stratified conditions promote blooms of cyanobacteria are at least three-fold. First, growth rates will increase as a result of the increase in the temperature in the top layer of the water column. Second, cyanobacteria will remain in the top layer of the water column where irradiance is greater, and not become mixed down to the bottom and into lower light, allowing them to maintain higher growth rates. Third, stratification may be a sign of increased residence times (reduced flushing rates), which minimizes loss of cyanobacterial biomass from the system and allows cyanobacteria to use all the nutrients available in the water column (Jeppesen *et al.* 2007). In other words, it's likely that stratification does not directly promote cyanobacterial blooms, but rather it promotes blooms indirectly through increased temperatures, irradiance and reduced loss rates (Elliott 2010).

3.6.2 Residence Time

Because residence time is determined by the flushing rate, the direct effect of increased residence time is to decrease the loss rate of cyanobacteria (Romo *et al.* 2013). Indirect effects of residence time are the same as those for stratification; this is because residence time and stratification typically covary such that stratification is maximal when residence time is minimal, and vice versa. Studies that report on the effect of residence time suggest that cyanobacterial abundance, cell size and toxin concentration are positively related to increased residence time (Elliott 2010, Romo *et al.* 2013).

3.7 Other Factors

Additional to the above-mentioned factors, a number of others may influence cyanobacterial blooms including grazing by higher trophic levels and exposure to toxic compounds such as herbicides and pesticides. Grazing in the Delta region is dominated by *Corbicula fluminea* (Jassby 2008). It is not known to what extent *C. fluminea* impacts cyanoHAB species versus the rest of the phytoplankton community in the Delta. The same is true for grazing by zooplankton. Another factor that may differentially impact cyanoHAB species versus the rest of the phytoplankton community is resistance to herbicides and pesticides. Investigations demonstrate substantial variability in sensitivity to herbicides of cyanobacteria compared with other phytoplankton such as green algae and diatoms (Peterson *et al.* 1997, Lurling and Roessink 2006)

4. Prevalence of CyanoHABs and Potential for Effects on Ecosystem Services in the Delta

The Sacramento-San Joaquin Delta (hereafter Delta) is formed at the intersection of two of California's largest rivers, the Sacramento and the San Joaquin Rivers, and contains 700 miles of sloughs and waterways that drain 47% of the runoff in the State of California (Figure 1.1). The land surrounding the waterways is composed of 57 leveed island tracts, many of which provide wildlife habitat. In the Delta, freshwater from the rivers mix with saltwater from the San Francisco Bay; together the Bay and the Delta form the West Coast's largest estuary.

4.1 Ecosystem Services

The Delta region has many ecosystem services including agriculture, drinking water supplies, and wildlife habitat, all of which translate directly to the beneficial uses designated in the Water Board Basin Plan (Appendix A). The population surrounding the Delta region, numbering 500,000 people, is principally engaged in agriculture and produce crops that bring in revenues exceeding $500 million annually. While there is some local demand on the water from the Delta, most of the water is distributed via the State Water Project and Federal Central Valley Projects to the Central Valley to irrigate farmland and to provide drinking water to Southern California (http://www.water.ca.gov/swp/delta.cfm). According to the California Department of Water Resources, about two thirds of Californians and millions of acres of irrigated farmland rely on the Delta for their water. Besides acting as a source of drinking water, the Delta is a popular recreation spot and many people use it for sport fishing.

In addition to the human demand, the Delta supplies critical habitat to a large wildlife ecosystem and intersects migration paths for several fish species, including salmon, traveling between the Pacific Ocean and the Sacramento River and beyond. This habitat is in a fragile state with close to 20 of its endemic species listed as endangered. A recent and unexpected decline in four pelagic fish species including the endangered Delta Smelt and the Longfin Smelt, as well as juvenile-Striped Bass and Threadfin Shad, has caused concern among resource managers and renewed calls for conservation of the fragile Delta ecosystem (Sommer *et al.* 2007).

Set against this backdrop of competing resource use by human populations and wildlife, a new threat to Delta ecosystem services and designated beneficial uses is emerging in the form of toxic cyanoHABs. The impact of toxic cyanobacteria on the aquatic ecosystem differs widely depending on whether their density is low or high. At low concentrations, they are not dense enough to affect light penetration or dissolved O_2 concentration; therefore, they do not affect the growth of other members of the aquatic community. However, even at low concentrations toxins released (upon death and cell lysis, or by grazing) can accumulate in tissues of higher trophic levels (Lehman *et al.* 2010). At high densities, cyanoHABs increase the turbidity of the water column to the point where light penetration is severely restricted suppressing the growth of other

phytoplankton, macrophytes, and benthic microalgae (Jeppesen *et al.* 2007, Paerl and Paul 2012). CyanoHABs also can cause night-time dissolved oxygen depletion via bacterial decomposition and respiration of dense blooms which results in fish kills and loss of benthic fauna (Paerl 2004, Paerl and Fulton 2006). At dense concentrations, mortality to aquatic animals such as sea otters, birds and seals may result from liver failure following ingestion of prey with high concentrations of toxin, or coming into physical contact with the toxin (Jessup *et al.* 2009, Miller *et al.* 2010). Humans coming in contact with the water may develop digestive and skin diseases (Section 2.2.6) and it may affect the drinking water supplies (Cheung *et al.* 2013). In the following sections, cyanoHAB abundance and toxin levels in the Delta vis-à-vis published guidance on alert levels are summarized in order to place the threat of cyanoHABs in the Delta into context.

4.2 Prevalence and Trends of CyanoHABs in the Delta

Since 1999 blooms of the toxin producing cyanobacteria *Microcystis aeruginosa* in the Delta have been observed by the Department of Water Resources (DWR), and have been reported in the scientific literature. In the beginning, only blooms of *Microcystis* were observed; these were documented visually appearing as little flakes of lettuce in the water (Lehman and Waller 2003). Later investigations (post 2005) employing microscopic enumeration and molecular characterizations have documented blooms comprised of a mix of *Aphanizomenon* sp. and *Microcystis*, with *Anabaena* sp. also present in much smaller densities (Lehman *et al.* 2010, Mioni *et al.* 2012).

While environmental indicators such as salinity, turbidity, temperature, total phytoplankton biomass (as Chl *a*), and phytoplankton species composition are monitored on a monthly basis by DWR, surface concentrations of cyanobacteria and cyanotoxins, which require special sampling, are not routinely monitored. As such, the information on the chronology of cyanoHAB occurrences presented here is taken from a handful of publications and reports, and varies somewhat in geographical extent according to where the authors sampled. Because *Aphanizomenon* and *Anabaena* densities have only been documented for two time points, the following sections will focus on *Microcystis* biomass and microcystin toxin concentrations. Additionally, these sections will focus on aquatic health rather than human health whose risks may be better evaluated from sampling of surface scums.

4.2.1 Spatial Distribution of Microcystis throughout the Delta

The Central Delta, between Antioch and Mildred Island, is typically the region with the highest surface *Microcystis* and *Aphanizomenon* concentrations. In 2003, the stations with the greatest recorded abundance of Chl *a* due to *Microcystis* (as determined by horizontal surface tows with a 75-µm mesh plankton net) were Jersey Point (D16), Mokelumne River Mouth and Navigation Marker 13 in the San Joaquin River, followed by San Mound Slough, Mildred Island, (D29) and Rancho del Rio (D28) in Old River (Figure 4.1). In following years, greatest abundance of

Microcystis has repeatedly occurred in the same areas in the San Joaquin and Old Rivers (Lehman *et al.* 2008, Mioni *et al.* 2012, Lehman *et al.* 2013). In 2012, abundant *Microcystis* colonies were also observed in the South-East Delta region in the Turning Basin of the Stockton Shipping Channel (Spier *et al.* 2013). Moving west from Antioch into Suisun Bay, *Microcystis* abundance decreases substantially to almost non-detectable by Chipps Island (Lehman *et al.* 2005, 2008, 2010). The same holds true when moving north where abundances detected at Antioch decline to almost zero by Collinsville at the entrance of the Sacramento River (Figure 4.1).

Whether or not the spatial distribution of *Microcystis* and other cyanoHAB species is affected favorably or unfavorably by concentrations of herbicides entering the Delta as run-off, or from the Sacramento and San Joaquin Rivers is not known. Recent reports suggest that a broad swath of herbicides and fungicides associated with agriculture is present at concentrations high enough to affect aquatic life (Orlando *et al.* 2014). As such, the impact of herbicides common to the Delta in selectively promoting certain phytoplankton species, including possibly cyanoHAB species, may deserve greater attention.

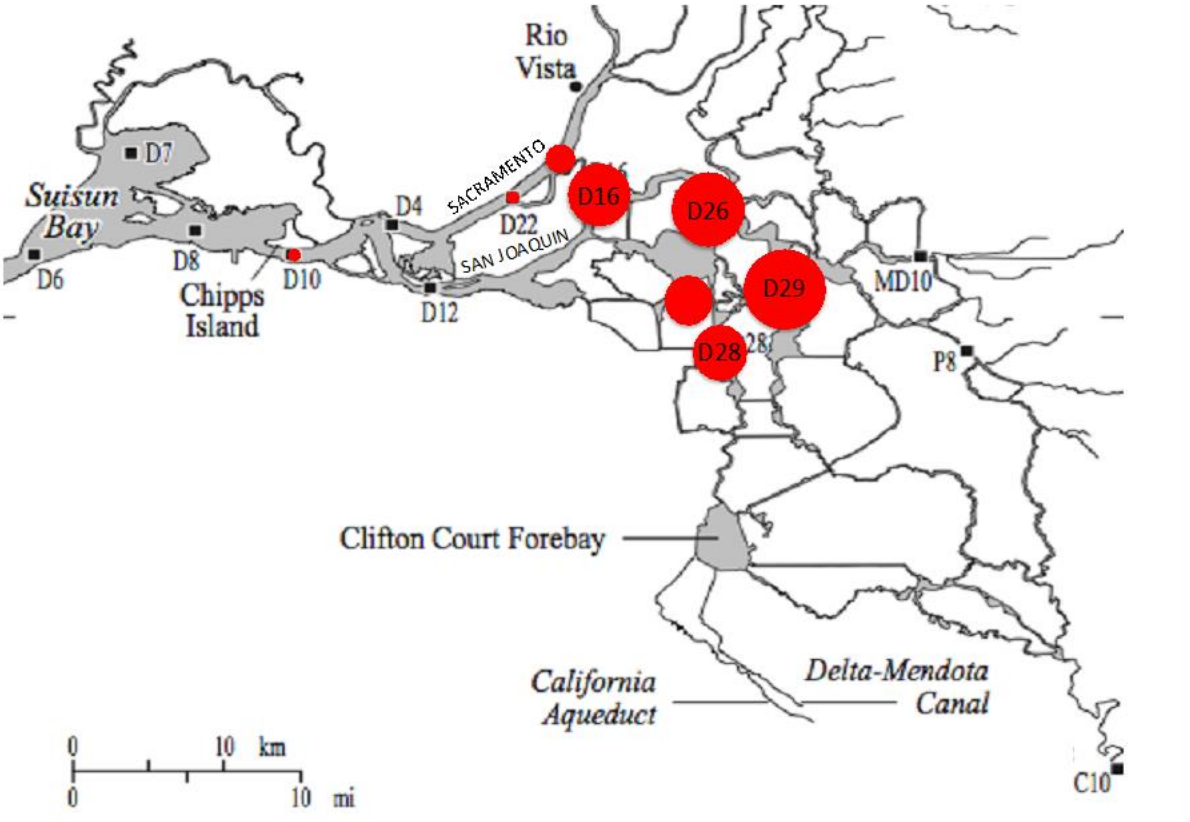


Figure 4.1. The Sacramento-San Joaquin Delta Region. Red bubbles mark locations with greatest Microcystis-associated surface Chl a concentrations (largest bubble=0.55 µg Chl a L^{-1}). Data from Lehman *et al.* 2005.

4.2.2 Interannual variability in Microcystis biomass in the Delta

Since 2003, *Microcystis* cell abundance in depth-integrated surface waters has varied from 4-40×10^3 cells mL^{-1} in the Delta (Lehman *et al.* 2008. The biomass (as surface Chl *a*) has also varied approximately 10-fold (Figure 4.2). Not only is *Microcystis* biomass patchy between years, its distribution in the years that it blooms is also variable. Even within a station, the distribution of *Microcystis* colonies is patchy, as evidenced by the low concentration of surface Chl *a*, sampled with horizontal net-tows normalized to total towed volume, which to date has not been above 0.6 µg Chl a L^{-1} (Figure 4.2). In the years following 2005, *Microcystis* was also present in the phytoplankton community together with *Aphanizomenon flos-aqua*, and to a lesser extent *Anabaena* sp. (Lehman *et al.* 2008, Mioni *et al.* 2012).

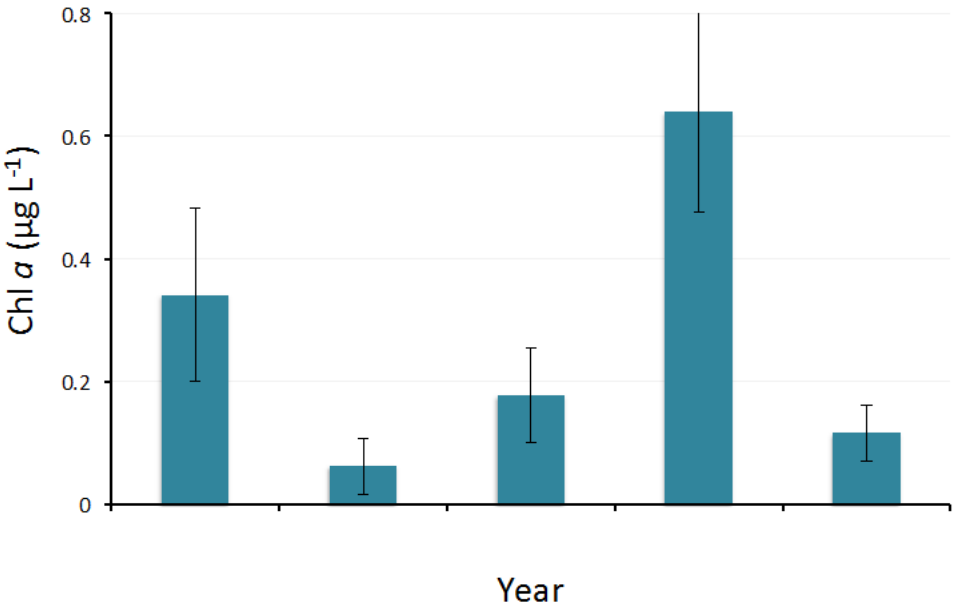


Figure 4.2. Interannual changes in surface Chl a due to abundance of Microcystis colonies. Means and standard deviations of 9 different stations in the San Joaquin River (Antioch (D12), Jersey Point (D16), Frank's Tract (D19), Potato Point (D26), Prisoners Point (D29), San Joaquin River at Turner Cut, Sand Mound Slough, Mildred Island, and Old River at Rancho del Rio (D28). Data from Lehman *et al.* 2005, 2013.

In addition to a high degree of horizontal variability, *Microcystis* cell densities and biomass also varies vertically in the water column, decreasing from the surface to almost zero at 1 m depth. The density of *Microcystis* in surface waters at the Central Delta Stations does not affect phytoplankton community composition in a measurable way. For example, at four stations where *Microcystis* dominated abundance of phytoplankton at the surface, the communities at 1m depth was a variable mix of different species of phytoplankton that was equally variable at stations containing no *Microcystis* in the surface. Rather than decreasing, the biomass of other

phytoplankton taxa increased in tandem with increasing *Microcystis* biomass (Lehman *et al.* 2010).

Compared with lakes widely recognized for severe CyanoHAB problems, *Microcystis* (and other cyanoHAB species) biomass appears low. For example, in Clear Lake spring and early summer Chl *a* concentrations average 11.5±8 µg Chl *a* L^{-1} but increase to 352±295 µg Chl a L^{-1} in the summer once *Microcystis* starts to bloom (Figure 4.4). Here, *Microcystis*-associated Chl *a* concentration is a factor of 100 to 1000 greater than it is in the Delta (Figure 4.4). One important caveat with respect to determining surface Chl *a* concentrations is that it depends on the method used to collect the surface Chl *a*. The difference between using a surface net tow (akin to what is used in Lehman *et al.* 2013) and a grab sample from the middle of a patch (akin to Mioni *et al.* 2012) can be close to be 100-fold, i.e. 0.2 µg Chl a L^{-1} versus 20 µg Chl a L^{-1}, respectively. This is because the former is an integrated measure and the latter is not, suggesting that the "coverage" of *Microcystis* colonies in surface waters of the Central Delta is around 1%. This is in sharp contrast with Clear Lake where surface Chl *a* is uniformly high (above 150 µg Chl a L^{-1}) at all stations during a bloom (Richerson 1994, Mioni *et al.* 2012).

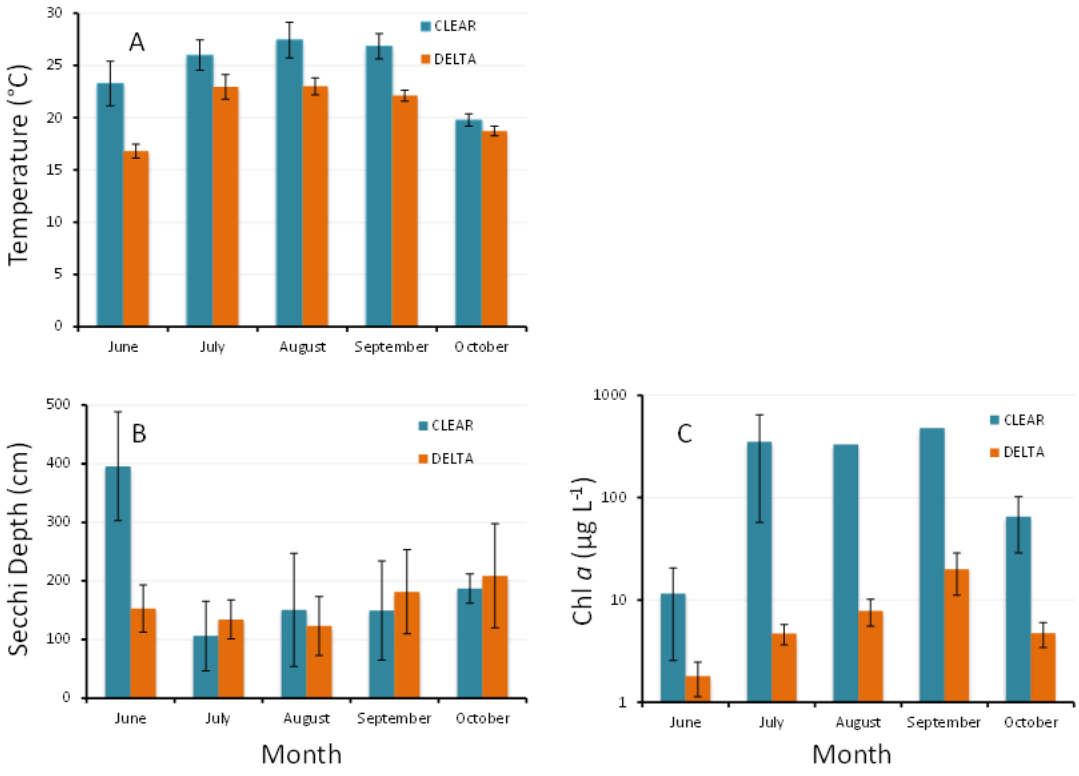


Figure 4.3. Comparison of environmental variables and Chl a in Clear Lake (Cyan) and the Delta (orange) using in-patch grab samples during the summer months of 2011. (A) Temperature, (B) Secchi disk depth, (C) Chl a. Data from Mioni *et al.* 2012.

4.2.3 Microcystin toxin concentrations in the Delta and San Francisco Bay

Given the number of different toxins produced by each cyanoHAB species, and the number of different genera present in Central California, one would expect a number of different toxins to be present in the water column. However, toxins other than microcystin are not frequently encountered (Kudela pers. com, Gibble and Kudela 2014). Based on the data available for the Delta, this section describes total microcystin concentrations and how they relate to *Microcystis* cell abundance.

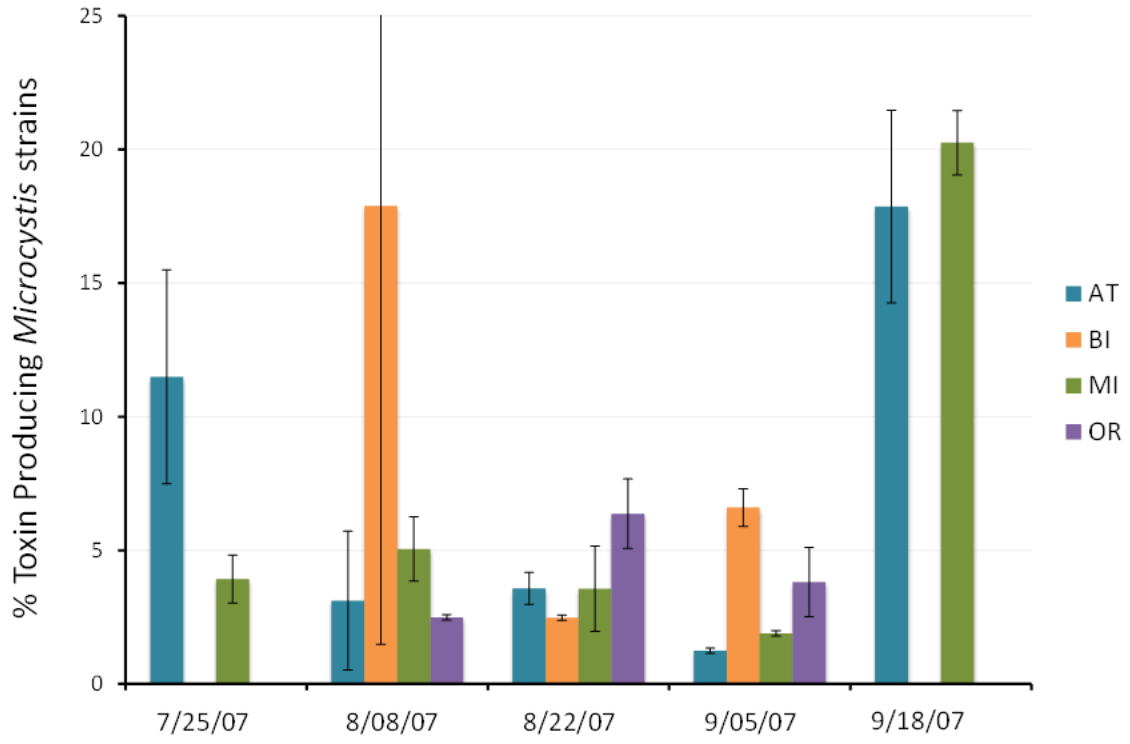


Figure 4.4. Percent toxin-producing strains in Microcystis assemblage at stations AT, Antioch (D12); BI, Brannan Island (D23); MI, Mildred Island; and OR, Old River at Rancho del Rio (D28). Data from Baxa *et al.* 2010.

Microcystis produces approximately 100-400 ng microcystin per µg Chl *a* in toxin producing strains (Sivonen and Jones 1999). Just as with other regions where *Microcystis* occurs, the strains that occur in the Delta are a mix of toxigenic and non-toxigenic strains (Baxa *et al.* 2010). Toxigenic strains generally comprise 2-20% of the total number of *Microcystis* strains present. This variation in the proportion of toxigenic strains is observed everywhere (i.e. at every station) and at all times (Figure 4.4). No single station stands out as consistently producing a greater proportion of toxigenic strains compared with other stations (Figure 4.4). Accordingly, total microcystin concentrations reflect total *Microcystis* cell abundance, typically varying from 10-50 ng L^{-1} (Lehman *et al.* 2008). However, in 2012 concentrations approaching 2000 ng L^{-1} were detected in the Stockton shipping channel during a *Microcystis* event (Spier *et al.* 2013).

In the Sacramento River, intermediate concentrations of total microcystins have been detected at a station close to Rio Vista (Brannon Island) where *Microcystis* cell abundance is low to non-detectable (Lehman *et al.* 2008, 2010). This station is connected via a channel to the San Joaquin River and the Frank's Tract area. Physical mixing of water directly from the San Joaquin River with brackish water at this station situated at the entrance to the Sacramento River may bring toxins but establishment of *Microcystis* populations may be prevented by the conditions in the Sacramento River including colder water, greater flow rates, mixing down to the bottom, and lower water clarity (Lehman *et al.* 2008).

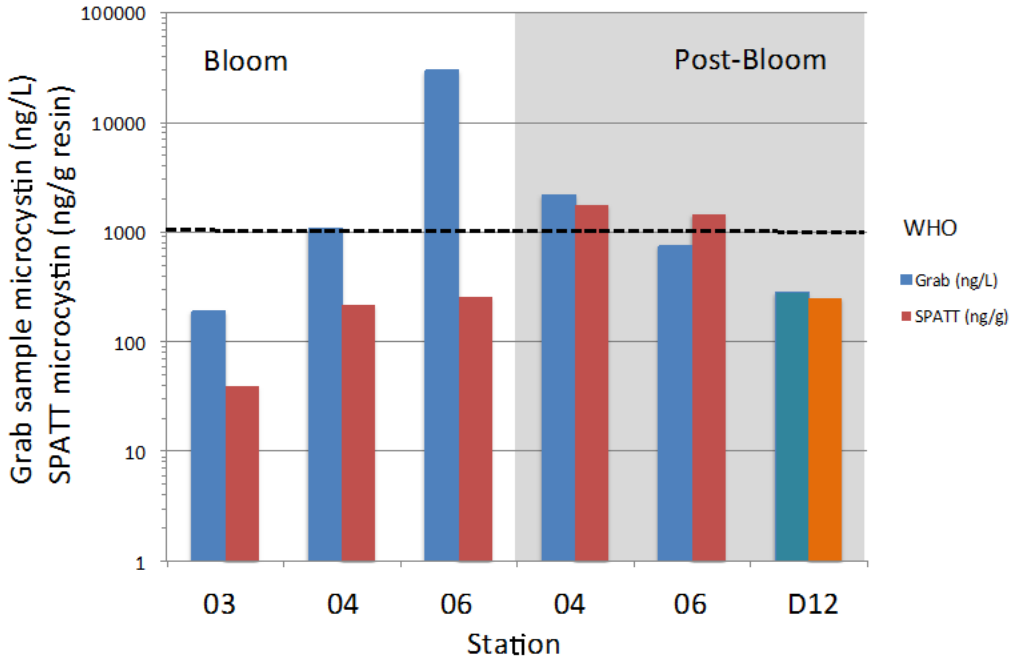


Figure 4.5. Microcystin toxin concentrations determined with grab samples (blue/cyan) and with SPATT resin (red/orange) at three stations in Clear Lake, during and after a Microcystis bloom, and at one station (D12, Antioch) in the Delta. Data from Mioni *et al.* 2012.

Microcystin toxin has also been detected at low concentrations throughout the Delta and the San Francisco Estuary using the novel Solid Phase Adsorption Toxin Tracking (SPATT) technique which integrates exposure of dissolved toxins over longer time spans (Kudela 2011). While valuable to indicate a potential for exposure to cyanotoxins, the comparison of SPATT to existing guidelines for human and aquatic health is problematic because SPATT detected concentrations are not directly comparable to traditional, instantaneous grab samples. For example, in Clear Lake microcystin detected with SPATT (ng/g resin) was 5-115 times lower than grab samples (ng/L) taken the last day of the SPATT deployment during the height of a *Microcystis* bloom (Figure 4.5). Post bloom, microcystin detected with SPATT was either comparable to, or double, levels measured in grab samples (Figure 4.5). While microcystin was

detectable both with SPATT and with grab samples in Clear Lake, microcystin was detectable with SPATT in the Delta, at similar levels as in Clear Lake, but not with grab samples. In the former system *Microcystis* was very abundant and in the latter it was not. The above example illustrates that given longer equilibration times, SPATT becomes more senstitive than grab samples at lower concentrations of toxins. Although difficult to "translate" directly into effects on aquatic life (i.e. Echols *et al.* 2000), SPATT detection may be a very useful system for identifying regions at risk for harm to aquatic life from toxin exposure (Gibble and Kudela 2014).

4.2.4 Potential for CyanoHAB Risk to Delta Beneficial Uses

Characterization of the risk of cyanoHABs to Delta beneficial uses is generally poor. While no guidelines for toxicity of cyanotoxins to aquatic life have been established for California, total microcystin levels found in the Delta are within the range of potential impacts to aquatic health, as recently reviewed by the California Office of Environmental Health Hazards (OEHHA 2009). For example, microcystins are acutely toxic to fish at concentrations as low as a fraction of a microgram per liter (OEHHA 2009). Chronic exposures can also be problematic; embryos and larval fish appear to be very sensitive to chronic exposures to microcystins, resulting in oxidative stress, reduced growth, developmental defects, and lethality; exposures as low as 0.25 µg/L resulted in oxidative stress to zebrafish embryos (OEHHA 2009).

Consumption of prey items with body burdens of cyanotoxins can also be a potential pathway of impact. Lehman *et al.* (2010) traced increasing concentrations of microcystins from the water (25-50 ng L^{-1}) to zooplankton (0.4-1.5 µg g dry wt^{-1}) to striped bass muscle tissue (1-3.5 µg g dry wt^{-1}) at Central Delta Stations. These values are within the range of sublethal microcystin doses to fish (2.5 µg g dry wt^{-1}; OEHHA 2009). The striped bass caught at stations where *Microcystis* cells comprised 100% of the surface Chl *a* had tumor lesions in their liver tissue, consistent with the sublethal effects caused by microcystin-LR toxin (OEHHA 2009, Lehman *et al.* 2010). This is consistent with fish feeding studies which demonstrate that microcystin-LR spiked diets result in lesions of the liver (Deng *et al.* 2010; Acuna *et al.* 2012a,b). Zooplankton are also acutely sensitive to *Microcystis aeruginosa* cells; diets consisting of 50% toxigenic and non-toxigenic *Microcystis* strains result in 100% mortality in the copepods *Eurytemora affinis* and *Pseudodiaptomus forbesi* (Ger *et al.* 2010). Interestingly, when fed diets containing only 10-25% *Microcystis* cells, both copepods demonstrate significantly greater survival on the toxigenic strain than the non-toxigenic strain, suggesting that bioactive compounds other than the microcystin toxin exert a greater adverse impact on the zooplankton (Ger *et al.* 2010). This is consistent with a number of the studies of the effect of cyanoHABs on zooplankton mentioned in Section 2.2.6.

Determination of risk to human health in the Delta is problematic because cyanoHABs monitoring has been focused on aquatic health (depth-integrated sampling) rather than human

health (via surface-scum sampling). With this caveat, toxin concentrations of 10-50 ng L^{-1} (Lehman *et al.* 2008) are 16-80 times lower than the Office of Environmental Health Hazard Assessment (OEHHA) Action Level for human health (Table 4.1), but the 2012 concentrations approaching 2000 ng L^{-1} in the Stockton shipping channel (Spier *et al.* 2013) exceed both the OEHHA Action level and the WHO guideline of 1000 ng L^{-1} (Table 4.1).

Table 4.1. Action levels developed by OEHHA (2009) for human health exposure to cyanotoxins compared with the WHO guidance level for microcystins and the EPA 10-day average exposure threshold.

Toxin	OEHHA Recreational Use (µg/L water)	OEHHA Consumption Level (ng/g fish)	WHO recreational Use (µg/L water)	EPA 10-day average (µg/L)
Microcystins	0.8	10	1.0	0.3
Cylindrospermopsin	4	70		
Anatoxin-a	90	5000		

4.2.5 Summary of Potential for Adverse Effects on Delta Beneficial Uses

A thorough characterization of the risks for adverse effects on Delta beneficial uses is hindered by the fact that cyanoHAB prevalence and toxin concentrations are currently not routinely monitored in the Delta; moreover, sampling has been focused on aquatic health and does not include sampling for human health risks. Determination of risk to human health is not possible at this time because surface scums are not currently being monitored. The current risk to Delta aquatic health is of concern and merits a more thorough investigation. This observation is based on total microcystin levels found in Delta fish tissues that are within the range of sublethal effects to fish as recently reviewed by the California Office of Environmental Health Hazards (OEHHA 2009). In addition, dissolved toxin concentrations (10- 50 ng L^{-1}) that are generally 16-80 times below the OEHHA action level, occasionally exceed both the OEHHA action level and the WHO guideline of 1000 ng L^{-1} in certain "hotspots" of the Delta. Whether or not these hotspots are expanding is currently not known and merits further investigation and monitoring.

5.0 Synthesis of Factors Influencing CyanoHABs presence and Toxin Production in the Delta

The charge of the cyanobacterial workgroup, as outlined in the Delta Nutrient Management Charter, is to "assess whether observed increases in the magnitude and frequency of cyanobacterial blooms in the Delta is the result of long-term changes in nutrient concentrations and whether management of nutrient loads can remedy the problems associated with cyanobacteria." The best way to characterize the relationship between the extent and frequency of bloom occurrence and nutrient concentrations is by regression analysis. Ideally, this type of analysis ought to be performed in multiple locations for longer time scales. Given that temperature, irradiance and water column clarity are such powerful triggers of blooms, stepwise multiple regression analysis to test the influence of several environmental indicators simultaneously on cyanoHAB cell densities would be even more useful in order to ascertain key triggers of the blooms in the Delta region.

While environmental indicators such as salinity, turbidity, temperature, total phytoplankton biomass (as Chl *a*), and phytoplankton species composition are monitored on a monthly basis by DWR, surface concentrations of phytoplankton, which requires special sampling, are not routinely monitored in this program. Therefore, the statistical analyses needed to answer the charge of the cyanobacterial working group cannot be performed at this time. Instead, this section focuses on summarizing factors known to favor cyanobacterial prevalence (from Section 2) and synthesizing available literature on the extent to which those factors may also be at play in the Delta.

5.1 Present and Future Factors associated with cyanoHAB prevalence in the Delta

5.1.1 Flow and mixing

Environmental and population drivers that promote growth of cyanoHABs in freshwater bodies around the world also play key roles in regulating growth of cyanoHABs in the Delta (Table 5.1). Chief among these is low flow. For example, Lehman *et al.* (2013) noted that increased abundance of *Microcystis* is associated with up to a 50% reduction in flow of water in the San Joaquin River. In 2004, *Microcystis* only appeared in the Central Delta when stream flow was 1-35 $m^3 s^{-1}$ (Lehman *et al.* 2008). In addition to direct effects of decreased flow such as increased stratification of the water column, changes in flow and mixing also impart indirect effects that may influence cyanobacterial growth. These include changes in turbulence, sediment resuspension (therefore turbidity), chemical consitutents, and water temperature to mention a few. Changes in these parameters typically cannot be separated from that of flow to determine their relative importance. For example, in the Delta, reduction in flow is accompanied by a 50% reduction in turbidity and volatile suspended solids. Decreased flow also leads to increased water temperatures. Conditions of decreased flow occur more predictably in dry years (Lehman *et al.*

2013). Within the summer season, reduced flows typically occur in the July-August time frame (Figure 5.1) and set the stage for the two factors necessary for bloom initiation, including increased water column temperature and water column clarity (decreased turbidity). While decreased flow may increase the abundance of *Microcystis*, increasing rates of flow decrease its abundance because of the negative effects of water column mixing, such as light limitation, on its growth. Artificial mixing is even used as a strategy to mitigate blooms of harmful cyanobacteria in lakes and reservoirs (Reynolds *et al.* 1983, Burford and O'Donohue 2006). In the Delta, natural mixing rates may be sufficient to restrict the abundance of *Microcystis* to 10-15% of the total phytoplankton community.

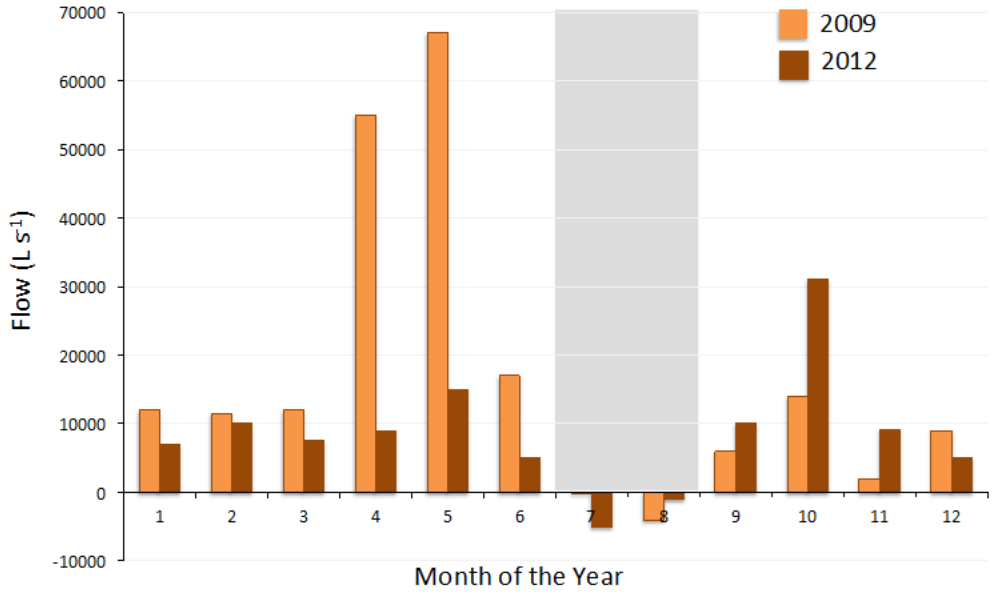


Figure 5.1. Variation in flow at Brandt Bridge in the Delta (years 2009 and 2012) illustrating the low- and reverse-flow window in July-August (shaded grey). Data and plot from Spier *et al.* 2013.

5.1.2 Temperature

Aside from the rate of water flow, water temperatures have increased globally over the last few decades as a result of global warming (Gille 2002, Hansen *et al.* 2005). In the Central Delta, a change from mainly negative deviations in the water temperature from the long-term mean to positive deviations occurred in 1999 (Figure 5.2). This local change in the water temperature may be part of the larger-scale global patterns and/or the Pacific Decadal Oscillation weather pattern which also changed sign in the same year (Cloern *et al.* 2007).

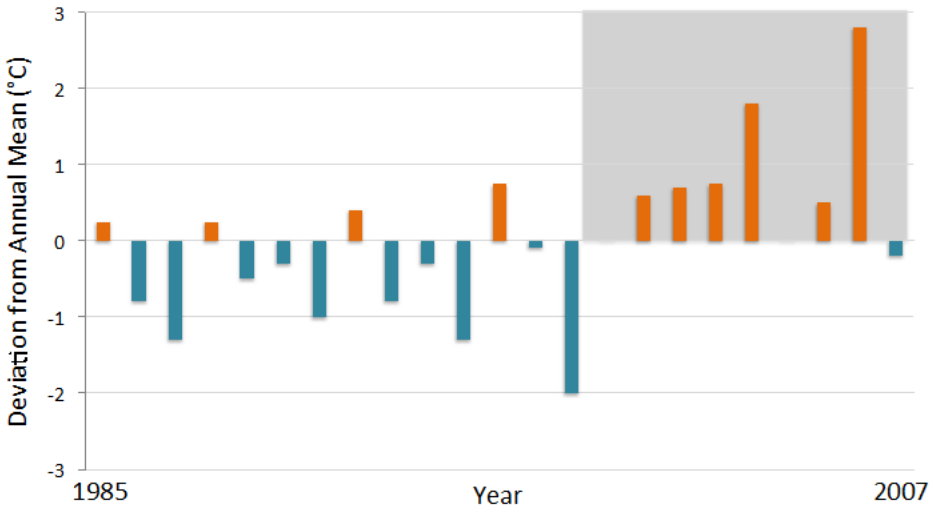


Figure 5.2. Deviation from the annual mean of maximum water temperatures at Stockton in the Central Delta. Grey shaded area indicates period from 1999 onwards with increased positive temperature deviations. Data from Brooks *et al.* 2011.

The interesting question with respect to changes in water temperatures is whether they are great enough to affect competition between cyanobacteria and other members of the phytoplankton community in the Central Delta. Presently, 40-75% of the phytoplankton community in the Delta is comprised of diatoms, followed by chlorophytes (15-30%), cyanobacteria (15-40%), cryptophytes (5-10%) and flagellates (0-10%), including dinoflagellates (Lehman 2007). In order for cyanoHAB species to to grow faster than diatoms and displace diatoms as the dominant member of the phytoplankton community, they would have to be able to accelerate their growth rates upto 2-3 fold. Alternatively, a scenario where the growth rate of diatoms would decrease and cyanobacteria would increase is necessary. Examining variation in growth rates with changes in environmental data, temperature appears the most likely candidate for bringing about such a change. Data from Figure 3.6 indicates that a doubling in cyanobacterial growth rates occurs with an increase in temperature from 20-27°C, whereas diatom growth rates decrease over the same temperature range. Therefore, a rise in temperature is a scenario under which cyanobacteria are able to outcompete diatoms.

This scenario is consistent with differences in temperature between a system, such as Clear Lake, where cyanoHABs dominate community composition, and the Delta. Comparing the 2011 environmental variables from Clear Lake and the Central Delta, two pre-bloom (June) differences become immediately clear. One is that the water temperature in Clear Lake is 7°C degrees warmer than the Delta (Figure 4.3). The other is that the Secchi disk depth is 2.6-fold greater in Clear Lake compared with the Delta (Figure 4.3). This difference in water clarity disappears in July when the *Microcystis* bloom takes off in Clear Lake, increasing Chl *a* 35-fold and decreasing the water clarity (Figure 4.3). Lehman *et al.* (2013) also predicted that the two

factors that potentially would make the greatest impact on accelerating the growth of *Microcystis*, and increase the frequency and duration of blooms in the Delta, would be increased water temperatures and increased water column clarity. The earlier in the growth season that these increases would occur the greater the window of opportunity for growth would become (see also Peeters *et al.* 2007).

5.1.3 Water Clarity

The Central Delta is highly turbid due to large amounts of sediments transported into the upper estuary via the Sacramento River as well as due to sediment resuspension. However, as more and more of the sediment load is being caught behind dams, sediment transport is on the decline and the upper estuary is becoming less turbid (Schoellhamer *et al.* 2012). Since 1975, turbidity at Stations D26 and D28 has declined by on average 2 and 4% per year, respectively (Jassby 2008). These average declines are accentuated by declines in turbidity of up to 50% during the low flow months (Lehman *et al.* 2013). If these present declines in turbidity in the Central Delta continue into the future, they may substantially promote growth of cyanoHAB species.

5.1.4 Nutrient Concentrations

If water temperatures did not increase above the summer-time average of 18-20°C, could there be a 2-fold acceleration in cyanobacterial growth rates with changes in N source, or with N:P ratio, at non-limiting nutrient concentrations that would enable them to outcompete diatoms and become dominant? To answer this question, we can 1) look to growth results from culture investigations and 2) investigate how nutrient ratios differ between a system that is overwhelmed by *Microcystis* (such as Clear Lake) compared with the Delta.

1) Culture investigations demonstrate that there is no significant, or consistent, change in growth rates with change in N source, or N:P ratios, at nutrient concentrations in excess of demand (Tilman *et al.* 1982, Tett *et al.* 1985, Reynolds 1999, Saker and Neilan 2001, Roelke *et al.* 2003, Sunda and Hardison 2007).
2) Comparing the ratios of dissolved N:P between the Delta and Clear Lake, 3.6±0.6 and 2.9±0.8, respectively, it's clear that these are essentially the same (Mioni *et al.* 2012). Nutrient ratios also do not vary from pre-bloom to bloom in the Delta, indicating that nutrients are in excess of phytoplankton demand for the entire summer season (Lehman *et al.* 2008, Mioni *et al.* 2012). Moreover, nutrient concentrations, or ratios, do not change sufficiently from year–to–year in order to explain year–to–year variation *Microcystis* biomass or occurrence. For example, since 1994 there has been no change in concentrations or ratios of nutrients in the Cental Delta (Appendix A).

Therefore, the initiation of *Microcystis* blooms around 1999 in the Delta was probably not associated with changes in nutrient concentrations or their ratios. However, as with all

phytoplankton blooms, once initiated, cyanoHABs cannot persist without an ample supply of nutrients. It is important to keep in mind that while nutrient reduction may not limit the onset or frequency of bloom occurrence, it will limit bloom duration, intensity and possibly also geographical extent. If, in the future, nutrient concentrations were to decrease to the point where they start to limit phytoplankton biomass, then the magnitude of the nutrient pool, as well as seasonal changes in the magnitude, would impact cyanoHAB concentration, distribution and bloom duration.

Interestingly, the long-term record for station D26 demonstrates that a decline in Chl *a* and corresponding increases in nitrogen concentrations (NH_4^+ and NO_3^-) and N:P ratios occurred in the period from 1985-1994 (Appendix A). Jassby (2008) reported similar changes in Chl *a* (decrease) and nitrogen (increase) at Central Delta Stations D16 and D28 between the years 1985 and 1994. Van Nieuwenhuyse (2007) hypothesized that the changes in N:P ratios and Chl *a* were driven by a decrease in phosphorus loadings to the Sacramento River that occurred in 1994; however the step change in P loading that year does not explain the gradual decrease in Chl *a* that started prior to 1994 (Appendix A).

Gradual decreases in Chl *a* concentrations may have been brought about by relative changes in flow and benthic grazing, leading to a new and lower Chl *a* equlibrium by the mid-1990's (Lucas and Thompson 2012). According to Lucas and Thompson (2012) the areas of the Delta where benthic grazing typically overwhelms phytoplankton growth rates are the same as those where *Microcystis* tends to bloom (Figure 4.1; Lehman *et al.* 2005). Because *Microcystis* floats at the very surface, it may avoid being grazed by clams in contrast with other phytoplankton that are distributed throughout the water column. It's important to bear in mind that large-scale (temporal and spatial) variation in environmental factors such as flow and grazing by clams may have a more profound impact on phytoplankton standing stocks, and competition among different phytoplankton taxa, compared with many of the autecological adaptations discussed in this review.

5.2 Summary

In the review of the global literature on factors influencing cyanobacterial blooms and toxin production, five principal drivers emerged as important determinants:

1) Water temperatures above 19°C
2) High irradiance and water clarity
3) Availability of N and P in non-limiting amounts; scientific consensus is lacking on the importance of N:P ratios and nutrient forms (e.g. ammonium) as a driver for cyanoHABs
4) Long residence times and stratified water column
5) Low salinity (<10 ppt) waters

Comprehensive understanding of the role of nutrients vis-à-vis other environmental factors in influencing cyanoHAB presence in the Delta is severely hampered by the lack of a routine monitoring program. The DWR monitoring program currently measures many of the environmental factors of interest, except cyanobacterial abundance and toxin concentration, which require a different approach than that used in standard phytoplankton monitoring. Drawing on the five factors influencing cyanoHABs, we can conclude the following:

- Because of the large effects of temperature and irradiance on accelerating, and decelerating, the growth rates of cyanoHABs, these two factors appear to exert key roles in the regulation of the onset of blooms. Cyanobacteria require temperatures above 20°C for growth rates to be competitive with eukaryotic phytoplankton taxa, and above 25°C for growth rates to be competitive with diatoms (Table 5.1). In addition, they require relatively high irradiance to grow at maximal growth rates. This is in contrast with diatoms that are able to keep near-maximal growth rates at irradiances limiting to cyanoHABs in the Delta, e.g., 50 µmol phot m^{-2} s^{-1} (Table 5.1).
- It appears that N and P are available in non-limiting amounts in the Delta; moreover concentrations, or ratios, do not change sufficiently from year-to-year to explain year-to-year variation in Microcystis biomass or occurrence. Therefore, the initiation of *Microcystis* blooms and other cyanoHABs are probably not associated with changes in nutrient concentrations or their ratios in the Delta. However, as with all phytoplankton blooms, once initiated, cyanoHABs cannot persist without an ample supply of nutrients. As long as temperatures, flow rates and irradiance remain favorable for growth, the size of the nutrient pool will determine the magnitude and extent of cyanoHAB blooms.
- Salinity is controlling the oceanward extent of cyanobacterial blooms in the Delta, but salinity gradients do not explain the spatial distribution of cyanoHABs in the Delta (Table 5.1). Notably, salinity regime is not a barrier to toxin transport, as cyanotoxins have been detected in San Francisco Bay.
- Higher flows, turbidity and lower temperatures during most of the year are likely restricting cyanobacterial blooms to the July-August time period.

Climate change and anthropogenic activity associated with land use changes have the potential to alter cyanoHAB prevalence in the future. Climate change will likely result in warmer temperatures and increased drought, the latter of which could result in reduced flows, increased residence time and water column stability leading to higher light availability in the Delta. Both higher temperatures and reduced flows would presumably result in a greater prevalence of cyanoHABs. It's noteworthy that phytoplankton biomass and primary productivity are depressed relative to available nutrients in the Delta, so it's unclear what the effect of modifying nutrient loads will have on frequency and intensity of cyanoHAB occurrence in the future.

Table 5.1. Summary of general physiological drivers of cyanobacterial growth, how they are manifested in population growth and competition with diatoms, and how they compare with environmental drivers observed to be operating in the Delta.

Physiological Driver	Population Driver	Observations in the Delta
Growth significantly slower below 20°C, and greater above 25°C, compared with eukaryotic phytoplankton taxa	Requires temperatures above 25°C for growth rates to be competitive with diatoms	Not observed at temperatures <19°C
Cyanobacteria have greater cellular N:P ratios than diatoms due to two light harvesting systems and peptide toxin production	At non-limiting nutrient concentrations, changes in ratios of nitrogen substrates or N:P does not affect competition among species or taxa	Nutrient concentrations, nitrogen speciation, and dissolved N:P ratios have not changed in the Delta over the last 25 years
Production of bioactive peptide compounds (toxic and non-toxic) results in high N demand of cells	Toxin production per cell is greatest at maximal growth rates; linked with external N concentrations and decrease at N limiting conditions; cyanoHABs do not secrete toxin	Inorganic N and P concentrations are at non-limiting concentrations for growth and toxin production; Variation in toxin produced per cell or in number of toxigenic vs non-toxigenic strains is not related to any specific environmental condition
Inefficient photosynthesis, low alpha; efficient at dissipating excess light energy via high concentration of carotenoid pigments in photosystems (*Microcystis*, *Anabaena* and *Aphanizomenon*)	CyanoHABs (*Microcystis*, *Anabaena* and *Aphanizomenon*) require high irradiance to grow; diatoms able to keep near-maximal growth rates at irradiances limiting to cyanoHABs (e.g. 50 µmol phot m^{-2} s^{-1})	High rate of water flow and mixing most of the growing season restricting blooms to low-flow periods (July-August), when turbidity is < 50 NTU, flow is <30 m^3 s^{-1} and irradiance > 50 µmol phot m^{-2} s^{-1} (Central Delta 2004-2008)
Growth optimal at salinities <10 ppt for most cyanoHAB species	CyanoHABs generally restricted to freshwater habitats and estuaries with salinities <10 ppt (Baltic Sea, San Francisco Delta, North Carolina)	Does not proliferate outside the Delta in the Sacramento River (freshwater) or Suisun Bay (mesohaline) suggesting that the primary agent restricting its spread is not salinity

6.0 RECOMMENDATIONS

The goal of this review is to synthesize available information to provide insight into cyanobacterial bloom occurrence in the Delta. The review has three major objectives:

1) Provide a basic review of biological and ecological factors that influence the prevalence of cyanobacteria and the production of cyanotoxins;
2) Summarize observations of cyanobacterial blooms and associated toxins in the Delta;
3) Synthesize literature to provide an understanding of what ecological factors, including nutrients, may be at play in promoting cyanobacterial blooms in the Delta.

This review found that the lack of a routine monitoring of cyanoHAB occurrence in the Delta greatly hindered our ability to summarize, with confidence, the status and trends of cyanoHABs in the Delta (Objective 2), and to what extent nutrients versus other factors were controlling their occurrence (Objective 3). Given this finding, our recommendations are focused on two principal actions:

1) Strengthening routine monitoring; and
2) Development and use of an ecosystem model, coupled with routine monitoring and special studies, to 1) understand controls on primary productivity and phytoplankton assemblage in the Delta and 2) test hypotheses regarding factors promoting or curtailing growth of cyanobacteria.

R1: Implement Routine Monitoring of CyanoHABs

DWR is currently conducting a monitoring program that routinely samples many of the variables of interest known to influence cyanoHABs. Comprehensive cyanoHAB monitoring should be added as a component to this program to fully evaluate risk to human and aquatic health as well as better understand linkages to factors that may be promoting or maintainting blooms.
To begin, a work plan should be developed which specifically scopes the needed changes in the program to comprehensively monitor cyanoHABs. Monitoring should include enumeration of major cyanobacterial species (e.g. *Microcystis*, *Aphanizomenon* and *Anabaena*). Sampling of toxins should include water column concentrations as well as mussel tissue concentrations or other important taxa that represent sentinels for bioaccumulation in the food web. Analyses of toxin concentrations should be expanded to include the six major cyanotoxins of concern identified in the OEHHA guidance in year 1 then adjusted based on the most commonly encountered toxins thereafter. In addition, selective sampling for analysis of concentrations of herbicides and fungicides commonly encountered in the Delta should be considered. The workplan should also consider monitoring needed to develop and calibrate an ecosystem model to further investigate controls on primary productivity and phytoplankton assemblage (see R2 below).

After an initial period of 3-5 years, the monitoring data should be used to comprehensively report on the status and trends of cyanoHABs and the factors that favor bloom occurrence in the Delta.

R2: Develop an Ecosystem Model of Phytoplankton Primary Productivity and HAB Occurrences to further Inform Future Risk and Hypotheses on Factors Controlling CyanoHABs

The Delta is at an advantage with respect to management of cyanoHABs in that naturally occurring high rates of flow and turbulence act to keep cyanobacteria in check. Despite this, future increases in temperature and residence time associated with climate change, increasing the degree and duration of stratification events, may substantially degrade the effectiveness of the Delta's breaking mechanism and increase the risk of cyanoHAB occurrences. Because nutrients are not currently limiting cyanobacterial blooms, it is critical that an improved understanding is gained of the factors that are controlling phytoplankton primary productivity in the Delta, since a relaxation of those factors followed by increased growth of phytoplankton could lead to increased risk of cyanoHABs.

To inform management actions moving into the future, an ecosystem model of phytoplankton primary productivity and HAB occurrences should be developed. This model should have the capability to provide information on primary productivity and biomass as well as planktonic food quality and transfer of carbon to higher trophic levels. Moreover, such a model could be used to assess the relative importance of environmental factors such as benthic grazing, flow, water column stability, temperature, to mention a few, at various times and locations in the Delta, on cyanobacterial growth. To step into model development, four steps should be taken: 1) examine existing models already available to determine suitability for this task, 2) utilize existing data from the Central Delta to explore, to the extent possible, the relationships between Chl *a*, phytoplankton composition, climate variables and other factors at stations where cyanoHABs are known to occur (e.g. D26, D28 and turning basin in the Stockton Shipping Channel). 3) Develop hypotheses regarding the environmental conditions in those areas that promote cyanoHABs. In addition, develop hypotheses regarding conditions needed to curtail cyanoHABs; including the effect of reducing nutrient loads on the entire phytoplankton community (including cyanobacteria) and on the transfer of carbon to higher trophic levels. These hypotheses can subsequently be tested through model development as well as potential future scenarios, and 4) a work plan should be developed that lays out the modeling strategy, model data requirements, and implementation strategy.

7.0 LITERATURE CITED

Acuna, S., D. Baxa and S. Teh. 2012a. Sublethal dietary effects of microcystin producing *Microcystis* on threadfin shad, Dorosoma petenense. *Toxicon* 60:1191-1202.

Acuna, S., D.F. Deng, P. Lehman and S. Teh. 2012b. Sublethal dietary effects of *Microcystis* on Sacramento splittail, *Pogonichthys macrolepidotus*. *Aquatic Toxicology* 110-111:1-8.

Ahn, C.Y., H.M. Oh and Y.S. Park. 2011. Evaluation of environmental factors on cyanobacterial bloom in eutrophic reservoir using artificial neural networks. *Journal of Phycology* 47:495-504.

Alexova, R., M. Fujii, D. Birch, J. Cheng, T.D. Waite, B.C. Ferrari and B.A. Neilan. 2011. Iron uptake and toxin synthesis in the bloom-forming *Microcystis aeruginosa* under iron limitation. *Environmental Microbiology* 13:1064-1077.

Arrigo, K.R., D.H. Robinson, D.L. Worthen, R.B. Dunbar, G.R. DiTullio, M. VanWoert and M.P. Lizotte. 1999. Phytoplankton community structure and the drawdown of nutrients and CO_2 in the Southern Ocean. *Science* 283:265-367.

Babica, P., L. Blaha and B. Marsalek. 2006. Exploring the natural role of microcystin – a review of effects on photoautotrophic organisms. *Journal of Phycology* 42:9-20.

Baker, P.D. 1999. Role of akinetes in the development of cyanobacterial populations in the lower Murray River, Australia. *Marine & Freshwater Research* 50:265-279.

Baker, P.D. and D. Bellifermine. 2000. Environmental influences on akinete germination of *Anabaena circinalis* and implications for management of cyanobacterial blooms. *Hydrobiologia* 427:65-73.

Baxa, D., T. Kurobe, K.A. Ger, P.W. Lehman and S.J. Teh. 2010. Estimating the abundance of toxic *Microcystis* in the San Francisco Estuary using quantitative real-time PCR. *Harmful Algae* 9:342-349.

Beard, S.J., B.A. Handley, P.K. Hayes and A.E. Walsby. 1999. The diversity of gas vesicle genes in *Planktothrix rubescens* from Lake Zurich. *Microbiology* 145:2757-2768.

Becher, P.G., J. Beuchat, K. Gademann and F. Juttner. 2005. Nostocarboline: isolation and synthesis of a new cholinesterase inhibitor from *Nostoc* 78-12A. *Journal of Natural Products* 68:1793-1795.

Berg, G.M., P.M. Glibert, N.O.G. Jorgensen, M. Balode and I. Purina. 2001. Variability in inorganic and organic nitrogen uptake associated with riverine nutrient input in the Gulf of Riga, Baltic Sea. *Estuaries* 24:204-214.

Berg, G.M., M. Balode, I. Purina, S. Bekere, C. Bechemin and S.Y. Maestrini. 2003. Plankton community composition in relation to availability and uptake of oxidized and reduced nitrogen. *Aquatic Microbial Ecology* 30:263-274.

Berg, G.M., J. Shrager, G. van Dijken, M.M. Mills, K.R. Arrigo and A.R. Grossman. 2011. Responses of *psbA*, *hli*, and *ptox* genes to changes in irradiance in marine *Synechococcus* and *Prochlorococcus*. *Aquatic Microbial Ecology* 65:1-14.

Berman, T. and S. Chava. 1999. Algal growth on organic compounds as nitrogen sources. *Journal of Plankton Research* 21:1423-1437.

Berry, J.P., M. Gantar, M.H. Perez, G. Berry and F.G. Noriega. 2008. Cyanobacterial toxins as allelochemicals with potential applications as algicides, herbicides and insecticides. *Marine Drugs* 6:117-146.

Boison, G., C. Steingen, L.J. Stal and H. Bothe. 2006. The rice field cyanobacteria *Anabaena azotica* and *Anabaena* sp. CH1 express vanadium-dependent nitrogenase. *Archives of Microbiology* 186:367-376.

Bolmstedt, A.J., B.R. O'Keefe, R.S. Shenoy, J.B. Memahon and M.R. Boyd. 2001. Cyanoviridin-N defines a new class of antiviral agent targeting N-linked, high-mannose glycans in an oligosaccharide-specific manner. *Molecular Pharmacology* 59:949-954.

Borner, T. and E. Dittmann. 2005. Molecular biology of cyanobacterial toxins. pp. 25-40 *in*: J. Huisman, H.C.P. Matthijs and P.M. Visser (eds.), Harmful Cyanobacteria. Springer. New York, NY.

Boyd, M.R., K.R. Gustafson, J.B. McMahon, R.H. Shoemaker, B.R. O'Keefe, T. Mori, R.J. Gulakowski, L. Wu, M.I. Rivera, C.M. Laurencot, M.J. Currens, J.H. Cardellina, R.W. Buckheit, Jr., P.L. Nara, L.K. Pannell, R.C. Sowder and L.E. Hendersong . 1997. Discovery of cyanovirin-N, a novel human immunodeficiency virus-inactivating protein that binds viral surface envelope glycoprotein gp 120: potential applications to microbicide development. *Antimicrobial Agents Chemotheraphy* 42:1521-1530.

Boyd, P.W., T.A. Rynearson, E.A. Armstrong, F. Fu, K. Hayashi, Z. Hu, D.A. Hutchins, R.M. Kudela, E. Litchman, M.R. Mulholland, U. Passow, R.F. Strzepek, K.A. Whittaker, E. Yu and M.K. Thomas. 2013. Marine phytoplankton temperature versus growth responses from polar to tropical waters – outcome of a scientific community-wide study. *PLoS ONE* 8(5): e63091 doi:10.1371/journal.pone.0063091.

Bourne, D.G., G.J. Jones, R.L. Blakely, A. Jones, A.P. Negri and P. Riddles. 1996. Enzymatic pathway for the bacterial degradation of the cyanobacterial cyclic peptide toxin microcystin LR. *Applied Environmental Microbiology* 62:4086-4094.

Bourne, D.G., P. Riddles, G.J. Jones, W. Smith, R.L. Blakely. 2001. Characterisation of a gene cluster involved in bacterial degradation of the cyanobacterial toxin microcystin LR. *Environmental Toxicology* 16:523-524.

Breitbarth, E., A. Oschlies and J. LaRoche. 2007. Physiological constraints on the global distribution of *Trichodesmium* – effect of temperature on diazotrophy. *Biogeosciences* 4:53-61.

Briand, J.F., C. Leboulanger, J.F. Humbert, C. Bernard and P. Dufour. 2004. *Cylindrospermopsis raciborskii* (cyanobacteria) invasion at mid-latitudes: selection, wide physiological tolerance, or global warming. *Journal of Phycology* 40:231-238.

Brookes, J.D. and G.G. Ganf. 2001. Variations in the buoyancy response of *Microcystis aeruginosa* to nitrogen, phosphorus and light. *Journal of Plankton Research* 23:1399-1411.

Brookes, J.D., G.G. Ganf, D. Green and J. Whittington. 1999. The influence of light and nutrients on buoyancy, filament aggregation and flotation of *Anabaena circinalis*. *Journal of Plankton Research* 21:327-341.

Brooks, M.L., E. Fleishman, L.R. Brown, P.W. Lehman, I. Werner, N. Scholz, C. Mitchelmore, J.R. Lovvorn, M.L. Johnson, D. Schlenk, S. van Drunick, J.I. Drever, D.M. Stoms, A.E. Parker and R. Dugdale. 2011. Life histories, salinity zones, and sublethal contributions of contaminants to pelagic fish declines illustrated with a case study of San Francisco Estuary, California, USA. *Estuaries and Coasts* DOI 10.1007/s12237-011-9459-6.

Burford, M.A., K.L. McNeale and F.J. McKenzie-Smith FJ 2006. The role of nitrogen in promoting *Cylindrospermopsis raciborskii* in a subtropical water reservoir. *Freshwater Biology* 51:2143-2153.

Burford, M.A. and M.J. O'Donohue. 2006. A comparison of phytoplankton community assemblages in artificial and naturally mixed subtropical water reservoirs. *Freshwater Biology* 51:973-982.

Burns, W.C. 1987. Insights into zooplankton-cyanobacteria interactions derived from enclosure studies. *New Zealand Journal of Marine and Freshwater Research* 21:477-482.

Butterwick, C., S.I. Heaney and J.F. Talling. 2005. Diversity in the influence of temperature on the growth rates of freshwater algae, and its ecological relevance. *Freshwater Biology* 50:291-300.

Cardellina, J.H., F.J. Marner and R.E. Moore. 1979. Seaweed dermatitis, structure of lyngbyatoxin-A. *Science* 204:193-195.

Carey, C.C., B.W. Ibelings, E.P. Hoffmann, D.P. Hamilton and J.D. Brookes. 2012. Eco-physiological adaptations that favour freshwater cyanobacteria in a changing climate. *Water Research* 46:1394-1407.

Carmichael, W.W. 2008. A world overview one-hundred-twenty seven years of research on toxic cyanobacteria – Where do we go from here? *in*: H.K.Hudnell (ed.), Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs. Advances in Experimental Medicine & Biology, 619. Springer. New York, NY.

Carmichael, W.W., N.A. Mahmood and E.G. Hyde. 1990. Natural toxins from cyanobacteria (blue-green algae). pp. 87-106 *in*: S. Hall and G. Strichartz (eds.), Marine Toxins, Origin, Structure and Molecular Pharmacology, vol. 418. American Chemical Society USA. Boston, MA.

Chapman, A.D. and C.L. Schelske. 1997. Recent appearance of *Cylindrospermopsis* (Cyanobacteria) in five hypereutrophic Florida lakes. *Journal of Phycology* 33:191-195.

Cheung, M.Y., S. Liang and J. Lee. 2013. Toxin-producing cyanobacteria in freshwater: a review of the problems, impact on drinking water safety, and efforts for protecting public health. *Journal of Microbiology* 51:1-10.

Chorus, I. and J. Bartram. 1999. Toxic Cyanobacteria in Waters: a Guide to Public Health. Significance, Monitoring and Management, London: The World Health Organiziation E and FN Spon.

Christiansen, G., J. Fastner, M. Erhard, T. Borner and E. Dittmann. 2003. Microcystin biosynthesis in *Planktothrix*: genes, evolution, and manipulation. *Journal of Bacteriology* 185:564-572.

Christoffersen, K., S. Lyck and A. Winding. 2002. Microbial activity and bacterial community structure during degradation of microcystins. *Aquatic Microbial Ecology* 27:125-136.

Cloern, J.E., A.D. Jassby, J.K. Thompson and K.A. Hieb. 2007. A cold phase of the East Pacific triggers new phytoplankton blooms in San Francisco Bay. *Proceedings of the National Academy of Sciences USA* 104:18561-18565.

Collier, J.L. and A.R. Grossman. 1994. A small polypeptide triggers complete degradation of light-harvesting phycobiliproteins in nutrient-deprived cyanobacteria. *The EMBO Journal* 13:1039-1047.

Collier, J.L., B. Brahamsha and B. Palenik. 1999. The marine cyanobacterium *Synechococcus* sp. WH7805 requires urease (urea amidohydrolase, EC 3.5.1.5) to utilize urea as a nitrogen source: molecular-genetic and biochemical analysis of the enzyme. *Microbiology* 145:447-459.

Conley, D.J., H.W. Paerl and R.W. Howarth, D.F. Boesch S.P. Seitzinger, K.E. Havens, C. Lancelot and G.E. Likens 2009. Controlling eutrophication: nitrogen phosphorus. *Science* 323:1014-1015.

Cox, P.A., S.A. Banack, S.J. Murch, *et al.* 2005. Diverse taxa of cyanobacteria produce b-N-methylamino-L-alanine, a neurotoxic amino acid. *Proceedings of the National Academy of Sciences USA* 102:5074-5078.

Davidson, K., R.J. Gowen, P. Tett, E. Bresnan, P.J. Harrison, A. McKinney, S. Milligan, D.K. Mills, J. Silke and A.M. Crooks. 2012. Harmful algal blooms: how strong is the evidence that

nutrient ratios and forms influence their occurrence? *Estuarine, Coastal and Shelf Science* 115:339-413.

Davis, T.W., M.J. Harke, M.A. Marcoval, J. Goleski, C. Orano-Dawson, D.L. Berry and C.J. Gobler. 2010. Effects of nitrogenous compounds and phosphorus on the growth of toxic and non-toxic strains of *Microcystis* during bloom events. *Aquatic Microbial Ecology* 61:149-162.

Deng, D.F., K. Zheng, F.C. Teh, P.W. Lehman and S.J. Teh. 2010. Toxic threshold of dietary microcystin (-LR) for quart medaka. *Toxicon* 55:787-794.

DeRuyter, Y.S. and P. Fromme. 2008. Molecular structure of the photosynthetic apparatus. pp. 217-269 *in*: A. Herrero and E. Flores (eds.), The Cyanobacteria Molecular Biology, Genomics and Evolution. Caister Academic Press. Norfolk, UK.

Devlin, J.P., O.E. Edwards, P.R. Gorham, M.R. Hunter, R.K. Pike and B. Stavric. 1977. Anatoxin-a, a toxic alkaloid from *Anabaena flos-aquae* NCR-44h. *Canadian Journal of Chemistry* 55:1367-1371.

Dodds WK, Bouska WW, Eitzmann JI et al. (2009) Eutrophication of U.S. freshwaters: Analysis of potential economic damages. Environ Sci Technol 43:12-19

Dolman, A.M., J. Rucker, F.R. Pick, J. Fastner, T. Rohrlack, U. Mischke and C. Wiedner. 2012. Cyanobacteria and cyanotoxins: the influence of nitrogen versus phosphorus. *PLoS ONE* 7(6):e38757. doi:10.1371/journal.one.0038757.

Downing, T.G., C.S. Sember, M.M. Gehringer and W. Leukes. 2005. Medium N:P ratios and specific growth rate comodulate microcystin and protein content in *Microcystis aeruginosa* PCC7806 and *M. aeruginosa* UV027. *Microbial Ecology* 49:468-473.

Downing, J.A., S.B. Watson and E. McCauley. 2001. Predicting cyanobacteria dominance in lakes. *Canadian Journal of Fisheries and Aquatic Sciences* 58:1905-1908.

Droop, M.R. 1974. The nutrient status of algal cells in continuous culture. *Journal of the Marine Biological Association of the United Kingdom* 55:541-555.

Dyble, J., P.A. Tester and R.W. Litaker. 2006. Effects of light intensity on cylindrospermopsin production in the cyanobacterial HAB species *Cylindrospermopsis raciborskii*. *African Journal of Marine Science* 28:309-312.

Echols, K.R., R.W. Gale, T.R. Schwartz, J.N. Huckins, L.L. Williams, J.C. Meadows, D. Morse, J.D. Petty, C.E. Orazio and D.E. Tillitt. 2000. Comparing Polychlorinated Biphenyl Concentrations and patterns in the Saginaw River using sediment, caged fish, and semipermeable membrane devices. *Environmental Science & Technology* 34:4095-4102.

Edmondson, W.R. and J.T. Lehman. 1981. The effect of changes in the nutrient income on the condition of Lake Washington. *Limnology and Oceanography* 26:1-29.

Elliott, J.A. 2010. The seasonal sensitivity of cyanobacteria and other phytoplankton to changes in flushing rate and water temperature. *Global Change Biology* 16:864-876.

Elmgren, R. and U. Larsson. 2001. Nitrogen and the Baltic Sea: managing nitrogen in relation to phosphorus. *The Scientific World* (1S2):371-377.

Elrifi, I.R. and D.H. Turpin. 1985. Steady-state luxury consumption and the concept of optimum nutrient ratios: a study with phosphate and nitrate limited *Selenastrum minutum* Chlorophyta). *Journal of Phycology* 21:592-602.

Elser JJ, Sterner RW, Gorokhova E et al. (2000) Biological stoichiometry from genes to ecosystems. *Ecological Letters* 3:540-550

Falkowski, P.G. 2000. Rationalizing elemental ratios in unicellular algae. *Journal of Phycology* 36:3-6.

Falkowski P.G. and J. LaRoche. 1991. Acclimation to spectral irradiance in algae. *Journal of Phycology* 27:8-14.

Findlay, D.L., R.E. Hecky, L.L. Hendzel, M.P. Stainton and G.W. Regehr. 1994. Relationships beween N2-fixation and heterocyst abundance and its relevance to the nitrogen budget of Lake 227. *Canadian Journal of Fisheries and Aquatic Sciences* S1:2254-2266.

Flores, E. and A. Herrero. 1994. Assimilatory nitrogen metabolism and its regulation. pp. 488-517 *in*: D.A. Bryant (ed.), The Molecular Biology of Cyanobacteria. Kluwe Academic Publishers. New York, NY.

Flores, E. and A. Herrero. 2005. Nitrogen assimilation and nitrogen control in cyanobacteria. *Biochemical Society Transactions*s 33:164-167.

Flores, E. and C.P. Worlk. 1986. Production, by filamentous, nitrogen-fixing cyanobacteria, of a bacteriocin and of other antibiotics that kill related strains. *Archives of Microbiology* 145:215-219.

Flores, E., J.E. Frias, L.M. Rubio and A. Herrero. 2005. Photosynthetic nitrate assimilation in cyanobacteria. *Photosynthesis Research* 83:117-133.

Forchammer, K. 2004. Global carbon/nitrogen control by PII signal transduction in cyanobacteria: from signals to targets. *FEMS Microbiology Reviews* 28:319-333.

Frederiksson, C. and B. Bergman. 1997. Ultrastructural characterization of cells specialized for nitrogen fixation in a non-heterocystous cyanobacterium, Trichodesmium spp. *Protoplasma* 197:76-85.

Frias, J.E., E. Flores and A. Herrero. 1994. Requirement of the regulatory protein NtcA for the expression of nitrogen assimilation and heterocyst development genes in the cyanobacterium Anabaena sp. PC 7120 *Molecular Microbiology* 14:823-832.

Fromme, P., P. Jordan and N. Krauss. 2001. Structure of photosystem I. *Biochimica et Biophysica Acta* 1507 5-31.

Fromme, P., J. Kern, B. Loll, J. Biersiadka, W. Saenger, H.T. Witt, N. Krauss and A. Zouni. 2002. Functional implications on the mechanism of the function of photosystem II including water oxidation based on the structure of Photosystem II. *Philosophical Transactions of the Royal Society of London. Series B-Biological Sciences* 357:1337-1344.

Fujiki, H., M. Suganuma, H. Suguri *et al.* 1990. New tumor promoters from marine natural products. pp. 232-240 *in*: S. Hall and G. Strichartz (eds.), Marine Toxins, Origin, Structure and Molecular Pharmacology, vol. 418. American Chemical Society USA. Boston, MA.

Garcia-Fernandez, J.M., N. Tandeau De Marsac and J. Diez. 2004. Streamlined regulation and gene loss as adaptive mechanisms in Prochlorococcus for optimized nitrogen utilization in oligotrohpic environments. *Microbiology and Molecular Biology Reviews* 68:630-638.

Geider, R. and J. La Roche. 2002. Redfield revisited: variability of C:N:P in marine microalgae and its biochemical basis. *European Journal of Phycology* 37:1-17.

Gerbersdorf, S.U. 2006. An advanced technique for immuno-labelling of microcystins in cryosectioned cells of Microcystis aeruginosa PCC 7806 (cyanobacteria): Implementations of an experiment with varying light scenarios and culture densities. *Toxicon* 47:218-228.

Ger, K.A., S.J. Teh, D.V. Baxa, S. Lesmeister and C.R. Goldman. 2010. The effect of dietary Microcystis aeruginosa and microcystin on the copepods of the upper San Francisco Estuary. *Freshwater Biology* doi:10.1111/j.1365-2427.2009.02367.x.

Gibble, C.M. and R.M. Kudela. 2014. Detection of persistent microcystin toxins at the land-sea interface in Monterey Bay, California. *Harmful Algae* 39:146-153.

Gilbert, J.J. 1996. Effect of temperature on the response of planktonic rotifers to a toxic cyanobacterium. *Ecology* 77:1174-1180.

Glibert, P.M., D. Fullerton, J.M. Burkholder, J.C. Cornwell and T.M. Kana. 2011. Ecological stoichiometry, biogeochemical cycling, invasive species, and aquatic food webs: San Francisco Estuary and comparative systems. *Reviews in Fisheries Science* 19:358-417.

Gille, S.T. 2002. Warming of the Southern ocean since the 1950s. *Science* 295:1275-1277.

Gobler, C.J., Davis, T.W., Coyne, K.J., and G.L. Boyer. 2007. The interactive influences of nutrient loading and zooplankton grazing on the growth and toxicity of cyanobacteria blooms in a eutrophic lake. *Harmful Algae* 6, 119–133.

Grossman, A.R. 2003. A molecular understanding of complementary chromatic adaptation. *Photosynthesis Research* 76:207-215.

Grossman, A.R., M.R. Schaefer, G.G. Chiang and J.L. Collier. 1993. The phycobilisome, a light-harvesting complex responsive to environmental conditions. *Microbiology Reviews* 57:725-749.

Grossman, A.R., D. Bhaya and Q. He. 2001. Tracking the light environment by cyanobacteria and the dynamic nature of light harvesting. *Journal of Biological Chemistry* 276:11449-11452.

Hansen, J., L. Nazaernko, R. Ruedy, M. Sato, J. Willis, A. Del Genio, D. Koch, A. Lacis, K. Lo, S. Menon, T. Novakav, J. Perlwitz, G. Russell, G.A. Schmidt and N. Tausnev. 2005. Earth's energy imbalance: confirmation and implications. *Science* 308:1431-1435.

Havens, K.E. 2008. Cyanobacteria blooms: effects on aquatic ecosys- tems. Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs, EPA, Adv. Exp. Med. Biol. 619, Springer Press, NY Chapter 33:733-747.

Hawkins, P.R., E. Putt, I. Falconer and A. Humpage. 2001. Phenotypical variation in a toxic strain of the phytoplankter *Cylindrospermopsis raciborskii* (Nostocales, Cyanophyceae) during batch culture. *Environmental Toxicology* 16:460-467.

Herrero, A. and E. Flores. 1990. Transport of basic amino acids by the dinitrogen-fixing cyanobacerium *Anabaena* PCC 7120. *Journal of Biological Chemistry* 265:3931-3935.

Herrero, A., A.M. Muro-Pastor and E. Flores. 2001. Nitrogen control in cyanobacteria. *Journal of Bacteriology* 183:411-425.

Herrero, A., A.M. Muro-Pastor, A. Valladares and E. Flores. 2004. Cellular differentiation and the NtcA transcription factor in filamentous cyanobacteria. *FEMS Microbiology Reviews* 28:469-487.

Hillebrand H, Steinert G, Boersma M, Malzahn A, Meunier CL, Plum C, Ptacnik R 2013. Goldman revisited: faster-growing phytoplankton has lower N:P and lower stoichiometric flexibility. *Limnology and Oceanography* 58:2076-2088.

Ho, T.Y., A. Quigg, Z.V. Finkel, A.J. Milligan, K. Wyman, P.G. Falkowski and M.M. Morel. 2003. The elemental composition of some marine phytoplankton. *Journal of Phycology* 39:1145-1159

Holland, A. and S. Kinnear. 2013. Interpreting the possible ecological role(s) of cyanotoxins: compounds for competitive advantage and/or physiological aide? *Marine Drugs* 11:2239-2258.

Hong, Y.A., R.R. Jonker, A. Inman, B. Biddanda, R. Rediske and G. Fahnenstiel. 2006. Occurrence of the toxin-producing cyanobacterium *Cylindrospermospsis raciborskii* in Mona and Muskegon Lakes, Michigan. *Journal of Great Lakes Research* 32:645-652.

Howard A, Irish AE, Reynolds CS. 1996. A new simulation of cyanobacterial underwater movement (SCUM′96). *Journal of Plankton Research* 18: 1373–1385.

Huber, V., C. Wagner, D. Gerten and R. Adrian. 2012. To bloom or not to bloom: contrasting responses of cyanobacteria to recent heat waves explained by critical thresholds of abiotic drivers. *Oecologia* 169:245-256.

Hudnell, H.K. (ed.). 2008. Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs. Advances in Experimental Medicine & Biology, 619. Springer. New York, NY.

Hudnell, H.K. 2010. The state of U.S. freshwater harmful algal blooms assessments, policy and legislation. *Toxicon* 55:1024-1034.

Huisman, J., R.R. Jonker, C. Zonneveld and F.J. Weissing. 1999. Competition for light between phytoplankton species: experimental tests of mechanistic theory. *Ecology* 80:211-222.

Huisman, J., J. Sharples, J.M. Stroom, P.M. Visser, W.E.A. Kardinaal, J.M.H. Verspagen and B. Sommeijer. 2004. Changes in turbulent mixing shift competition for light between phytoplankton species. *Ecology* 85:2960-2970.

Jacoby, J.M., Collier, D.C., Welch, E.B., Hardy, F.J., and M. Crayton,. 2000. Environmental factors associated with a toxic bloom of *Microcystis aeruginosa*. *Can. J. Fish. Aquat. Sci*. 57, 231–240.

Jassby, A. 2008. Phytoplankton in the upper San Francisco Estuary: Recent biomass trends, their causes and their trophic significance. *San Francisco Estuary and Watershed Science* 6(1) https://escholarship.org/uc/item/71h077r1.

Jeppesen, E., B. Kronvang, M. Meerhoff, M. Sondergaard, K.M. Hansen, H.E. Andersen, T.L. Lauridsen, L. Liboriussen, M. Beklioglu, A. Ozen and J.E. Olesen. 2007. Climate change effects on runoff, catchment phosphorus loading and lake ecological state, and potential adaptations. *Journal of Environmental Quality* 38:1930-1941.

Jessup D.A., Miller M.A., Ryan J.P. et al. 2009. Mass stranding of marine birds caused by a surfactant-producing Red Tide. PLoS One 4(2): e4550. doi:10.1371/journal.pone.0004550

Jones, G.J., D.G. Bourne, R.L. Blakely and H. Coelle. 1994. Degradation of the cyanobacterial hepatotoxin microcystin by aquatic bacteria. *Natural Toxins* 2:228-235.

Jones, G.J. and P.T. Orr. 1994. Release and degradation of microcystin following algicide treatment of a *Microcystis aeruginosa* bloom in a recreational lake, as determined by HPLC and protein phosphatase inhibition assay. *Water Research* 28:871-876.

Kaebernick, M., B.A. Neilan, T. Borner and E. Dittmann. 2000. Light and the transcriptional response of the microcystin gene cluster. *Applied Environmental Microbiology* 66:3387-3392.

Kamennaya N.A. and A.F. Post. 2011. Characterization of cyanate metabolism in marine *Synechococcus and Prochlorococcus* spp. *Applied and Environmental Microbiology* 77:291-301

Kaplan, A. and L. Reinhold. 1999. The CO_2 concentrating mechanisms in photosynthetic microorganisms. *Annual Review of Plant Physiology and Plant Molecular Biology* 50:539-570.

Kaplan-Levy, R.N., O. Hadas, M.L. Summers, J. Rucker and A. Sukenik. 2010. Akinetes: Dormant cells of cyanobacteria. pp. 5-28 *in*: E. Lubzens, J. Cerda and M. Clark (eds.), Dormancy and Resistance in Harsh Environments. Topics in Current Genetics. Vol. 21. Springer-Verlag. Heidelberg, GE.

Karlsson-Elfgren, I., K. Rengefors and S. Gustafsson. 2004. Factors regulating recruitment from the sediment to the water column in the bloom-forming cyanobacterium Gloeotrichia echinulata. *Freshwater Biology* 49:265-273.

Keating, K.I. 1977. Allelopathic influence on blue-green bloom sequence in a eutrophic lake. *Science* 196:885-887.

Keating, K.I. 1978. Blue-green algal inhibition of diatom growth: transition from mesotrophic to eutrophic community structure. Science 199:971-973.

Kellmann, R., T.K. Mihali, Y.J. Jeon, R. Pickford, F. Pomati and B.A. Neilan. 2008. Biosynthetic intermediate analysis and functional homology reveal a saxitoxin gene cluster in cyanobacteria. *Applied Environmental Microbiology* 74:4044-4053.

Kim, B.H., W.S. Lee, Y.O. Kim, H.O. Lee and M.S. Han. 2005. Relationship between akinete germination and vegetative population of *Anabaena flos-aquae* (Nostocales, Cyanobacteria) in Seokchon reservoir (Seoul, Korea). *Archiv fur Hydrobiologie* 163:49-64.

Klausmeier, C.A., E. Litchman, T. Daufresne and S.A. Levin. 2004. Optimal nitrogen-to-phosphorus stoichiometry of phytoplankton. *Nature* 429:171-174.

Klein, D., D. Daloze, J.C. Braekman, L. Hoffmann and V. Demoulin. 1995. New hapaindoles from the cyanophyte *Hapalasiophon laingii*. *Journal of Natural Products* 58:1781-1785.

Klemer, A.R., J. Feuillade and M. Feuillade. 1982. Cyanobacterial blooms: carbon and nitrogen limitation have opposite effects on the buoyancy of *Oscillatoria*. *Science* 2158:1629-1631.

Konopka, A., J. Kromkamp and L.R. Mur. 1987. Regulation of gas vesicle content and buoyancy in light- or phosphate-limited cultures of *Aphanizomenon flos-aquae* (Cyanophyta). *FEMS Microbial Ecology* 45:135-142.

Kudela, R.M. 2011. Characterization and deployment of Solid Phase Adsorption Toxin Tracking (SPATT) resin for monitoring of microcystins in fresh and saltwater. *Harmful Algae* 11:117-125.

Kudo, I., M. Miyamoto, Y. Noiri and Y. Maita. 2000. Combined effects of temperature and iron on the growth and physiology of the marine diatom *Phaeodactylum tricornutum* (Bacillariophyceae). *Journal of Phycology* 36:1096-1102.

Laamanen M, Kuosa H 2005. Annual variability of biomass and heterocysts of the N2-fixing cyanobacterium *Aphanizomenon flos-aquae* in the Baltic Sea with reference to *Anabaena* spp. and *Nodularia spumigena*. *Boreal Environment Research* 10:19-30.

Lee, S.J., M.H. Jang, H.S. Kim, B.D. Yoon and H.M. Oh. 2000. Variation of microcystin content of *Microcystis aeruginosa* relative to medium N:P ratio and growth stage. *Journal of Applied Microbiology* 89:323-329.

Lee, H.M., M.F. Vazquez-Bermudez and N. Tandeau de Marsac. 1999. The global nitrogen regulator NtcA regulates transcription of the signal trasducer PII (GlnB) and influences its phosphorylation level in response to nitrogen and carbon supplies in the cyanobacterium *Synechococcus* sp. strain PCC 7942. *Journal of Bacteriology* 181:2697-2702.

Lehman, P. W. 2007. The influence of phytoplankton community composition on primary productivity along the riverine to freshwater tidal continuum in the San Joaquin River, California. *Estuaries and Coasts* 30: 82-93.

Lehman, P.W. and S. Waller. 2003. Microcystis blooms in the Delta. *IEP Newsletter* 16:18-19.

Lehman, P.W., G. Boyer, C. Hall, S. Waller and K. Gehrts. 2005. Distribution and toxicity of a new colonial *Microcystis aeruginosa* bloom in the San Francisco Bay Estuary, California. *Hydrobiologia* 541:87-99.

Lehman, P.W., G. Boyer, M. Satchwell and S. Waller. 2008. The influence of environmental conditions on the seasonal variation of *Microcystis* cell density and microcystins concentration in San Francisco Estuary. *Hydrobiologia* 600:187-204.

Lehman, P.W., S.J. Teh, G.L. Boyer, M.L. Nobriga, E. Bass and C. Hogle. 2010. Initial impacts of *Microcystis aeruginosa* blooms on the aquatic food web in the San Francisco Estuary. *Hydrobiologia* 637:229-248.

Lehman, P.W., K. Marr, G.L. Boyer, S. Acuna and S.J. Teh. 2013. Long-term trends and causal factors associated with *Microcystis* abundance and toxicity in San Francisco Estuary and implications for climate change impacts. *Hydrobiologia* 718:141-158.

Leonardos, N. and R.J. Geider. 2004. Responses of elemental and biochemical composition of *Chaetoceros muelleri* to growth under varying light and nitrate:phosphate supply ratios and their influence on critical N:P. *Limnology and Oceanography* 49:2105-2114.

Levine, S.N. and W.M. Lewis. 1987. A numerical model of nitrogen fixation and its application to Lake Valencia, Venezuela. *Freshwater Biology*l 17:265-274.

Lewellyn, L.E. 2006. Saxitoxin, a toxic marine natural product that targets a multitude of receptors. *Natural Products Report* 23:200-220.

Likens, G.E., 1972. Eutrophication and aquatic ecosystems. In: Nutrients and Eutrophication: The Limiting-Nutrient Controversy, *Limnology and Oceanography Special Symposium,* vol. 1. pp. 3–13.

Lindell, D. and A.F. Post. 2001. Ecological aspects of *ntcA* gene expression and its use as an indicator of the nitrogen status of marine *Synechococcus* spp. *Applied Environmental Microbiology* 67:3340-3349.

Lindell, D., E. Padan and A.F. Post. 1998. Regulation of *ntcA* expression and nitrite uptake in the marine *Synechococcus* sp. Strain WH7803. *Journal of Bacteriology* 180:1878-1886.

Lindell, D., S. Penno, M. Al-Qutob, E. David, T. Rivlin, B. Lazar and A.F. Post. 2005. Expression of the N-stress response gene *ntcA* reveals N-sufficient *Synechococcus* populations in the oligotrophic northern Red Sea. *Limnology and Oceanography* 50:1932-1944.

Livingstone, D. and G.H.M. Jaworski. 1980. The viability of akinetes of blue-green algae recovered from the sediments of Rostherne Mere. *European Journal of Phycology* 15:357-364.

Lopez, C.B., Jewett, E.B., Dortch, Q., Walton, B.T., Hudnell, H.K. 2008. Scientific Assessment of Freshwater Harmful Algal Blooms. Interagency Working Group on Harmful Algal Blooms, Hypoxia, and Human Health of the Joint Subcommittee on Ocean Science and Technology. Washington, DC.

Lucas, L.V. and J.K. Thompson. 2012. Changing restoration rules: exotic bivalves interact with residence time and depth to control phytoplankton productivity. *Ecosphere* 3(12):117.

Luque, I. and K. Forchammer. 2008. Nitrogen assimilation and C/N sensing. pp 334-382 *in*: A. Herrero and E. Flores (eds.), The Cyanobacteria Molecular Biology, Genomics and Evolution. Caister Academic Press. Norfolk, UK.

Luque, I., E. Flores and A. Herrero. 1994. Molecular mechanisms for the operation of nitrogen control in cyanobacteria. *The EMBO Journal* 13:2862-2869.

Lurling, M., F. Eshetu, E.J. Faassen, S. Kosten and V.M. Huszar. 2013. Comparison of cyanobacterial and green algal growth rates at different temperatures. *Freshwater Biology* 58:552-559.

Lurling, M. and I. Roessink. 2006. On the way to cyanobacterial blooms: Impact of the herbicide metribuzin on the competition between a green alga (*Scenedesmus*) and a cyanobacterium (*Microcystis*). *Chemosphere* 65:618-626.

Lyck, S., N. Gjølme and H. Utkilen. 1996. Iron starvation increases toxicity of *Microcystis aeruginosa* CYA 228/1 (Chroococcales, Cyanophyceae). *Phycologia* 35:120-124.

MacKintosh, C., K.A. Beattie, S. Klumpp, P. Cohen and G.A. Codd. 1990. Cyanobacterial microcystin-LR is a potent and specific inhibitor of protein phosphatase 1 and 2A from both mammals and higher plants. *FEBS Letters* 264:187-192.

Maeda, S.I., M. Okamura, M. Kobayashi and T. Omata. 1998. Nitrite-specific active transport system of the cyanobacterium *Synechococcus* sp. Strain PCC 7942. *Journal of Bacteriology* 180:6761-6763.

Martin-Luna, B., E. Sevilla, J.A. Hernandez, M.T. Bes, M.F. Fillat and M.L. Peleato. 2006. Fur from *Microcystis aeruginosa* binds in vitro promoter regions of the microcystin biosynthesis gene cluster. *Phytocheistry* 67:876-881.

Mbedi, S., M. Welker, J. Fastner and C. Wiedner. 2005. Variability of the microcystin synthetase gene cluster in the genus *Planktothrix* (Oscillatoriales, Cyanobacteria). *FEMS Microbiology Letters* 245:299-306.

McGregor GB, Fabbro LK 2000. Dominance of *Cylindrospermopsis raciborskii* (Nostocales, Cyanoptokaryota) in Queensland trophical and subtropical reservoirs: implications for monitoring and management. *Lakes and Reservoirs: Research and Managemen* 5:195-205.

Mejean, A., R. Mazmouz, S. Mann, A. Calteau, C. Medigue and O. Ploux. 2010. The genome sequence of the cyanobacterium *Oscillatoria* sp. PCC 6506 reveals several gene clusters responsible for the biosynthesis of toxins and secondary metabolites. *Journal of Bacteriology* 192:5264-5265.

Miller, M.M., R.M. Kudela, A. Mekebri, D. Crane, S.C. Oates, M.T. Tinker, M. Staedler, W.A. Miller, S. Toy-Choutka, C. Dominik, D. Hardin, G. Langlois, M. Murray, K. Ward and D.A. Jessup. 2010. Evidence for a novel marine harmful algal bloom: cyanotoxin (microcystin) transfer from land to sea otters. *PLoS ONE* 5(9):e12576. Doi:10.1371/journal.pone.0012576.

Mills, M.M. and K.R. Arrigo. 2010. Magnitude of oceanic nitrogen fixation influenced by the nutrient uptake ratio of phytoplankton. *Nature Geoscience* DOI: 10.1038/NGEO856.

Mioni, C., R. Kudela and D. Baxa. 2012. Harmful cyanobacteria blooms and their toxins in Clear Lake and the Sacramento-San Joaquin Delta (California). Surface Water Ambient Monitoring Program Report 10-058-150.

Mobeley, H.I., M.D. Island and R.P. Hausinger. 1995. Molecular biology of microbial ureases. *Microbiological Reviews* 59:451-480.

Moffitt, M.C. and B.A. Neilan. 2004. Characterization of the nodularin synthetase gene cluster and proposed theory of the evolution of cyanobacterial hepatotoxins. *Applied Environmental Microbiology* 70:6353-6362.

Moisander, P.H., E. McClinton and H.W. Paerl. 2002. Salinity effects on growth, photosynthetic parameters, and nitrogenase activity in estuarine planktonic cyanobacteria. *Microbial Ecology* 43:432-442.

Moisander, P.H., H.W. Paerl and J.P. Zehr. 2008. Effects of inorganic nitrogen on taxa-specific cyanobacterial growth and *nifH* expression in a subtropical estuary. *Limnology and Oceanography* 53:2519-2522.

Molot L.A., Watson S.B., Creed I.F. et al. 2014. A novel model for cyanobacteria bloom formation: the critical role of anoxia and ferrous iron. *Freshwater Biology* 59:1323-1340

Morris, R.J., D.E. Williams, H.A. Luu, C.F.B. Holmes, R.J. Andersen and S.E. Calvert. 2000. The adsorption of microcystin-LR by naural clay particles. *Toxicon* 38:303-308.

Montesinos, M.L., A. Herrero and E. Flores. 1997. Amino acid transport in taxonomically diverse cyanobacteria and identification of two genes encoding elements of a neutral amino acid permease putatively involved in recapture of leaked hydrophobic amino acids. *Journal of Bacteriology* 179:853-862.

Muro-Pastor, M.I., J.C. Reyes and F.J. Florencio. 2005. Ammonium assimilation in cyanobacteria. *Photosynthesis Research* 83:135-150

Mynderse, J.S., R.E. Moore, M. Kashiwagi and T.R. Norton. 1977. Antileukemia activity in the Oscillatoriaceae, isolation of debromoaplysiatoxin from *Lyngbya*. *Science* 196:538-540.

Nielsen, M.V. 1992. Irradiance and daylength effects on growth and chemical composition of *Gyrodinium aureolum* Hulburt in culture. *Journal of Plankton Research* 14:811-820.

Nixon, S.W. 1986. Nutrient dynamics and the productivity of marine coastal waters. pp. 97-115 in R. Halwagy, D. Clayton and M. Behbehani (eds). Marine Environment and Pollution. The Alden Press. Oxford, UK.

O'Brien, K.R., M.A. Burford and J.D. Brookes. 2009. Effects of light history on primary productivity in a *Cylindrospermopsis raciborskii*-dominated reservoir. *Freshwater Biology* 54:272-282.

OEHHA 2009. Microcystins: A brief overview of their toxicity and effects, with special reference to fish, wildlife, and livestock. Integrated Risk Assessment Branch. Office of Environmental Health Hazard Assessment. Ecotoxicology Program. California Environmental Protection Agency. January 2009.

Ohtani, I., R.E. Moore and M.T.C. Runnegar. 1992. Cylindrospermopsin, a potent hepatotoxin from the blue-green alga *Cylindrospermopsis raciborskii*. *Journal of the American Chemical Society* 114:7941-7942.

Oliver, R.L. 1994. Floating and sinking in gas-vacuolate cyanobacteria. *Journal of Phycology* 30:161-173.

O'Neill, J., T.W. Davis, M.A. Burford and C.J. Gobler CJ 2012. The rise of harmful cyanobacteria blooms: the potential roles of eutrophication and climate change. *Harmful Algae* 14:313-334.

Orlando, J.L., M. McWayne, C. Sanders and M. Hladik. 2014. Dissolved pesticide concentrations entering the Sacramento–San Joaquin Delta from the Sacramento and San Joaquin Rivers, California, 2012–13: U.S. Geological Survey Data Series 876, 28 p., http://dx.doi.org/10.3133/ds876.

Orr, P.T. and G.J. Jones. 1998. Relationship between microcystin production and cell division rates in nitrogen-limited *Microcystis aeruginosa* cultures. *Limnology and Oceanography* 43:1604-1614.

Paerl HW 2004. Estuarine eutrophication, hypoxia and anoxia dynamics: causes, consequences and controls. In: Rupp GL, White MD (eds) Proceedings of the 7th International symposium on fish physiology, toxicology and water quality. EPA Office of Research and Development, Athens, Georgia, USA EPA/600/R-04/049.

Paerl, H.W. 2008. Nutrient and other environmental controls of harmful cyanobacterial blooms along the freshwater-marine continuum. *Advances in Experimental Medicine and Biology* 619:216-241.

Paerl, H.W., P.T. Bland, N.D. Bowles and M.E. Haibach. 1985. Adaptation to high-intensity, low wavelength light among surface blooms of the cyanobacterium *Microcystis aeruginosa*. *Applied Environmental Microbiology* 49:1046-1052.

Paerl, H.W. and R.S. Fulton III. 2006. Ecology of harmful cyanobacteria. pp. 95-107 *in*: E. Graneli and J. Turner (eds.), Ecology of Harmful Marine Algae. Springer-Verlag, Berlin.

Paerl, H.W., N.S. Hall and E. Calandrino. 2011. Controlling harmful cyanobacterial blooms in a world experiencing anthropogenic and climatic-induced change. *Science of the Total Environment* 40:1739-1745.

Paerl, H.W., N.S. Hall, B.L. Peierls, and K.L. Rossignol. 2014b. Evolving paradigms and challenges in estuarine and coastal eutrophication cynamics in a culturally and climatically stressed world. *Estuaries and Coasts* 37:243-258.

Paerl, H.W. and J. Huisman. 2008. Blooms like it hot. *Science* 320:57-58.

Paerl, H.W. and V.J. Paul. 2012. Climate change: links to global expansion of harmful cyanobacteria. *Water Research* 46:1349-1363.

Paerl, H.W., J. Tucker and P.T. Bland. 1983. Carotenoid enhancement and its role in maintaining blue-green algal (*Microcystis aeruginosa*) surface blooms. *Limnology and Oceanography* 28:847-857.

Paerl, H.W., H. Xu, N.S. Hall, G. Zhu, B. Qin, Y. Wu, K.L. Rossignol, L. Dong, M.J. McCarthy and A.R. Joyner. 2014a. Controlling cyanobacterial blooms in hypertrophic Lake Taihu, China: will nitrogen reductions cause replacement of non-N_2 fixing by N_2 fixing taxa? *PLoS ON*E 9(11):e113123 doi:10.1371/journal.one.0113123.

Palinska, K.A., T. Jahns, R. Rippka and N. Tandeau De Marsac. 2000. *Prochlorococcus marinus* strain PCC 9511, a picoplanktonic cyanobacterium, synthesizes the smallest urease. Microbiology 146:3099-3107.

Parsons, T.R., K. Stephens and J.D.H. Strickland. 1961. On the chemical composition of eleven species of marine phytoplankters. *Journal of the Fisheries Research Board of Canada* 18:1001-1016.

Peeters, F., D. Straile, A. Lorke and D.M. Livingstone. 2007. Earlier onset of the spring phytoplankton bloom in lakes of the temperate zone in a warmer climate. *Global Change Biology* 13:1898-1909.

Peterson, H.G., C. Boutin, K.E. Freemark and P.A. Martin. 1997. Toxicity of hexazinone and diquat to green algae, diatoms, cyanobacteria and duckweed. *Aquatic Toxicology* 39:111-134.

Post, A.F., B. Rihtman and Q. Wang. 2012. Decoupling of ammonium regulation and ntcA transcription in the diazotrophic marine cyanobacterium *Trichodesmium* sp. IMS101. *The ISME Journal* 6:629-637.

Qin, B.Q., P.Z. Xu, Q.L. Wu, L.C. Luo and Y.L. Zhang. 2007. Environmental issues of Lake Taihu, China. *Hydrobiologia* 581:3-14.

Qin, B., G. Zhu, G. Gao, Y. Zhang, W. Li, H.W. Paerl and W.W. Carmichael WW 2010. A drinking water crisis in Lake Taihu China: linkage to climatic variability and Lake management. *Environmental Management* 45:105-112.

Quigg, A., Z.V. Finkel, A.J. Irwin Y. Rosenthal, T.-Y. Ho, J.R. Reinfelder, O. Schofield, F.M.M. Morel and P.G. Falkowski . 2003. The evolutionary inheritance of elemental stoichiometry in marine phytoplankton. *Nature* 425:291-294.

Quintero, M.J., M.L. Montesinos, A. Herrero and E. Flores. 2001. Identification of genes encoding amino acid permeases by inactivation of selected ORFs from the *Synechocystis* genomic sequence. *Genome Research* 11:2034-2040.

Ramasubramanian, T.S., T.F. Wei and J.W. Golden. 1994. Two *Anabaena* sp. strain PCC 7120 DNA-binding factors interact with vegetative cell- and heterocyst-specific genes. *Journal of Bacteriology* 176:1214-1223.

Ramm, J., A. Lupu, O. Hadas, A. Ballot, J. Rucker, C. Wiedner and A. Sukenik. 2012. A CARD-FISH protocol for the identification and enumeration of cyanobacterial akinetes in lake sediments. *FEMS Microbiology Ecology* 82:23-36.

Rapala J., Lahti K., Sivonen K., and S.I. Niemelä. 1994. Biodegradability and absorption on lake sediments of cyanobacterial hepatotoxins and anatoxin-a. *Letters in Applied Microbiology* 19: 423 – 426

Rapala J., Berg K.A., Lyra C. et al. 2005. *Paucibacter toxinivorans* gen. nov., sp. nov., a bacterium that degrades cyclic cyanobacterial hepatotoxins microcystins and nodularin. *International Journal of Systematic and Evolutionary Microbiology* 55:1563-1568.

Rapala, J., K. Sivonen, C. Lyra and S.I. Niemela. 1997. Variation of microcystins, cyanobacterial hepatotoxins, in *Anabaena* spp. as a function of growth stimuli. *Applied Environmental Microbiology* 63:2206-2012.

Raven, J.A. 1984. A cost-benefit analysis of photon absorption by photosynthetic cells. *New Phytologis* 98:593-625.

Redfield, A.C. 1958. The biological control of chemical factors in the environment. Am Sci 46:205-221.

Reynolds, C.S. 1999. Non-determinism to probability, or N:P in the community ecology of phytoplankton. *Archiv fur Hydrobiologie* 146:23-35.

Reynolds, C.S. 2006. Ecology of Phytoplankton. Cambridge University Press. Cambridge, UK.

Reynolds, C.S., S.W. Wiseman, B.M. Godfrey and C. Butterwick. 1983. Some effects of artificial mixing on the dynamics of phytoplankton populations in large limnetic enclosures. *Journal of Plankton Research* 5:203-232.

Rhee, G.Y. 1978. Effects of N:P atomic ratios and nitrate limitation on algal growth, cell composition, and nitrate uptake. *Limnology and Oceanography* 23:10-25.

Richerson, P.J., Suchanek, T.H. and Why, S.J. 1994. *The causes and control of algal blooms in Clear Lake.* Final report, July 28, 1994. Clean Lake Diagnostic/Feasibility Study for Clear Lake, California. pp.182.

Rippka R., Deruelles J., Waterbury J. B., Herdman M. and R. Y. Stanier. 1979. Generic assignments, strain histories and properties of pure cultures of cyanobacteria. *Journal of General Microbiology* 111:1-61

Robarts, R.D. and T. Zohary. 1987. Temperature effects on photosynthetic capacity, respiration and growth rates of phytoplankton of bloom-forming cyanobacteria. *New Zealand Journal of Marine and Freshwater Research* 21:391-401.

Roelke, D.L., S. Augustine and Y. Buyukates. 2003. Fundamental predictability in multispecies competition: The influence of large disturbance. *The American Naturalist* 162:615-623.

Rohrlack, T., K. Christoffersen, P.E. Hansen, W. Zhang, O. Csarnecki, M. Henning, J. Fastner, M. Erhard, B.A. Neilan and M. Kaebernick. 2003. Isolation, characterization, and quantitative analysis of microviridin J, a new *Microcystis* metabolite toxic to *Daphnia*. *Journal of Chemical Ecology* 29:1757-1770.

Rohrlack, T., E. Dittmann, M. Henning, T. Borner and J.G. Kohl. 1999. Role of microcystins in poisoning and food ingestion inhibition of Daphnia galeata caused by the cyanobacterium *Microcystis aeruginosa*. *Applied Environmental Microbiology* 65:737-739.

Romo, A., J. Soria, F. Fernandez, Y. Ouahid and A. Baron-Sola. 2013. Water residence time and the dynamics of toxic cyanobacteria. Freshwater Biology 58:513-522.

Rucker, J., E.I. Tingwey, C. Wiedner, C.M. Anu and B. Nixdorf. 2009. Impact of the inoculum size on the population of Nostocales cyanobacteria in a temperate lake. *Journal of Plankton Research* 31:1151-1159.

Runnegar, M.T., S.M. Kong, Y.Z. Zhong, J.E. Ge and S.C. Lu. 1994. The role of glutathione in the toxicity of a novel cyanobacterial alkaloid cylindrospermopsin in cultured rat hepatocytes. *Biochemical and Biophysical Research Communications* 201:235-241.

Ryther, J.H. and W.M. Dunstan. 1971. Nitrogen, phosphorus and eutrophication in the coastal marine environment. *Science* 171:1008-1112.

Saker, M.L. and B.A. Neilan. 2001. Varied diazotrophies, morphologies, and toxicities of genetically similar isolates of *Cylindrospermopsis raciborskii* (Nostocales, Cyanophyceae) from northern Australia. *Applied Microbiology* 67:1839-1845.

Sauer, J., M. Gorl and K. Forchammer. 1999. Nitrogen starvation in *Synechococcus* PCC 7942: involvement of glutamine synthetase and NtcA in phycobiliprotein degradation and survival. *Archives of Microbiology* 172:247-255.

Schindler, D.W. 1977. Evolution of phosphorus limitation in lakes. *Science* 195:260-262.

Schindler, D.W., R.W. Hecky, D.L. Findlay *et al.* 2008. Eutrophication of lakes cannot be controlled by reducing nitrogen input: results of a 37 year whole ecosystem experiment. *Proceedings of the National Academy of Sciences USA* 105:11254-11258.

Schoellhamer, D.H., S.A. Wright and J. Drexler. 2012. A conceptual model of sedimentation in the Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science* 10(3): https://escholarship.org/uc/item/2652z8sq.

Sivonen, K. and T. Borner. 2008. Bioactive compounds produced by cyanobacteria. pp. 159-197 *in*: A. Herrero and E. Flores (eds.), The Cyanobacteria Molecular Biology, Genomics and Evolution. Caister Academic Press. Norfolk, UK.

Sivonen K. and G.J. Jones. 1999. Cyanobacterial toxins. pp. 41-111 *in*: I. Chorus and J. Bertram (eds.), Toxic Cyanobacteria in Water: Guide to Public Health Consequences, Monitoring and Management. The World Health Organiziation E & FN Spon. London, UK.

Skulberg, O.M., W.W. Carmichael, R.A. Anderson, S. Matsunaga, R.E. Moore and R. Skulberg. 1992. Investigations of a neurotoxic Oscillatorialean strain (cyanophyceae) and its toxin. Isolation and characterization of homo-anatoxin-a. *Environmental Toxicology and Chemistry* 11:321-329.

Smith, V.H. 1983. Low nitrogen to phosphorus ratios favor dominance by blue-green algae in lake phytoplankton. *Science* 221:669-671.

Smith, V.H. 1990. Nitrogen, phosphorus, and nitrogen fixation in lacustrine and estuarine ecosystems. *Limnology and Oceanography* 35:1852-1859.

Solomon, C.M., J.L. Collier, G.M. Berg and P.M. Glibert. 2010. Role of urea in microbial metabolism in aquatic systems: a biochemical and molecular review. *Aquatic Microbial Ecology* 59:67-88.

Sommer, T., C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga and K. Souza. 2007. The collapse of pelagic fishes in the upper San Francisco Estuary. *Fisheries* 32:270-277.

Sorensson, F. and E. Sahlsten. 1987. Nitrogen dynamics of a cyanobacterial bloom in the Baltic Sea: new versus regenerated production. Mar Ecol Prog Ser 37:277-284.

Spier, C., W. Stringfellow, J. Hanlon, M. Estiandan, T. Koski and J. Kaaria. 2013. Unprecedented bloom of toxin-producing cyanobacteria in the Southern Bay-Delta Estuary and its potential negative impact on the aquatic food web. University of the Pacific Ecological Engineering Research Program Report 4.5.1.

Sprosser, P., H.M. Shafit, M. Presing, A.W. Kovacs and S. Herodek. 2003. Nitrogen uptake and fixation in the cyanobacterium *Cylindrospermopsis raciborskii* under different nitrogen conditions. Hydrobiologica 506-509:169-174.

Stockner, J.G. and J.W.G. Lund. 1970. Live algae in postglacial lake deposits. *Limnology and Oceanography* 15:41-58.

Stucken K., John U., Cembella A., Soto-Liebe K. and M. Vasquez. 2014. Impact of nitrogen sources on gene expression and toxin production in the diazotroph *Cylindrospermopsis raciborskii* CS-505 and non-diazotroph *Raphidiopsis brookii* D9. *Toxins* 6:1896-1915.

Stuken, A. and K.S. Jakobsen. 2010. The cylindrospermopsin gene cluster of *Aphanizomenon* sp. strain 10E5: Organization and recombination. *Microbiology* 156:2438-2451.

Suikkanen, S., M. Laamanen and M. Huttunen. 2007. Long-term changes in summer phytoplankton communities of the open northern Baltic Sea. *Estuarine, Coastal and Shelf Science* 71:580-592.

Sukenik, A., J. Beardall and O. Hadas. 2007. Photosynthetic characterization of developing and mature akinetes of *Aphanizomenon ovalisporum* (Cyanoprokaryota). *Journal of Phycology* 43:780-788.

Sunda, W.G. and D.R. Hardison. 2007. Ammonium uptake and growth limitation in marine phytoplankton. *Limnology and Oceanography* 52:2496-2506.

Tanigawa, R., M. Shirokane, S.S. Maeda, T. Omata, K. Tanaka and H. Takahashi. 2002. Transcirptional activation of NtcA-dependent promoters of *Synechococccus* sp. PCC 7942 by 2-oxogluterate in vitro. *Proceedings of the National Academy of Sciences USA* 99:4251-4255.

Terao, K., S. Ohmori, K. Igarashi, I. Ohtani, M.F. Watanabe, K.I. Harada, E. Ito and M. Watanabe. 1994. Electron microscopic studies on experimental poisoning in mice induced by cylindrospermopsin isolated from the blue-green alga *Umezakia natans*. *Toxicon* 32:833-843

Terry KL, Laws EA, Burns DJ (1985) Growth rate variation in the N:P requirement ratio of phytoplankton. *Journal of Phycology* 21:323-329

Tett, P., S.I. Heaney and M.R. Droop. 1985. The Redfield ratio and phytoplankton growth rate. *Journal of the Marine Biological Association of the United Kingdom* 65:487-504.

Thiel, T. 1993. Characterization of genes for an alternative nitrogenase in the cyanobacterium *Anabaena variabilis*. *Journal of Bacteriology* 175:6276-6286.

Thiel, T. and C.P. Wolk. 1983. Metabolic activities of isolated akinetes of the cyanobacterium *Nostoc spongiaforme*. *Journal of Bacteriology* 156:369-374.

Thomas RH, Walsby AE. 1985. Buoyancy regulation in a strain of *Microcystis. Journal of General Microbiology* 131: 799–809.

Tillett, D., E. Dittmann, M. Erhard, H. von Dohren, T. Borner and B.A. Neilan. 2000. Structural organization of microcystin biosynthesis in *Microcystis aeruginosa* PCC 7806: an integrated peptide-polyketide synthase system. *Chemical Biology* 7:753-764.

Tilman, D., S.S. Kilham and P. Kilham. 1982. Phytoplankton community ecology: the role of limiting nutrients. *Annual Review of Ecology, Evolution, and Systematics* 13:349-372.

Tomatini, A., A.H. Knoll, C.M. Cavanaugh and T. Ohno. 2006. The evolutionary difersification of cyanobacteria: Molecular-phylogenetic and paleontological perspectives. *Proceedings of the National Academy of Sciences USA* 103:5442-5447.

Tonk, L., K. Bosch, P.M. Visser and J. Huisman. 2007. Salt tolerance of the harmful cyanobacterium *Microcystis aeruginosa*. *Aquatic Microbial Ecology* 46:117-123.

Tonk, L., D.B. van de Waal, P. Slot, J. Huisman, H.C. Matthijs and P.M. Visser. 2008. Amino acid availability determines the ratio of microcystin variants in the cyanobacterium *Planktothrix agardhii*. *FEMS Microbiology Ecology* 65:383-390.

Tonk, L., P.M. Visser, G. Christiansen, E. Dittmann, E.O.F.M. Snelder, C. Wiedner, L.R. Mur and J. Huisman. 2005. The microcystin composition of the cynobacterium *Planktothrix agardhii* changes toward a more toxic variant with increasing light intensity. *Applied Environmental Microbiology* 71:5177-5181.

Trimbee, A.M. and E.E. Prepas. 1987. Evaluation of total phosphorus as a predictor of the relative biomass of blue-green algae with emphasis on Alberta lakes. *Canadian Journal of Fisheries and Aquatic Sciences* 44:1337-1342.

Turner S., Pryer K.M., Miao V.P. and J.D. Palmer. 1999. Investigating deep phylogenetic relationships among cyanobacteria and plastids by small subunit rRNA sequence analysis. *Journal of Eukaryotic Microbiology* 46:327-338.

Turpin, D.H. 1991. Effects of inorganic N availability on algal photosynthesis and carbon metabolism. *Journal of Phycology* 27:14-20.

Tsuji, K., T. Watanuki, F. Kondo, M.F. Watanabe, S. Suzuki, H. Nakazawa, M. Suzuki, H. Uchida, and K.-I. Harada. 1995. Stability of microcystins from cyanobacteria II. Effect of UV light on decomposition and isomerization. *Toxicon* 33:1619-1631.

Utkilen, H. and N. Gjølme. 1995. Iron-stimulated toxin production in *Microcystis aeruginosa*. *Applied Environmental Microbiology* 61:797-800

Valladares, A., M.L. Montesinos, A. Herrero and E. Flores. 2002. An ABC-type, high-affinity urea permease identified in cyanobacteria. *Molecular Microbiology* 43:703-715.

Van Der Westhuizen, A.J. and J.N. Eloff. 1985. Effect of temperature and light on the toxicity and growth of the blue-green alga *Microcystis aeruginosa* (UV006). *Planta* 163:55-59.

Van Nieuwenhuyse, E.E. 2007. Response of summer chlorophyll concentration to reduced total phosphorus concentration in the Rhine River (Netherlands) and the Sacramento-San Joaquin Delta (California, USA). *Canadian Journal of Fisheries and Aquatic Sciences* 64:1529-1542.

Vazquez-Bermudez, M.F., A. Herrero and E. Flores. 2002. 2-Oxogluterate increases the binding affinity of the NtcA (nitrogen control) transcription factor for the *Synechococcus* glnA promoter. *FEBS Letters* 512:71-74.

Vezie, C., L. Brient, K. Sivonen G. Bertru, J.-C. Lefeuvre and M. Salkinoja-Salonen. 1998. Variation of microcystin content of cyanobacterial blooms and isolated strains in Lake Grand-Lieu (France). *Microbial Ecology* 35:126-135.

Vezie, C., J. Rapala, J. Vaitomaa, J. Seitsonen and K. Sivonen. 2002. Effect of nitrogen and phosphorus on growth of toxic and nontoxic *Microcystis* strains and on intracellular microcystin concentrations. *Microbial Ecology* 43:443-454.

Visser, P.M., J. Passarge and L.R. Mur. 1997. Modelling vertical migration of the cyanobacterium *Microcystis*. Hydrobiologia 349-99-109.

Walsby, A.E. 1994. Gas vesicles. *Microbiological Reviews* 58:94-144.

Walsby, A.E. 2005. Stratification by cyanobacteria in lakes: a dynamics buoyancy model indicates size limitations met by Planktothrix rubescens filaments. *New Phytologist* 168:365-376.

Walsby, A.E., G. Ng, C. Dunn and P.A. Davis. 2004. Comparison of the depth where Planktothrix rubescens stratifies and the depth where the daily insolation supports its neutral buoyancy. *New Phytologist* 162:133-145.

Wallace, B.B. and D.P. Hamilton. 1999. The effect of variation in irradiance on buoyancy regulation in *Microcystis aeruginosa*. *Limnology and Oceanography* 44:273-281.

Watanabe, M.F. and S. Oishi. 1985. Effects of environmental factors on toxicity of a cyanobacterium (*Microcystis aeruginosa*) under culture conditions. *Applied Environmental Microbiology* 49:1342-1344.

Wei, T.F., T.S. Ramasubramanian and J.W. Golden. 1994. *Anabaena* sp. strain PCC 7120 ntcA gene required for growth on nitrate and heterocyst development. *Journal of Bacteriology* 176:4473-4482..

Welker, M. and H. von Dohren. 2006. Cyanobacterial peptides – Nature's own combinatorial biosynthesis. *FEMS Microbiology Reviews* 30:530-563.

Wiedner, C., P.M. Visser, J. Fastner, J.S. Metcalf, G.A. Codd and L.R. Mur. 2003. Effects of light on the microcystin content of *Microcystis* strain PCC 7806. *Applied Environmental Microbiology* 69:1475-1481.

Wolk, C.P., A. Ernst and J. Elhai. 1994. Heterocyst metabolism and development. pp. 769-823 *in*: D.A. Bryant (ed.), The Molecular Biology of Cyanobacteria. Kluwe Academic Publishers. New York, NY.

Wu, Z., J. Shi and R. Li. 2009. Comparative studies on photosynthesis and phosphate metabolism of Cylindrospermospsis raciborskii with Microcystis aeruginosa and Aphanizomenon flos-aquae 2009. *Harmful Algae* 8:910-915

Wynne, D. and G.Y. Rhee. 1986. Effects of light intensity and quality on the relative N and P requirement (the optimum N:P ratio) of marine planktonic algae. *Journal of Plankton Research* 8:91-103

Yamamoto Y. and H. Nakahara. 2005. The formation and degradation of cyanobacterium *Aphanizomenon flos-aquae* blooms: the importance of pH, water temperature, and day length. *Limnology* 6:1-6.

Yang, F., Y. Zhou, L. Yin, G. Zhu, G. Liang and Y. Pu. 2014. Microcystin-degrading activity of an indigenous bacterial strain *Stenotrophomonas acidaminiphila* MC-LTH2 isolated from Lake Taihu. *PLoS ONE* 9(1): e86216. doi:10.1371/journal.pone.0086216

Yoshimasa, Y. and H. Nakahara. 2005. The formation and degradation of cyanobacterium *Aphanizomenon flos-aquae* blooms: the importance of pH, water temperature, and day length. *Limnology* 6:1-6.

Yoshizawa, S., R. Matsushima, M.F. Watanabe, K. Harda, A. Ichihara, W.W. Carmichael and H. Fujiki. 1990. Inhibition of protein phosphatases by microcystin and nodularin associated with hepatotoxicity. *Journal of Cancer Research and Clinical Oncology* 116:609-614.

APPENDIX A

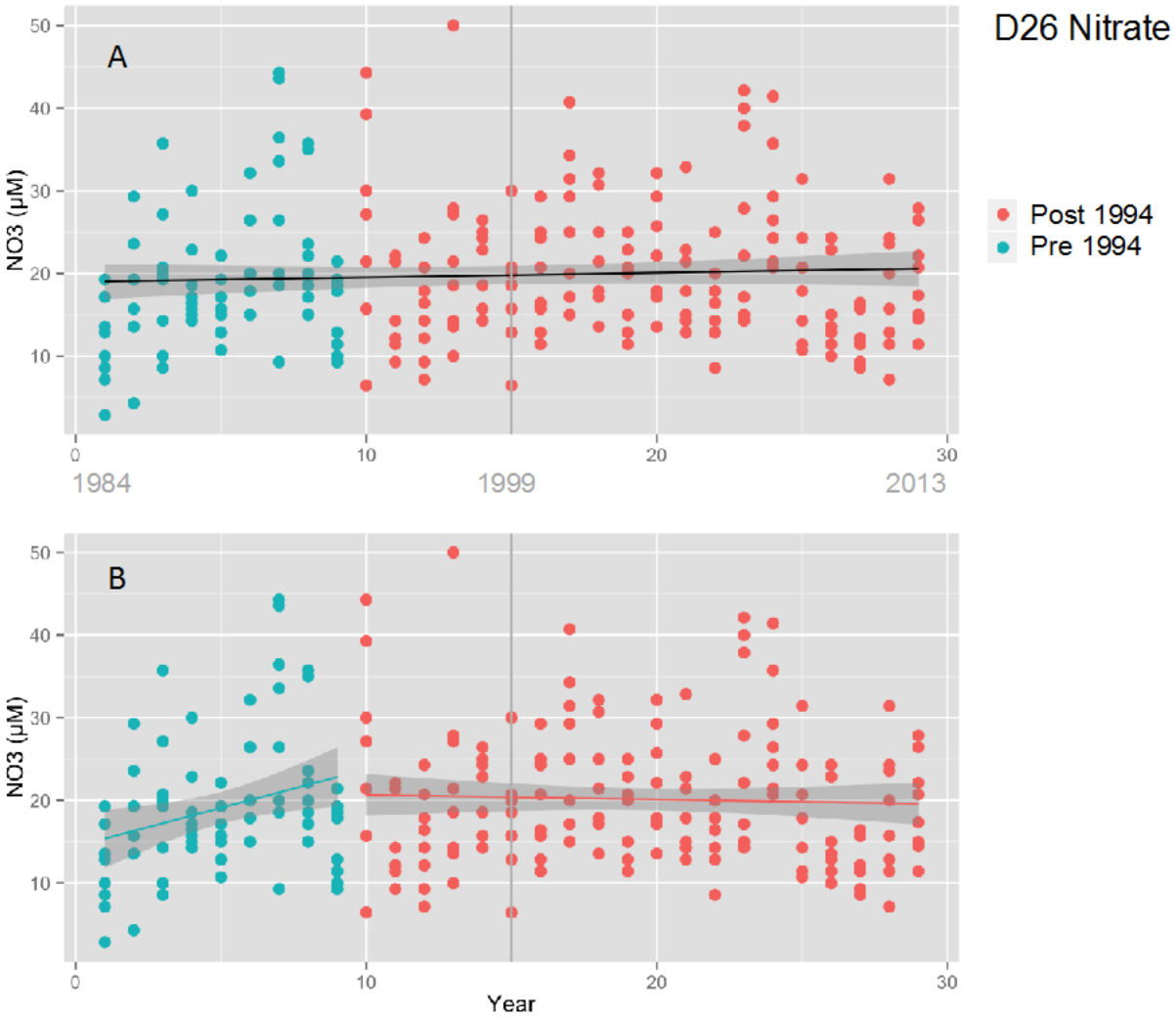


Figure A-1. Changes in the concentration of nitrate (NO_3^-) over time (1985-2013) at station D26 in the Delta. Green filled circles denote period before 1994 and red filed circles denote the period after 1994. Vertical grey line denotes the year 1999 when Microcystis started occurring. A) Regression of NO_3^- versus time for the period 1985-2013 (black line) with 95% confidence interval in grey. B) Regression of NO_3^- versus time for the period 1985-1994 (green line) and the period 1994-2013 (red line). Slopes significantly different from zero in bold in regression table:

Nitrate	1985-2013	1985-1994	1994-2013
Slope	0.09066	**1.374**	-0.02962
Probability	0.226	0.00149	0.832
multi- R^2	0.00424	0.09127	0.0001988

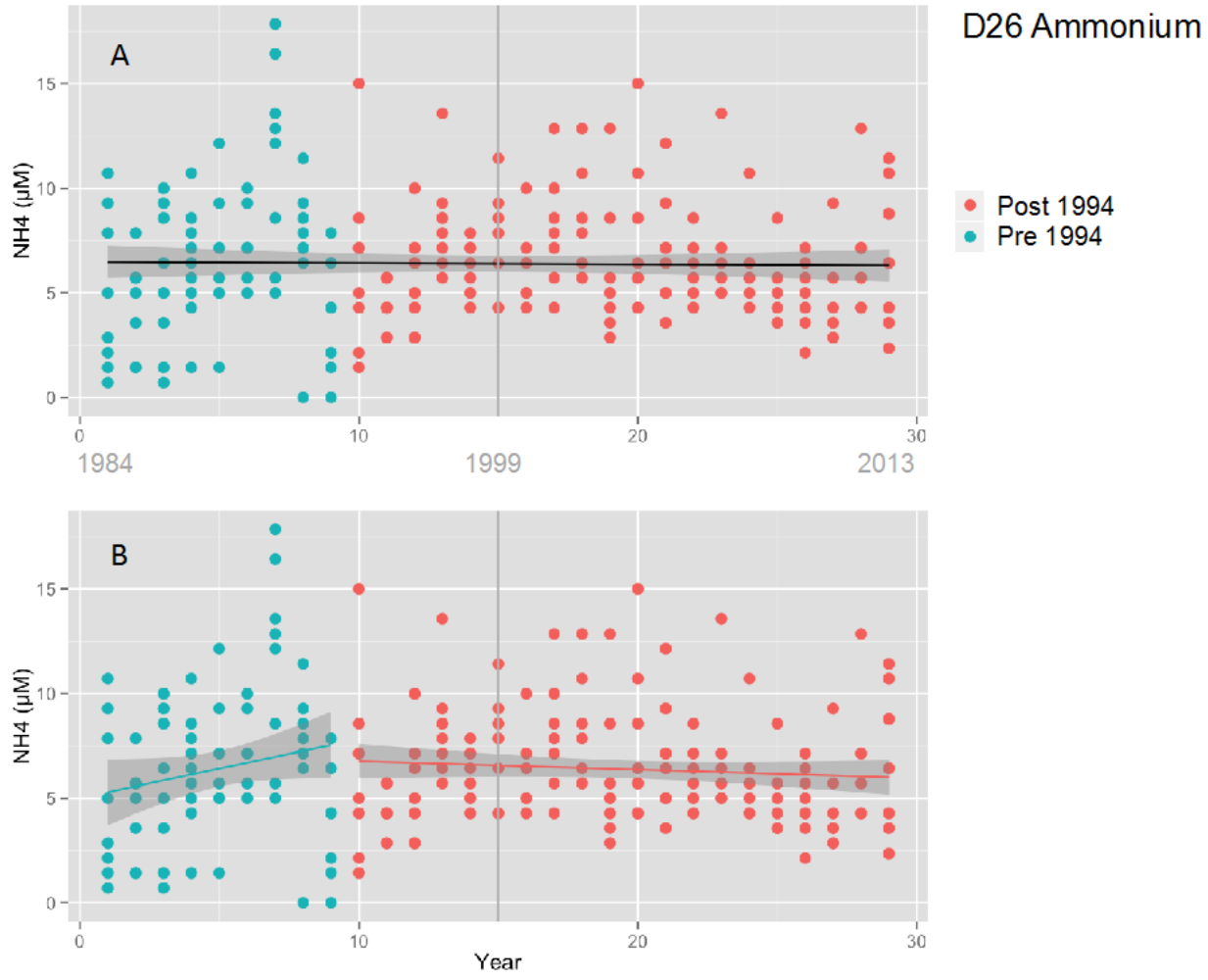


Figure A-2. Changes in the concentration of ammonium (NH_4^{+}) over time (1985-2013) at station D26 in the Delta. Green filled circles denote period before 1994 and red filed circles denote the period after 1994. Vertical grey line denotes the year 1999 when Microcystis started occurring. A) Regression of NH_4^{+} versus time for the period 1985-2013 (black line) with 95% confidence interval in grey. B) Regression of NH_4^{+} versus time for the period 1985-1994 (green line) and the period 1994-2013 (red line). Slopes significantly different from zero in bold in regression table:

Ammonium	1985-2013	1985-1994	1994-2013
Slope	-0.038	**0.3801**	-0.03525
Probability	0.108	0.023	0.358
multi- R^2	0.007448	0.04779	0.00374



Figure A-3. Changes in the concentration of phosphate (PO_4^{3-}) over time (1985-2013) at station D26 in the Delta. Green filled circles denote period before 1994 and red filed circles denote the period after 1994. Vertical grey line denotes the year 1999 when Microcystis started occurring. A) Regression of PO_4^{3-} versus time for the period 1985-2013 (black line) with 95% confidence interval in grey. B) Regression of PO_4^{3-} versus time for the period 1985-1994 (green line) and the period 1994-2013 (red line). Slopes significantly different from zero in bold in regression table:

Phosphate	1985-2013	1985-1994	1994-2013
Slope	**-0.048906**	0.03673	-0.008772
Probability	2.00E-16	0.263	0.157
multi- R^2	0.2594	0.01183	0.008855



Figure A-4. Changes in the N:P ratio (mol:mol) over time (1985-2013) at station D26 in the Delta. Green filled circles denote period before 1994 and red filed circles denote the period after 1994. Vertical grey line denotes the year 1999 when Microcystis started occurring. A) Regression of N:P ratio versus time for the period 1985-2013 (black line) with 95% confidence interval in grey. B) Regression of N:P ratio versus time for the period 1985-1994 (green line) and the period 1994-2013 (red line). Slopes significantly different from zero in bold in regression table:

N:P Ratio	1985-2013	1985-1994	1994-2013
Slope	**0.3726**	**0.6236**	0.02932
Probability	3.79E-16	0.000572	0.736
multi- R^2	0.1747	0.1064	0.0005047

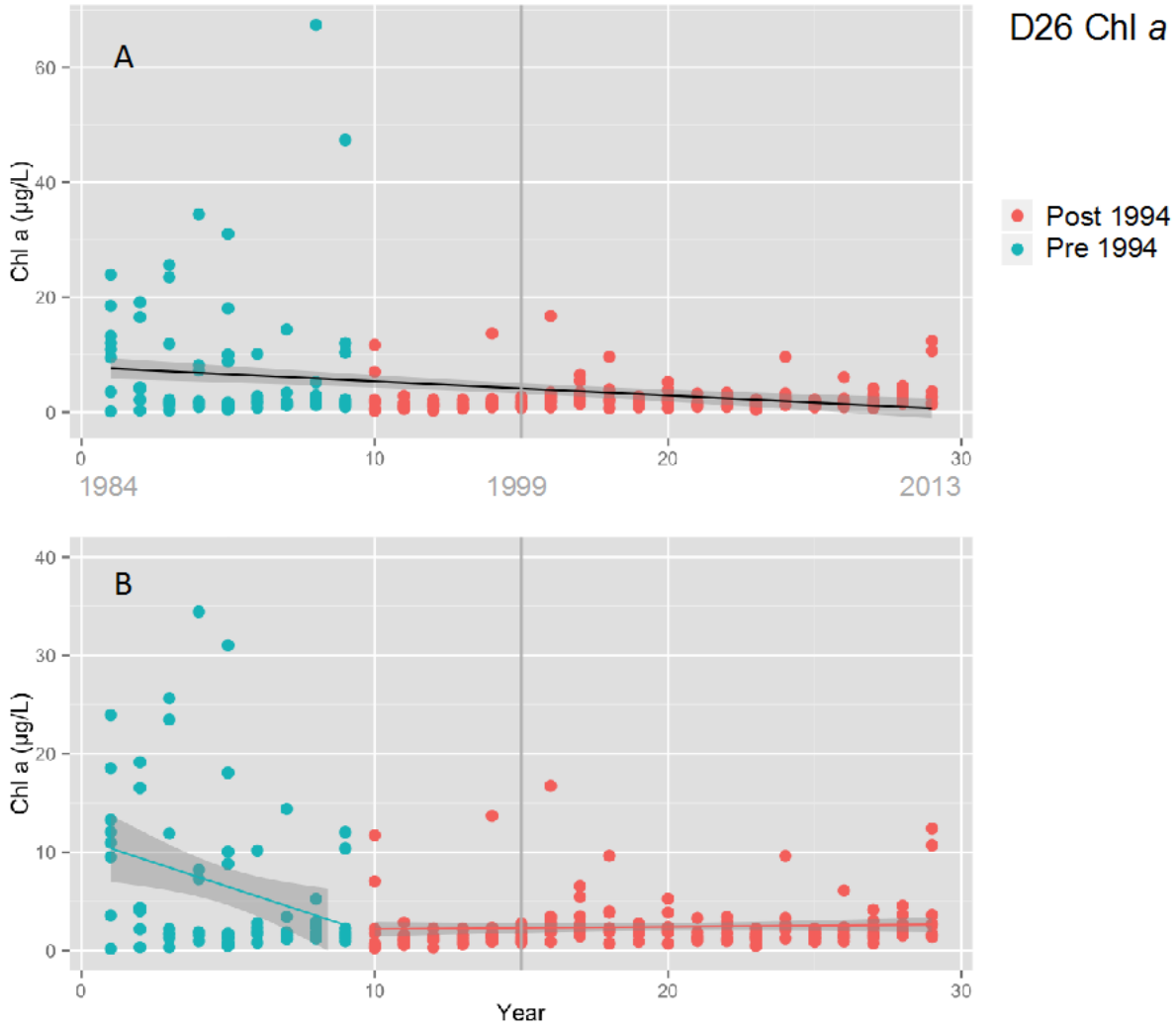


Figure A-5. Changes in the concentration of Chlorophyll a (Chl a) over time (1985-2013) at station D26 in the Delta. Green filled circles denote period before 1994 and red filed circles denote the period after 1994. Vertical grey line denotes the year 1999 when Microcystis started occurring. A) Regression of Chl a versus time for the period 1985-2013 (black line) with 95% confidence interval in grey. B) Regression of Chl a versus time for the period 1985-1994 (green line) with two of the high values from 1994 removed, and the period 1994-2013 (red line). Slopes significantly different from zero in bold in regression table:

Chl *a*	1985-2013	1985-1994	1994-2013
Slope	**-0.1676**	-0.7386	0.03936
Probability	2.87E-05	0.00759	0.1148
multi- R^2	0.05143	0.07266	0.01116

APPENDIX B

Comments from the Scientific Working Group and responses from the authors.

Author	Page	Comment	Response
Anonymous	iii	Under Finding #3, second bullet, regarding ratios of Nand P in Delta: I'm reading this to mean ratios of total N and total P (including various forms of each). I don't know that enough research has been done to determine if the ratios of the different forms can be an important driver.	Ratios of N:P are important drivers when one nutrient is in limiting supply and slows the growth rate down. Ratios of different forms of the same nutrient are important if a certain form produces a lower growth rate than the other; research on this topic is discussed under section 3.2.3 p24.
Foe	11	Under section 2.2.5, first paragraph, last sentence: Add something like this to last sentence on page 11, "it was deduced that *under nutrient limiting conditions*phytoplankton would become …"	Done
Foe	19	On pages 19, 22, and 38 you note that nutrient concentrations are one factor constraining the accumulation of cyanoHAB biomass. Can you estimate either from information from the delta or other waterbodies what range of N and P concentrations would be needed to limit cyanoHAB biomass and toxin levels below a low or moderate probability of human and wildlife health effects? Presumably there are a number of complicating factors including the fact that cyanoHABs co occur with blooms of other algal species which would also pull down nutrient levels. I understand that your estimate is likely to be fairly gross. Would it be possible to refine the range through a series of laboratory and/or field experiments? Could this be considered an information gap? Maybe discuss this somewhere around page 37?	I tried to do this in the original version where based on measurements of microcystin toxin that was harmful to aquatic life (0.8 µg/L) I calculated the amount of Microcystis-associated surface Chl a needed to produce that amount (7 µg/L). Because the science group did not like this estimation I've removed it from the paper. However, using 7 µg/L surface Chl a as a rough estimate, you would need greater or equal to 7 moles N/L to sustain such a level; this is not discussed in the current version
Foe	29	Second paragraph: You might note that Ger *et al.*, 2010 found that both toxin producing and non-toxin producing strains of Microcystis reduced the survival of both Eurytemora affinis and Pseudodiaptomus forbesi in 10 day lab bioassays. This suggests that the presence of other microcystis metabolites also contribute to overall toxicity.	A new section (4.2.4) on p39 entitled "Potential for CyanoHAB Risk to Delta Beneficial Uses" has been where the Ger (2010) paper and additional papers mentioned by Peggy Lehman are discussed
Foe	32	Under section 4.2.3, second paragraph: Brannan Island is located inside the legal boundary of the delta.	This sentence has been changed to read "Sacramento River" instead
Foe	35	Under section 4.2.4 under potential adverse effects on Delta beneficial uses: What can be concluded about the potential toxicity of cyanoHABs to aquatic organisms including zooplankton and larval fish in the Delta? Presumably there is the possibility of both direct and indirect effects. See Ger et al 2010 for an example of direct toxicity and Acuna et al (2012) and Deng et al (2010) for examples of bioaccumulation related effects. Peggy gave citations for all these papers. If uncertainty exists about the extent of	These effects and papers are discussed in a new section (4.2.4) on p39 entitled "Potential for CyanoHAB Risk to Delta Beneficial Uses". I think uncertainty exists regarding 1) whether the organisms reflect concentrations that are in the water column or 2) they bioaccumulate the toxin 3) what affects the zooplankton - toxic or non-toxic cells

		potential toxicity, then should this be listed as an information gap? What information is most important to collect first?	
Foe	38	Figure 5.2 shows nutrient trends at station D26 in the delta between 1994 and 2014. The conclusion is that nutrients concentrations are not changing. Longer term nutrient analysis suggest otherwise. Nutrient concentrations, N speciation, and dissolved N:P ratios have changed in the delta over the last 40 years. More DIN, more NH4, less SRP and an increase in the N:P ratio (Jassby 2008; Glibert, 2010[3] ; Van Nieuwenhuyse, 2007[4]) [3] Reviews in Fishery Science, 18:211-232 [4] Canadian journal of fisheries and aquatic science 64:1529-1542	I reanalyzed the nutrient data going back to 1985. My new interpretation is in section 5.1.4 on p43. I included the Van Nieuwenhuyse and Jassby citations. Appendix A provides plots of NO3, NH4, PO4, N:P, and Chl a from station D26. I demonstrate that one can draw different conclusions from these data depending on whether they are broken into separate time periods or analyzed as one long time course.
Foe	39	Around page 39. You note that cyanoHAB growth rates are a positive function of water clarity. The Delta has become clearer. The delivery of suspended sediment from the Sacramento River to the Delta has decreased by about half during the period between 1957 and 2001 (Wright and Schoellhamer (2004)[1] and this has resulted in a statistically significant -2 to -6 percent decrease per year in SPM between 1975 and 2005 (Jassby, 2008)[2]. Of course, it is uncertain whether the trend will continue. Might this increase in clarity also increase the frequency and magnitude of cyano blooms in Delta and make other factors like nutrients more important? [1] San Francisco Estuary and Watershed Science, 2004 volume 2, issue 2 [2] San Francisco Estuary and Watershed Science, 2006 volume 6, issue 1	This is true and I've added a new section (5.1.3) entitled Water Clarity (p 43) where this additional information is discussed.
Joab	ii	Second paragraph, second sentence. Add "the" between "by" and "Water Board".	Done
Joab	ii	Under Finding #2, item 1), change "e,g." to e.g.,"	Removed
Joab	1	Under section 1.1, first sentence. Add "in" between "found" and "Northern California".	Done
Joab	1	Last paragraph, first sentence regarding the commissioning of literature reviews: Actually we only commissioned two white papers (to date) on cyano	Changed to "two"

		and macrophytes. We are working on commissioning the third.	
Joab	4	Under section 2.1, first paragraph, fourth sentence. In sentence, "Cyanobacteria also produce and array…" Change "and" to "an".	Done
Joab	5	In Table 2.1, under the Nostocales (Group 4), is Cylindrospermum the correct name?	It is the correct name; however, I could just as easily have mentioned Cylindrospermopsin which is a more recognizable species.
Joab	6	Second paragraph, second sentence. You identify Group 5 as having toxic cyanoHAB-forming cyanobacteria: Don't you mean Group 4 based on the species identified in Table 2.1? Also, which group is Planktothrix in? I did not see them identified in the table - can they be added?	I did mean Group 4; it's been changed. I've also indicated in the text which subgroup Planktothrix belongs to
Joab	8	Under Ammonium transport section, third paragraph. Change "alterate" to "alternate".	Done
Joab	8	Under Nitrate transport and reduction section, last sentence regarding nitrate uptake: What concentrations of ammonia are relevant? Are these concentrations in the cells or the water column?	External; sentence changed to reflect this
Joab	9	First paragraph, first sentence: Carbon fixation seems to be very important in the nutrient uptake process. What controls carbon fixation? Is there someway to reduce their carbon fixation?	Irradiance controls CO2 fixation; this has been mentioned
Joab	9	Fourth paragraph, last sentence. Remove "have" between "their genomes" and "demonstrates".	Done
Joab	10	Under Nitrogen fixation, second paragraph, last sentence relating to n2 fixation under iron-limiting conditions: What is the iron-limiting condition? Do we know?	Where iron is not enough to support cell division
Joab	10	Under nitrogen fixation, last paragraph, seventh sentence. Correct the spelling of "heterocyst".	Done
Joab	11	First paragraph: What are the conditions for N starvation?	When N concentration is not enough to support cell division of available biomass
Joab	19	In Figure 3.1, step 6 states to add grazers: Are their cyanobacteria grazing fish and zooplankton?	This figure was very busy and included many processes not discussed in the White Paper; I've substituted a new and simpler figure
Joab	38	Under section 5.2, first paragraph, first sentence: This citation is now 8 years old. Is there any recent information to suggest if these percentages have changed significantly?	Not that I'm aware
Joab	39	First paragraph: Correct the spelling of "cyanHABs" to "cyanoHABs". Do global search in document to check spelling of cyanoHAB.	Done
Joab	39	Second full paragraph: In sentence, "In Clear Lake, Both N and P…" delete capital B and make lowercase.	Sentence changed

Joab	41	In Table 5.1, Observations in the Delta "temperatures above 25° C rarely occur." - Temperatures in the San Joaquin River near Stockton have over the past 3 years (2012-2014) reached over 25°C from June through October, most likely due to this persistent drought and overall increase in temperature.	Sentence has been removed
Kudela	31	Figure 4.2. I think this is an issue with Peggy's original figure, because I remember seeing it before, but the chlorophyll units don't make much sense. 0.1 ng/L is barely detectable under the best of circumstances.	Y-axis corrected to µg/L
Kudela	N/A	The toxin table is very thorough, but it might be worth pointing out that, based on available information, Central California seems to be dominated by microcystins. We have all of those genera present but we don't very often see saxitoxins or anatoxin-a. Admittedly we don't look that often either, but we have tested some samples from Clear Lake, SF Bay, and Pinto Lake. We very rarely get low levels of STX, and one low hit for anatoxin-a in Clear Lake. We did see low levels of anatoxin-a in Lake Chabot also, and if you go further north, anatoxin-a becomes dominant in the Eel River basin. This supports Mine's decision to focus on microcystins in the report, but the implication of that section is that we could see a wide variety of toxins, and we usually don't.	This has been pointed out in the first paragraph of section 4.2.3
Kudela	N/A	Temperature. While I completely agree with Mine's summary, bear in mind that we do see toxin at low temperatures (this is documented in Kudela 2012 and Gibble and Kudela 2014). We were not tracking species, but it seems likely that it's related to a shift in composition to more cold-tolerant species such as Planktothrix. We tend to get two peaks of toxicity—one at lower biomass and cooler temperatures, and the second (larger) when Microcystis is dominant.	I was not aware of the Gibble Kudela paper; would like to add appropriate discussion
Kudela	N/A	Marine toxins. I'm not sure I completely believe it but there is a recent article (which I can't find right now—looking for it) that documents presence of microcystins in marine waters, from marine cyanobacteria.	Noted

Kudela	N/A	I'd be very supportive of developing an ecosystem model, but for CHABs in particular you probably need a fairly complex model that can parameterize both end-members (riverine and marine). A good hydrodynamic model would be a great place to start. I'm not sure how easy or difficult it would be to add a biological model on top of that, or whether you'd need two models, etc. It's probably my own bias but I would start with assembling all the available data and run statistical analyses on that (Peggy's done quite a bit of this already) to see what variables emerge as most important. Cecile Mioni has been attempting that with the Bay/Delta data and it's been interesting, in that there are no clear physical drivers related to cell abundance or toxicity. She looked at all the usual ones, temperature, salinity, nutrients, etc. suggesting that either there's not enough data (a real possibility) or that it's not a simple relationship. That of course leads back to the need for more monitoring and modeling.	Noted
Mussen	iii	Under Finding #4, third sentence regarding increased nutrient loading: With continued regluatory controls on nutrient loads into the system, we should not necessarily expect nutrient loading to increase substantially in the future.	This has been removed
Mussen	1	Under section 1.1, in fourth sentence "The Delta is widely recognized as in "crisis" because of competing demands…" Add "human effects on the environment and" between "because of" and "competing".	Done
Mussen	4	Last paragraph, second sentence. Add "in local communities" between "irrigation of farms" and "as well as". Plus, remove the words "drinking water to" after the words "as well as".	Sentence has been revised
Mussen	7	Under Carbon Fixation, fifth sentence. Add "near" between "concentrate CO2" and "its vicinity".	Sentence has been revised
Mussen	28	Under section 4.1 Ecosystem Services, second paragraph, third sentence: Change "Striped Bass" to "juvenile-Striped Bass".	Done
Mussen	29	First paragraph, fourth sentence: "At high densities…(Paerl 2004, Paerl and Fulton 2006)" is a repeat from text in the paragraph above on page 28.	Noted; the repeat text has been removed
Mussen	29	First paragraph, sixth sentence "At dense concentrations…" - If low nutrient concentrations can be used to limit the magnitude of future cyanoHAB blooms, the effects of lower nutrient concentrations must also be considered for all other plant and algae species growing in the system (this is especially important for the period followin onset of a future cyanoHAB blooms where nutrients in the area would be fully depleted).	Noted; this point has been brought up in the recommendations section (6.0) in conjunction with hypotheses development

Mussen	38	Under section 5.2, second paragraph, first sentence refering to growth of cyanoHABs versus diatoms: Without nutrient limitation, growth rates may not determine which phytoplanktong species is dominant in the system. Other factors such as light availability, buoyancy, temperature, salinity and grazing pressure may determine the dominant species.	This sentence, presently in section (5.1.4) has been revised to clarify point
Mussen	40	Under second bullet, third sentence concerning blooms not persisting without ample supply of nutrients: Once a bloom consumes the available nutrients, would nutrient remineralization be able to sustain some lower concentration of cyanoHABs presence throughout the remainder of the growth season? Could cyanoHABs persist at harmful levels in this manner?	I think typically not; harmful levels require a certain level of biomass to be sustained
Mussen	40	Under second bullet, third sentence: Add "flow rates," between "temperatures," and "and irridiance".	Done
Mussen	40	Under second bullet, third sentence: Remove "s" from word "remains".	Done
Mussen	40	Last paragraph, fourth sentence starting with "Increase nutrient loading…": Please see my comment above on increased nutrient loading.	This has been removed
Mussen	42	Under R1, second paragraph discussing enumeration of cell counts: What about the inclusion of "and average biomass?"	Controversy regarding how it is to be measured; could be discussed under recommendations
Mussen	43	Under R2, first paragraph, second sentence: Replace "higher chlorophyll a" with "increased phytoplankton growth in the Delta".	Done
Mussen	43	Last paragraph, first sentence concerning informing management actions: It is also important to model expected nutrient levels with levels of reduced loading. The time required for a reduction and the amount of nutrient regeneration in a system can be highly variable.	Section expanded in order to note this point
Mussen	43	Last paragraph, first sentence. Add "s" to "action" making it "actions".	Done
Mussen	43	Last paragraph, second sentence regarding modeling primary productivity and biomass: CyanoHAB growth rates under ideal conditions (which may be used as the basis for a model design) can be quite different from their growth rates at near-limiting nutrient conditions. Do we know what low nutrient concentrations (thresholds) would be necessary to prevent the overgrowth of different cyanoHABs? How would other plants and algae in the system be affected by low nutrient concentrations? With limited nutrients, can we predict which phytoplankton species would be dominant in the system, and how the dominant species may change with climatic factors such as temperature, flow, and turbidity, or with differing grazing rates?	Section expanded in order to note this point

Orr	iii	Under #3, first bullet - During the last meeting lower temperatures (18°C) were discussed. Are there references for the blooms at lower temperatures in the delta?	None that I'm aware of
Orr	28	For the last sentence on page 28 under section 4.1. Ecosystem Services, "CyanoHABs also can cause night-time dissolved oxygen depletion via bacterial decomposition and respiration of dense blooms which results in fish kills and loss of benthic fauna (Paerl 2004, Paerl and Fulton 2006) - Does this occur in the Delta or is flow mixing sufficient to prevent the issue?	This is an example of an adverse effect noted in other systems
Orr	29	In the second paragraph, the sentences starting with "At low concentrations…(Lehman *et al.* 2010)" are already in the preceding paragraph. Consider removing.	This has been removed
Orr	29	Regarding the thrid sentence at the top of the page, "However, even at low concentrations, toxins released (upon death and cell lysis, or by grazing) can bioaccumulate in higher trophic levels (Lehman *et al.* 2010) - There is some disagreement on this topic in the literature. Based on the Lehman paper alone it seems unclear whether the toxins bioaccumulate or simply occur in tissue at concentrations that are not greater than the surrounding environment. In other systems it depends on the particular toxin and species in question. I recommend removing the "even at low concentrations" to make a more conservative statement. Another option would be to state they have been observed in higher trophic levels in the delta and leave the bioaccumulation to be addressed in recommendations or further research.	This sentence has been modified
Orr	32	Under section 4.2.3, last sentence in first paragraph "Using the relationship 115 ng microcystin µg surface Chl a^{-1} (Figure 4.4), *Microcystis*-associated surface Chl a concentration of 7 µg L^{-1} (sampled using a horizontal net tow) would produce enough microcystin (800 ng L^{-1}) to reach the OEHHA Action Level, and constitute an action level for the Delta." I am concerned with the concept of using Chl a to determine actions levels. While Chl a and microcystin levels are related the correltation is not linear and does not take other cyanotoxins into account. Whether or not chl a correlates with other toxins would be an interesting question.	This can be discussed further; to be on the safe side I removed Figure 4.4 and the calculation of a surface Chl a level that could potentially constitute an action level

Orr	36	Under section 5.1, last half of paragraph relating to flow and turbidity - Is there data to suggest that increased turbidity reduces risk of HABs in the delta that is independent of flow rate or temperature? HABs are common in other water bodies with high turbidity. The observation the HABs are controlled by turbidity may be an artifact of higher flows and lower temps. In low flows and turbid water could buoyancy regulating species stay near the surface to receive the necessary light intensity?	Yes, I do think that the effect of turbidity cannot be separated from the effect of flows in the Delta; whether turbidity alone has the same effect is not clear. I have revised this statement to reflect that the two covary
Orr	42	Under R1, second paragraph discussing monitoring - Consider not listing species. If the plan is long term the species of concern may change or expand.	Adaptive management strategies should take care of that; the species are listed as an example
Orr	42	Under R1, last sentence in first paragraph, correct the misspelling of "calibrate".	Done
Orr	N/A	The introductory sections have a broad perspective regarding toxigenic algal species. However, the discussion of factors influencing cyanobacterial blooms appears to focus on microcystins as a model for all blooms. I think the dicussion of other species should be increased.	The literature is heavily tilted towards microcystins therefore the white paper as well. However, Kudela noted in his comments that cyanobacterial toxins other than microcystins are almost not detected in the Delta; a statement to this effect has been added in the first paragraph of section 4.2.3
Orr	N/A	I am concerned about how tubidity is discussed. If data is available I recommend discussing it separately from flow and temperature. If turbidity related data is not available avoid general assumptions regarding its influence on blooms.	I have repeated previously published statements regarding turbidity and Microcystis in the Delta; the assumptions in the published work are stated. A new section (5.1.3) on water clarity in the Delta has been added.
Orr	N/A	It was unclear to me what the end goal of the monitoring program is. If a clearer question(s) can be developed I encourage adding a more specific monitoring plan.	To be discussed at the next meeting
Orr	N/A	I heard some monitoring questions from the group and am interested in how common these questions are among the group. I suspect there will be some disagreement about the hypothesized answers but the questions seemed shared. (See 4 questions below)	Noted
Orr	N/A	1. When and where do we reach the required surface temperatures for a bloom? (microcystis exclusively?) a. What is the appropriate depth to measure temperature?	Noted
Orr	N/A	2. Do nutrient limited conditions occur during blooms in the delta? Presumed not to. a. Does this occur in some areas but not others? b. Are we close enough for this to occur in near future? c. Is this question species or nitrogen source dependent in a non-limited system?	Noted
Orr	N/A	3. Spatially where are both temperature and nutrients high and do we need more spatial resolution?	Noted

Orr	N/A	4. Is chlorophyll a the right parameter to be measuring? a. Does it correlate with microcystin concentrations?	Noted
Taberski	iii	Delete "already exists" under the section R1, first sentence.	Done
Taberski	1	Add "of" under section 1.1, 4th sentence "…Delta is widely recognized as in "crisis" because *of* competing demands…"	Done
Taberksi	1	Delete "d" in word "declined" under section 1.1, last sentence "…including the continued declined of …"	Done
Taberski	22	The paragraph under sub-section "Confounding factors:" is not clear, particularly the last sentence is confusing.	This sentence has been revised
Taberski	29	In the 5th sentence at the top of the page, insert a space in the word "watercolumn".	Done
Taberski	32	In table 4.1, I think you should also include the OEHHA thresholds.	Table below has OEHHA thresholds
Taberski	39	Under the last paragraph for section 5.2, the last sentence "…nutrients are unlikely to play a role in the onset or frequency of bloom occurrence in the Delta." - I agree. Nutrient concentrations would play a role, though, in the magnitude (concentration) and duration of a bloom. If nutrients were lower, they would be depleted more quickly and the bloom would crash. This was stated in the Summary bullet #2. That clarification should be added to this paragraph.	This has been added
Taberski	40	Under the second bullet, in the third sentence, correct the misspelling of "initiated".	Done
Taberski	40	In the last paragraph, in the second sentence, put a space in the word "watercolumn".	Done
Taberksi	40	In the last paragraph, in the third sentence, change the sentence to read as "Both *higher* temperature*s* and reduced …"	Changed
Taberksi	42	Under R1, first sentence, delete the wording "already exists".	Done
Taberski	N/A	A section should be added on risk to aquatic life.	Done
Taberski	N/A	Historical data should be analyzed based on driving factors to evaluate risk (areas with high temperatures/low turbidity/long residence time)	Example analysis of nutrient concentrations at station D26 performed; included in Appendix A
Taberski	N/A	Recommended monitoring should be based on specific management questions related to status and trends, hotspots, risks to humans, animals and aquatic life, and directing management actions.	Noted
Taberski	N/A	Monitoring information should be collected on processes and projections needed for modeling cyanoHABs and directing management actions. The SF Bay RMP's management questions could be used as a model for developig management questions for cyanoHABs. The RMP's management questions are:	Noted

Taberski	N/A	1. Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely? a. Which chemicals have the potential to impact humans and aquatic life and should be monitored? b. What potential for impacts on humand and aquatic life exists due to contaminants in the Estuary ecosystem? c. What are appropriate guidelines for protection of beneficial uses? d. What contaminants are responsible for observed toxic responses?	Noted
Taberski	N/A	2. What are the concentrations and masses of contaminants in the Estuary and its segments? a. Do spatial patterns and long-terms trends indicate particular regions of concern?	Noted
Taberski	N/A	3. What are the sources, pathways, loadings, and processes leading to contaminant-related impacts in the Estuary? a. Which sources, pathways, and processes contribute most to impacts? b. What are the best opportunities for management intervention for the most important contaminant sources, pathways, and processes? c. What are the effects of management actions on loads from the most important sources, pathways, and processes?	Noted
Taberski	N/A	4. Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased? A. What are the effects of management actions on the concentrations and mass of contaminants in the Estuary? B. What are the effects of management actions on the potential for adverse impacts of humans and aquatic life due to Bay contamination?	Noted
Taberski	N/A	5. What are the projected concentrations, masses, and associated impacts of contaminants in the Estuary? A. What patterns of exposire are forecast for major segments of the Estuary under various management scenarios? B. Which contaminants are predicted to increase and potentially cause impacts in the Estuary?	Noted
Thompson	ii	You only have four, not five, major findings identified in the Executive Summary section	Corrected
Thompson	iii	Under Finding #3, first bullet, second sentence relating to temperature for growth: Should we specifiy the time frame over which the temperature is measured? e.g., instantaneous, daily average, daily max or min. This will matter more when we get to modeling phytoplankton dynamics.	Save for the modeling

Thompson	19	Under section 3, first sentence: Correct spelling of word "prompted" by adding a "p" between "m" and "t".	Done
Thompson	20	Under section 3.1, in sentence "Indeed, recent decades has witnessed…" Replace word "has" with "have".	Done
Thompson	20	Under section 3.2.1, first paragraph, reference Edmondson and Lehman 1981 was not included in the reference section.	Done
Thompson	21	Under Cellular N:P compostion section: Reference Mills *et al.* was not included in the reference section and date missing in citation.	Corrected; citation added
Thompson	22	Under Confounding Factors, third sentence: Should we introduce the concept that there may be time lags between nutrient uptake and increased biomass, such that a correlation between two variables at a given point in time may not imply causality?	Good idea; sentence added under confounding factors on page 23 of revised manuscript.
Thompson	22	Under Confounding Factors, third sentence discussing parameters: Is there a diagram from a paper or textbook that we could borrow and reference, that shows the patterns of these variables over time before, during and after a bloom? (e.g., temperature, nutrient concentration, nutrient uptake rate, phytoplankton biomass). Something to show phytoplankton biomass peaking as nutrients draw down.	I found one diagram that showed a dinoflagellate peaking as nutrients were drawn down but nothing for cyanobacteria; after looking for the same pattern for cyanobacteria for half day I gave up
Thompson	27	Last paragraph under section 3.6 on stratification and residence time: Suggest adding a brief discussion of the potential role of ferrous iron. See Molot *et al.* 2014. A novel model for cyanobacteria bloom formation: the critical role of anoxia and ferrous iron. Freshwater Biology 59:1323-1340. The article mainly deals with lakes but there is a section on page 1330 that mentions shallow, nearshore regions of lakes, including harbors, inshore areas of Lake Erie, and embayments of Georgian Bay (Lake Huron). [**Text from Introduction shown on next line**.]	The potential role of toxins acting as siderophores and aiding cyanobacteria with iron uptake providing an advantage in competition with eukaryotes is discussed in a new expanded paragraph on p. 19 and the Molot *et al.* citation has been added to this section.

Thompson	27	**Here's some text from the Introduction**: "We cannot predict with any certainty when a cyanobacteria bloom will begin once temperatures are warm enough to support growth or the duration of a bloom except through empirical observations from previous years. Nor do we know why the problem is worsening in some mesotrophic systems." "Clearly, the predictive state of cyanobacteria science is unsatisfactory. This dissatisfaction may have contributed to the recent debate challenging he supremacy of the P paradigm in eutrophication management. Wurtsbaugh, Lewis, Paerl, and their colleagues argue that N plays a major role alongside P in promoting cyanobacteria blooms and that both N and P should be controlled (refs). This argument has been vigorously challenged in return by Schindler and his colleagues who claim that controlling N to control cyanobacteria will not work because N-fixation by cyanobacteria will compensate to a large extent for induced N shortages (refs). The outcome of this on-going debate can be expected to influence the direction of billions of dollars in public expenditures to remedy nutrient loading." "Our purpose here is to present a novel model that does not supplant the important roles of P and N as major macronutrients, but instead weaves additional ideas into older ones to create a novel and more comprehensive conceptual framework with much more explanatory power that spans the range of conditions where cyanobacteria blooms have been observed."	Noted
Thompson	28	Under section 4.1 Ecosystem Services, second paragraph, Reference Sommer *et al.* 1997 not included in reference section.	Citation added
Thompson	30	Figure 4.1 - Can we get a higher resolution version of this map? It was blurry in the original Word version, prior to becoming a Google doc.	Will investigate
Thompson	36	Under section 5.0, first paragraph, last sentence: Should we specify that the variables may need to be time-lagged in order for the correlations to be apparent?	I actually prefer to be vague in case entirely different statistics are needed
Thompson	38	Under section 5.2, first paragraph, second sentence referring to Microcystis and Aphanizomenon becoming more common: Is the reference for this statement the Lehman 2007 paper? I think it would be worth referencing it again at the end of this sentence, or adding an additional reference as necessary.	This is based on Lehman's 2008 paper and the Mioni *et al.* 2012 report; thesecitations have been added
Thompson	38	Under section 5.2, second paragraph, second and fourth sentence refering to Figure 2: I think this is now [Figure] 3.3. Check Figure number.	Corrected: now figure 3.6

Thompson	39	Second full paragraph, reference to Figure 4.5: This information is not shown in this figure. Check your Figure number.	Correct, the reference to this figure has been deleted
Thompson	39	Second full paragraph, last sentence related to culture investigations: It would strengthen the point to reference (re-reference) some key papers here.	Done
Thompson	41	In Table 5.1, Observations in the Delta "when turbidity is <50 NTU, flow is <30 m^3s^{-1} and irradiance >50 µmol phot $m^{-2}s^{-1}$": Please briefly state where in the Delta this was measured, and over what spatial and temporal scale.	Done
Ward	N/A	**Comment 1:** Of the five questions the Work Group is tasked with answering, the first is to determine whether the principal physical and biological factors promoting cyanobacteria blooms and toxin production in the Delta have been identified. My reading of the current work in this area leads me to conclude that these factors have not yet been adequately characterized. More importantly, the critical task of accurately gauging the relative weight of various factors that are known to influence/control the formation of toxigenic (or other) blooms still seems beyond our capability at present, whether in the Delta or in other waterbodies for which some relevant data is available. These deficiencies are particularly problematic for the development of a model that has practical utility. The field work and laboratory studies on Delta water quality and Delta species involved with the Pelagic Organism Decline that were cited in the draft white paper and/or distributed to the Work Group are largely “Microcystis-centric” and “microcystin-centric”. There is, in my view, a very large risk in attributing (1) all significant microcystin production to Microcystis in the Delta, and; (2) focusing on microcystin(s) to the exclusion of the effects of other possible toxigenic genera and other cyanotoxins. Dr. Berg’s draft white paper duly notes the existence of many other toxigenic genera and other cyanotoxins, but it seems the Delta-specific research on these possibilities may not yet be available for review.	Noted; Please see new comment under section 4.2.3 on toxin data available from Central California demonstrating that very few detections of toxins other than microcystins have been made in the Delta

Ward	N/A	**Comment 1 continued:** This is not a trivial point: for example, various Aphanizomenon strains can produce saxitoxin, microcystin(s), cylindrospermopsin, BMAA, and anatoxin-a (Paerl & Otten, 2013), and Lehman *et al.* have noted the presence of this genus in the estuary, bay and/or Delta. Though it is quite possible that I have overlooked Delta-specific studies on Aphanizomenon strains which examined the possibility that one or more of these toxins is present, if it is true that these studies have not been conducted yet, it would be ill-advised to presume that microcystin(s) are some sort of "model" toxin that can be regarded as a generic equivalent of all of the others in a subsequent modeling exercise, especially given their chemical and toxicological heterogeneity. Similarly, the diazotrophic cyanobacteria such as Aphanizomenon may respond rather differently to "nutrient limitation" (of nitrogen) than the non-diazotrophic genera such as Microcystis. If both genera produce microcystins, then microcystin production per se may continue in a water body as nitrogen becomes more limiting for Microcystis. Comparisons of diazotrophic cyanobacteria with non-nitrogen fixing cyanobacteria to nitrogen-limited conditions tend to show the following pattern: diazotrophs (e.g., Aphanizomenon) tend to produce toxins such as microcystin under nitrogen-limited conditions, whereas non-nitrogen fixers such as Microcystis and Planktothrix increase toxin production under non-limiting conditions.	Not necessarily; please see Dolman 2012 citation for patterns of abundance of various species and toxin production in over 100 lakes in Germany under different N:P scenarios described in "Meta analyses of Lake Studies" on page 24.
Ward	N/A	**Comment 1 continued (references):** Holland, A., Kinnear, S. Interpreting the possible ecological role(s) of cyanotoxins: compounds for competitive advantage and/or physiological aide? Marine Drugs 2013, 11(7), 2239-2258 http://www.mdpi.com/1660-3397/11/7/2239 Paerl, H. Otten, T. Harmful Cyanobacterial Blooms: Causes, Consequences, and Controls. Microbial Ecology 2013 May;65(4):995-1010 http://www.unc.edu/ims/paerllab/research/cyanohabs/me2013.pdf Leao, P. *et al.* The chemical ecology of cyanobacteria. Natural Products Reports, 2012 Mar;29(3):372-91 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4161925/pdf/nihms-599340.pdf	
Ward	N/A	**Comment 2:** Given my time limitations for reviewing more recent work on how/whether nutrient management can reduce the magnitude and frequency of cyanobacteria blooms and toxin formation, I was unable to conduct the review I had originally anticipated on this question.	Noted

Ward	N/A	**Comment 3:** I believe the draft white paper correctly examines and compares the relative significance of various factors in controlling the growth and development of toxigenic blooms based on the limited data now available on this subject that is "Delta-specific". However, as stated in answer to Question 1 (above), I also believe the factors considered, while appropriate, are nevertheless an incomplete list. At our meeting I mentioned the apparent role of competition for iron as a factor in bloom formation and dominance in freshwater ecosystems, and provided a citation for this. Other factors which should be considered include the differences in sensitivity to herbicides between cyanobacteria and other phytoplankton that are being reported in studies conducted elsewhere, and the role of allelopathy in bloom formation, dominance, and senescence. Allelopathy is also discussed in references provided in answer to Question 1. For pesticides – in this case, I focused on herbicides – please refer to references provided below.	Allelopathy was dicussed in the original version of the White paper under "Potential Functions of toxin production" on page 18. Two new references have been added to the previous references on allelophathy in this section.
Ward	N/A	**Comment 3 continued (references):** The USGS maintains an online geo-referenced database which charts the most commonly-used pesticides in CA as they have continued to change in recent years that is current through 2012: http://water.usgs.gov/nawqa/pnsp/usage/maps/compound_listing.php Lurling, M., Roessink, I.On the way to cyanobacterial blooms: Impact of the herbicide metribuzin on the competition between a green alga (Scenedesmus) and a cyanobacterium (Microcystis). Chemosphere, 2006, 65:4, 618-626. Peterson, H. *et al.* Toxicity of hexazinone and diquat to green algae, diatoms, cyanobacteria and duckweed. Aquatic Toxicology, 1997, 39(2), 111-134. Arunakumara, K. *et al.* Metabolism and degradation of glyphosate in aquatic cyanobacteria: a review African Journal of Microbiology Research, 2013 Vol. 7(32), pp. 4084-4090. http://www.academicjournals.org/article/article1380269900_Arunakumara%20et%20al.pdf	The potentially important influence of herbicides and fungicides on the prevalence of cyanobacteria vis-à-vis other phytoplankton is discussed in a new Section 3.7 on p. 31 and again under Section 4.2.1 p 33. Because concentrations of herbicides in the Delta have been demonstrated to be quite high, a recommendation has been added that selective sampling for herbicides and pesticides be instituted in the Delta.
Ward		**Comment 4**: In answer to this question, please see the additional references supplied in answer to Questions (1) and (3).	A citation by Holland and Kinnear (2013) has been added on the benefits of toxin production under iron limiting conditions as mentioned in previous comments.

Ward	N/A	**Comment 5:** Overall, I agree with the draft recommendation put forward regarding monitoring of CyanoHABs (Recommendation 1), but would place more emphasis on monitoring for more immediate threats to public health e.g., intakes for drinking water treatment plants either within the bloom-prone areas of the Delta. The waterboard's drinking water program staff has informed me that some public water supply systems are struggling to successfully contend with this issue elsewhere in California, and this may also be a recurrent problem for smaller communities in the Delta. With perennially limited resources, public health protection should be given the highest priority, followed closely by protection of beneficial uses such as threatened/endangered species already impacted by the Pelagic Organism Decline, and a (seasonal?) surveillance program for areas of the Bay/Delta which experience periods of frequent and prolonged recreational uses water-contact uses, fishing, etc. With respect to Recommendation 2, I am unclear as to what the model being described is intended to accomplish: will it, if properly deployed, facilitate successful toxigenic bloom "forecasting"? Will use of whatever model results from this development process be of assistance, say, to managers of local public water supplies whose intakes are situated in the Delta? Having worked on this issue for ten years, I am concerned that our scarce resources are not being directed at immediate (& often seasonally recurrent) cyanotoxin hazards, and that local public health officials and water system managers have too few resources to respond effectively, and in a timely manner, when these episodes occur.	Noted

Ward	N/A	**Comment 5 continued:** As an example, last year the public water supply system for 400,000 people in the greater Toledo area were shut down, causing a public emergency and immediate potable water shortage for the entire population, when a microcystin-producing Microcystis bloom swamped the treatment plant's capacity to remove it in the "finished" drinking water. The National Guard was called-up to help deliver potable to this large urban population, and the problem did not abate for several days. Prior to this episode, NOAA had been doing quite a bit of modeling, bloom-forecasting, and other scientific investigations on these recurrent toxigenic blooms on western portion of Lake Erie where Toledo area residents obtain their public water supplies. The NOAA investigations remain on-going, and no doubt have provided much useful information on the role of various environmental factors in bloom formation: their "mission", however, is not to protect specific public water supplies from catastrophic events such as this episode. http://www.washingtonpost.com/news/post-nation/wp/2014/08/04/toledos-water-ban-and-the-sensitivity-of-our-drinking-systems/	Noted

APPENDIX C

Comments from the Stakeholder and Technical Advisory Group (STAG) members and responses from the authors.

Author	Page	Comment	Response
Lee	N/A	Overall Comment: The findings expressed in the draft white papers are consistent with our many years of experience investigating nutrient-related water quality, our findings in investigating Delta nutrient impacts and control of excessive aquatic plants, as well as with the findings expressed in presentations made at the CWEMF Delta Nutrient Modeling Workhop discussed below.	Noted
Lee	N/A	There remains little ability to quantitatively and comparatively describe the role of nutrients (N and P) in controlling the excess fertilization of the Delta waters.	Noted
Lee	N/A	There is considerable misinformation in the professional arena on the relative roles of N and P concentrations and loads, and the ratios of N to P in affecting water quality in the Delta; some of the information presented on nutrient/water quality issues is biased toward preconceived positions.	Noted
Lee	N/A	Based on the results of the US and international OECD eutrophication study and our follow on studies of more than 600 waterbodies worldwide (lakes, reservoirs, estuarine systems) the planktonic chlorophyll levels in the Central Delta are well-below those that would be expected based on the phosphorus loads to the Delta.	Noted
Lee	N/A	There is a lack of understanding of the quantitative relationship between nutrient loads and fish production in the Delta.	Noted
Lee	N/A	The Delta Stewardship Council's timetable for developing Delta nutrient water quality objectives by January 1, 2016, and to adopt and begin implementation of nutrient objectives, either narrative or numeric as appropriate, in the Delta by January 1, 2018 is unrealistically short.	Noted
Lee	N/A	There is need for substantial well-funded, focused, and intelligently guided research on Delta nutrient water quality issues over at least a 10-yr period in order to develop the information needed to generate a technically sound and cost-effective nutrient management strategy for the Delta.	Noted
Lee	N/A	As discussed in our writings, some of which are noted below, it will be especially dfficult to develop technically valid and cost-effective nutrient control programs for excessive growths of macrophytes in the Delta.	Noted

Mioni	3	#2: pH may also be important (I see some correlations and I think Raphe mentioned a report). I believe some cyanobacteria can be more competitive when pH increases due to CO2 concentrating mechanism. I think Alex Parker did some research on the Delta pH... Also, the residence time may be affected by the pumping station located near the EMP Old River D28 station (a station with typically high Microcystis abundance).	Noted
Mioni	13	last paragraph: Please talk to Anke Mueller-Solger. I believe Microcystis was there before 2000 but was simply not monitored as closely or did not cause such bloom.	Noted
Mioni	16	Carbon fixation: I would include a few reference to the cyanobacteria carbon concentrating mechanism.	Noted
Mioni	16	Table 2.3: Microcystin LD50 varies depending on the variant	Noted
Mioni	20	typo "preceding"	Noted
Mioni	21	N:P ratio: I would cite Hans Paerl as well. I believe he has shown (in Lake Taihu?) that the N:P ratios were not so fixed for cyanobacteria.	Noted
Mioni	29	Salinity: I think Pia Moissander did phylogenetic studies in the SFBD and has shown that there were two types of Microcystis, one of those was associated with higher salinity.	Noted
Mioni	31	I agree that absolute concentrations of nutrients is more relevant than N:P ratios with regards to cyanobacteria. I believe Hans Paerl also demonstrated this (Nature paper? I can't recall the exact source).	Noted
Mioni	37	last paragraph: typo "water column"	Noted
Mioni	39	Old River stn (D28) usually has the highest abundance based on my monitoring. Antioch also has a high abundance of Microcystis. Pia Moisander's paper show that there may be two different strains (different requirements?) between antioch and other stations. It varies between years at other stations (see attached examples but please do not use as this is for the paper I am writing...)	Noted

Mioni	40	It really depends on the year. Aphanizomenon was very sporadic before 2011 and I focused on enumerating Microcystis which was the dominant cyanoHAB. But in 2011, Aphanizomenon was pretty significant. The tricky part here is that the Aphanizomenon cells are much larger than Microcystis so even if Aphanizomenon doesn't reach the cell density of Microcystis, it doesn't mean they are not dominating the bloom (e.g. 2011, it would clog my filters pretty quickly at some stations)... In 2012, Microcystis abundance was higher than in 2011 but Apha was still pretty abundant. I think that the "bloom" classification based on cell density should be revised to take into account the biovolume... Cell counts can be misleading.	Noted
Mioni	44	There is definitely variations explained by the method but there are also variations due to heterogeneity, patchiness and temporal variation. In Clear lake, while on station (within maybe 30min or less), we could see the scum moving very quickly with the wind. Also, the two net samples mostly applies to colonial forms of Microcystis although it occurs also as single cells and microcolonies. Another bias is the cell count. Prior to do my cell counts, I was homogenizing the samples by dislocating the colonies physically (based on prior research and comparison). I suspect that not dislocating the colonies prior to do the cell count may result in bias as the person enumerating the cells may not be able to count accurately as colonies can be more 3D than 2D (I hope it makes sense)... Although there is a bias in all methods, I do not think I ever collected samples in the same time than Peggy and at the same location. Thus, the comparison is a little puzzling to me. We never did intercomparison of the cell enumeration from the same samples. It would be more relevant to compare methods for the toxicology work since we did intercomparison of methods for the same samples.	Noted
Mioni	48	"colonial Microcystis have been more common", see my comments regarding the bias of tow net sampling versus grad raw water samples...	Noted

Mioni	4 & 35	#3 and page 35, temperature: Lenny Grimaldo generated a logistic model based on my CALFED data (see attached) which shows that Microcystis bloom probability raises to 50% when surface water temperature reaches 25C. Also, I suspect there is a minimum temperature that would need to be sustained for several days if not week for a bloom to initiate.	Noted
Mioni	42-43	I think the SWAMP report could be cited, especially for the SPATT results.	Noted
Mioni	Fig 4.5	Figure 4.5: the axis are not labelled and I have trouble understanding this figure.	Noted
Mioni	48	I could not find the figure 2 mentioned here…	Noted

EXHIBIT 16

mercury by frequency, magnitude, and geographic extent such that the affected environment would be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby substantially increasing the health risks to wildlife (including fish) or humans consuming those organisms. Based on these findings, this impact is considered to be less than significant. No mitigation is required.

Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16

***NEPA Effects*:** The potential types of effects on mercury resulting from implementation of the Environmental Commitments under Alternative 4A would be generally similar to those described under Alternative 4 (see Section 8.3.3.9). However, the magnitude of effects on mercury and methylmercury at locations upstream of the Delta, in the Delta, and the SWP/CVP Export Service Areas related to habitat restoration would be considerably lower than described for Alternative 4. This is because the amount of habitat restoration to be implemented under Alternative 4A would be very low compared to the total proposed restoration area that would be implemented under Alternative 4. The small amount of habitat restoration to be implemented under Alternative 4A may occur on lands in the Delta formerly used for irrigated agriculture. Habitat restoration proposed under Alternative 4A has the potential to increase water residence times and increase accumulation of organic sediments that are known to enhance methylmercury bioaccumulation in biota in the vicinity of the restored habitat areas. Design of restoration sites would be guided by Environmental Commitment 12, which requires development of site-specific mercury management plans as restoration actions are implemented. The effectiveness of minimization and mitigation actions implemented according to the mercury management plans is not known at this time, although the potential to reduce methylmercury concentrations exists based on current research. Although Environmental Commitment 12 would be implemented with the goal to reduce this potential effect, there remain uncertainties related to site-specific restoration conditions and the potential for increases in methylmercury concentrations in the Delta in the vicinity of the restored areas. Therefore, the effect of Environmental Commitments 3, 4, 6–12, 15, and 16 on mercury and methylmercury is considered to be adverse.

***CEQA Conclusion*:** There would be no substantial, long-term increase in mercury or methylmercury concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to the SWP/CVP Export Service Areas due to implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 relative to Existing Conditions. However, in the Delta, due to the small amount of tidal restoration areas proposed, relative to Existing Conditions, uptake of mercury from water and/or methylation of inorganic mercury may increase in localized areas as part of the creation of new, marshy, shallow, or organic-rich restoration areas. Although not quantifiable, on a local level, increases in methylmercury concentrations may be measurable. Methylmercury is CWA Section 303(d)-listed within the affected environment, and therefore any potential measurable increase in methylmercury concentrations would make existing mercury-related impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans. Design of restoration sites would be guided by Environmental Commitment 12, which requires development of site-specific mercury management plans as restoration actions are implemented. The effectiveness of minimization and mitigation actions implemented according to the mercury management plans is not known at this time, although the potential to reduce methylmercury concentrations exists based on current

research. Although Environmental Commitment 12 would be implemented with the goal to reduce this potential effect, the uncertainties related to site specific restoration conditions and the potential for increases in methylmercury concentrations in the Delta result in this potential impact being considered significant because, as described above, any potential measurable increase in methylmercury concentrations would make existing mercury-related impairment measurably worse. No mitigation measures would be available until specific restoration actions are proposed. Therefore, this impact is considered significant and unavoidable.

Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and Maintenance

Upstream of the Delta

As described for Alternative 4 (in Section 8.3.3.9), nitrate levels in the major rivers (Sacramento, Feather, American) are low, generally due to ample dilution available in the reservoirs and rivers relative to the magnitude of the point and non-point source discharges, and there is no correlation between historical water year average nitrate concentrations and water year average flow in the Sacramento River at Freeport. Consequently, any modified reservoir operations and subsequent changes in river flows under Alternative 4A, relative to Existing Conditions or the No Action Alternative (ELT), are expected to have negligible, if any, effects on average reservoir and river nitrate-N concentrations in the Sacramento River watershed upstream of the Delta.

In the San Joaquin River watershed, nitrate concentrations are higher than in the Sacramento River watershed, owing to use of nitrate based fertilizers throughout the lower watershed. The correlation between historical water year average nitrate concentrations and water year average flow in the San Joaquin River at Vernalis is a weak inverse relationship—that is, generally higher flows result in lower nitrate concentrations, while low flows result in higher nitrate concentrations (linear regression r^2=0.49; Figure 2 in Appendix 8J, *Nitrate*). Under Alternative 4A, long-term average flows at Vernalis would decrease an estimated 1% relative to Existing Conditions and would remain virtually the same relative to the No Action Alternative (ELT). Given the relatively small decreases in flows and the weak correlation between nitrate and flows in the San Joaquin River, it is expected that nitrate concentrations in the San Joaquin River would be minimally affected, if at all, by anticipated changes in flow rates under the No Action Alternative (ELT).

In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea level rise. These effects would occur independent of the alternative and, thus, the alternative-specific effects on nitrate in the LLT are expected to be similar to those described above.

Any negligible changes in nitrate concentrations that may occur under Alternative 4A in the water bodies of the affected environment located upstream of the Delta would not be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade the quality of these water bodies, with regard to nitrate.

Delta

Mass balance calculations indicate that under Alternative 4A relative to Existing Conditions and the No Action Alternative (ELT), nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Table 34). Although changes at specific Delta locations and for specific months may be substantial on a relative basis (Appendix

EXHIBIT 17

requirement. The NEPA analysis isolates the effect of the alternative from the effects of sea level rise, climate change, future water demands, and implementation of required actions such as the Fall X2 requirement.

When compared to NAA_ELT and informed by the NEPA analysis, the average delta smelt abiotic habitat index under Alternative 4A restoration would be similar to NAA_ELT with Fall X2 under Scenarios H3_ELT and H4_ELT. Overall, there would be a beneficial impact on the species compared to existing conditions without Fall X2. Therefore, since Alternative 4A would benefit rearing delta smelt because the abiotic habitat index would be greater than Existing Conditions, the impact would be less than significant. No mitigation would be required.

Table 11-4A-3. Differences in Delta Smelt Fall Abiotic Index between Alternative 4A (Scenarios H3_ELT and H4_ELT) and Existing Biological Conditions Scenarios, Averaged by Prior Water Year Type

	EXISTING CONDITIONS vs. Alternative 4A		NAA_ELT vs. Alternative 4A	
Water Years	H3_ELT	H4_ELT	H3_ELT	H4_ELT
All	1,150 (29%)	1,184 (30%)	99 (2%)	132 (3%)
Wet	2,478 (53%)	2,485 (53%)	38 (1%)	46 (1%)
Above Normal	2,013 (53%)	2,032 (53%)	68 (1%)	88 (2%)
Below Normal	271 (7%)	354 (9%)	232 (6%)	316 (8%)
Dry	150 (4%)	212 (6%)	161 (5%)	222 (6%)
Critical	9 (0%)	11 (0%)	9 (0%)	11 (0%)

Note: Negative values indicate lower habitat indices under alternative scenarios. Water year 1922 was omitted because water year classification for prior year was not available.

Impact AQUA-6: Effects of Water Operations on Migration Conditions for Delta Smelt

As described for Alternative 4, the initiation of delta smelt upstream migration is associated with pulses of freshwater inflow, which are turbid, cool, and less saline (Grimaldo et al. 2009). Changes in flow under Alternative 4A could change turbidity, but are not expected to result in changes in water temperatures or pulses of local rainwater into the Delta. As described above in Impact AQUA-4 and in the discussion of Alternative 4, in-Delta water temperatures would not change in response to Alternative 4A flows. The modeling results indicate no biologically meaningful changes in water temperature within the Delta under Alternative 4, and this would also be the case for Alternative 4A.

As described in more detail for Alternative 4, turbid water is an important habitat characteristic for delta smelt (Nobriga 2008; Feyrer et al. 2011). Operation of the north Delta intakes (water conveyance facilities) is estimated to result in around 11%[2] of sediment being removed from the Sacramento River, the main source of sediment for the Delta and downstream subregions. In addition, sediment could be accreted (captured) in restored areas (*Environmental Commitment 4 Tidal Natural Communities Restoration*) ; see Impact AQUA-220. These actions could limit sediment supply to areas currently important to delta smelt, such as Suisun Bay, which would result in less seasonal deposition of sediment that could be resuspended by wind-wave action to make/keep the overlying water column turbid. Therefore, there is a potential for a slight increase in water clarity,

[2] This estimate is from the working draft Biological Assessment for the California WaterFix.

EXHIBIT 18

Independent Review Panel Report for the 2016 California WaterFix Aquatic Science Peer Review

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Scope and Purpose of the Review: This report presents the findings of the 2016 California WaterFix Aquatic Science Peer Review. An Independent Review Panel was convened by the Delta Science Program to provide the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and California Department of Fish and Wildlife (CDFW) with an independent scientific evaluation of the methods and approaches for developing the joint Biological Opinion requirements and analyses prepared for the CDFW 2081(b) Incidental Take Permit application for the California WaterFix.

The Panel was charged with reviewing: (1) selected sections of the Biological Assessment (BA) that seeks to predict the effects of the WaterFix project on Endangered Species Act (ESA)-listed species and their designated critical habitats, (2) the draft Analytical Approach to developing the joint Biological Opinion (AABO) and (3) the proposed methods for assessing project effects on Longfin Smelt.

After reviewing a set of documents (Appendix 1), the Panel participated in a public meeting in Sacramento, CA on April 5-6, 2016. On the first day of this meeting, the Panel interacted with agency representatives following their presentations on the three topics above. On day 2, the Panel communicated and discussed its preliminary findings to agency representatives and the public. This report summarizes the Panel's findings and recommendations in full detail.

Executive Summary

The new water dual conveyance facilities proposed as part of the CA WaterFix (WaterFix or CWF) project would create substantial changes in the aquatic environment of the lower San Joaquin and Sacramento Rivers, the Delta, and downstream estuarine areas. The construction and operation of the Waterfix facilities must comply with U.S. Endangered Species Act (ESA) Section 7(a)(2). As part of the ESA consultation, the US Bureau of Reclamation (Reclamation) and the CA Department of Water Resources (DWR) have written an extensive Biological Assessment (BA) that projects the future effects of the new facilities on ESA-listed species and their designated critical habitats. In addition, National Oceanographic Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) are evaluating the effects of the proposed CWF on listed species and their designated critical habitats and are working towards the development of a joint Biological Opinion (BO). Further assessment under the California Endangered Species Act (CESA) also includes the analytical framework proposed for the incidental take analysis for Longfin Smelt that is listed under CESA.

The Independent Review Panel (Panel) was charged with reviewing sections of the BA, as well as the draft Analytical Approach to developing the BO. The Panel was asked to focus on those BA sections (Appendix 1) that project the future effects of facility construction and the completed, operational project on listed salmonids and smelt species. Potential effects during operation could arise from withdrawals at the new water intakes on the Sacramento River, altered physical structure and water flow patterns at the existing southern Delta pumping facilities, altered spawning and rearing habitat in the rivers, Delta, and estuary, altered river-flow regimes, changing future climate, and other future changes in the aquatic environment. The Panel was charged with evaluating whether the models, analytical methods, and assumptions used in the BA, and their uncertainties, were clearly described and were based on the best available science.

The Panel finds that the best available science was generally used as a basis for the BA's models and analytical methods and that these were adequately described. The Panel also supports the BA's consistent strategy of comparing the projected effects on fish of the Proposed Action (PA) versus a No Action Alternative (NAA), under future scenarios of environmental conditions that were constructed from historical time series and adjusted to include likely trends of climate change.

However, the best available science for the greater Delta area is inhibited by important knowledge gaps and that science often provides only piecemeal and quantitatively uncertain projections of future environmental conditions in the Delta area and of fish responses to those conditions. In this report, the Panel identifies many of these knowledge gaps and uncertainties in the BA, some of which could be addressed during the development of the BO. Most of the gaps, however, can only be addressed by extended future research, monitoring, and adaptive management in construction and operational phases. As a result, a BA written in 2016 cannot realistically reduce the uncertainties of most of its model projections. And, while the BA acknowledges many uncertainties about species response to direct impacts (e.g., entrainment at North Delta Diversions or southern Delta facilities), the systematic and cumulative effects from more indirect sources (e.g., food web, predators) have equally great uncertainties and require more consideration.

The Panel finds that the best available models are currently being used to simulate water transport throughout the Delta and its watershed, with some concern expressed for reliability of these models. However, the Panel had greater concerns about future sediment movement and water quality, and in particular, about whether the North Delta Diversions (NDD) might exacerbate the downstream sediment starvation that is already occurring. The Panel also feels that the BO should consider potential changes to fluvial and tidal fish habitat throughout the Delta and not just near the NDD and southern Delta facilities, due to systematic changes in inundation and salinity that would be caused by PA operations. Finally, the Panel suggests that projected climate change influences should extend beyond 2030, in spite of their significantly greater uncertainties.

The Panel finds that the salmonid survival models are generally adequate, although they do not capture the relative timings of peak flows and outmigration of the more vulnerable life history stages. In addition, possible depensatory mortality is not considered, nor is the cumulative effect, over a sequence of dry years, of predicted greater mortality under the PA, for juvenile Chinook Salmon. The Panel also finds that possible screen-impingement and predation effects on salmonids at the NDD are likely to require targeted adaptive management experimentation. We are also concerned that important changes in location and timing of available rearing and migratory habitat under the PA are not being captured by BA model projections, nor are the effects of the PA on salmonid predators such as Striped Bass. The Panel approves of using the Viable

Salmonid Population framework (McElhany et al. 2000) in the draft AABO. However, the data are limited and the uncertainty is high for applying that framework to Delta salmonids.

The BA analyses for Delta Smelt comprehensively addressed the effects of numerous factors on all life stages. However, as with salmonids, each of the single-factor analyses was independent of the others and no analysis assessed cumulative effects in the context of a full life cycle/population model. The Panel noted the uncertainties surrounding potential beneficial effects of the PA, potential negative effects, and probable neutral effects. The key projected beneficial effects are reduced entrainment at the southern Delta facilities. The BA's considerations of screen impingement effects at the NDD, potential habitat loss, and turbidity reductions were felt to be highly uncertain. In particular, the Panel recommends additional evaluation of PA effects in the Suisun Marsh area which studies have identified as high-abundance Delta Smelt habitat. The Panel also finds high uncertainties about the PA's effects on Delta Smelt's predators and food sources.

The draft Analytical Approach for Longfin Smelt is hampered by little information on Longfin Smelt population dynamics and abundance. The Panel finds that this knowledge gap results in high uncertainty of the BA's comparisons of PA and NAA effects, particularly on Longfin Smelt entrainment at the southern Delta facilities. The BA and the Analytical Approach also employ a particle tracking model (PTM) to estimate the fate of smelt larvae as passive drifters; however, the Panel has highlighted some known concerns about the PTM analyses. Because so little quantitative knowledge exists about the Delta's Longfin Smelt population, the Panel reinforces the BA's emphasis on real-time operational management and monitoring to minimize Longfin Smelt entrainment effects under the PA.

The Panel noted that the BA's quantitative comparisons of PA and NAA effects have two major sources of uncertainty: the uncertainty of future environmental conditions, and the model-prediction uncertainty of how fish will respond to those conditions. Although the BA does a good job of representing the first source, the Panel finds that the BA often understates and misinterprets model-prediction uncertainty. The Panel recommends specific methods to increase the realism of uncertainty estimates and interpretations in the BA. Because high uncertainty is a pervasive issue in the BA comparisons of NAA and PA, the Panel also recommends that the Analytical Approach

to the BO should describe how this uncertainty will be formally and quantitatively incorporated into the BO's decision-making process.

The substantial uncertainties of nearly all BA analyses are the dominant theme of the Panel's findings. If the WaterFix project goes forward, the Panel believes that its uncertain impacts on ESA-listed fish species can only be addressed by a vigorous, well-supported, protective program of "active" adaptive management (AM), and by application of the precautionary principle when developing the BO. The Panel articulates this view more fully within the report and outlines the essential components of a successful AM program. The Panel also recommends that the Analytical Approach to the BO describe how the AM design and implementation for WaterFix will be evaluated.

Table of Contents

Executive Summary ……. 3
1. Introduction…….. 8
    1.1. Background…….. 8
    1.2. Charge to the Panel, with Panel Responses…….. 9
    1.3. Acknowledgements……. 14
2. General Comments from the Panel……. 15
    2.1. Modeling of Hydrodynamics, Climate Change, and Habitat…… 15
    2.2. Effects on Salmonids……. 22
    2.3 Effects on Delta Smelt …….. 33
    2.4 Effects on Longfin Smelt…… 46
    2.5 Estimating and Interpreting Quantitative Uncertainties ……. 49
    2.6 Adaptive Management …….. 53
3. List of Recommendations……60
4. References……..62

Appendix 1 - Materials for CA WaterFix Aquatic Science Peer Review – Phase I
Appendix 2 - Memo to the Panel on modeled Sacramento River flows.

1. Introduction

1.1 Background

As part of its formal charge**,** the Panel was given the following background for its review, which we quote in its entirety:

> "The Bureau of Reclamation (Reclamation) and the California Department of Water Resources (DWR) coordinate the operation of the Central Valley Project (CVP) and the State Water Project (SWP). As part of the California WaterFix (CWF), DWR proposes to construct and operate new water conveyance facilities in the Sacramento–San Joaquin River Delta, including three intakes, two tunnels, associated facilities, and a permanent head of Old River gate; as well as operate existing southern Delta facilities in coordination with these new facilities.
>
> Because the operation of the CVP/SWP is coordinated, Reclamation is the lead agency for the Endangered Species Act (ESA) Section 7 consultation. This consultation is also intended to address consultation with the U.S. Army Corps of Engineers to issue permits pursuant to Rivers and Harbors Act Section 10, Clean Water Act Section 404, and 33 United States Code 408. It is understood that additional consultation on the U.S. Army Corps of Engineers permitting may be required as the CWF is more fully developed.
>
> As noted above, the construction and operation of the new dual conveyance facilities will need to comply with ESA Section 7(a)(2). As part of the CWF ESA consultation, Reclamation and DWR have written a Biological Assessment (BA) that summarizes the effects of the action on ESA-listed species and their designated critical habitats. NOAA's National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) are evaluating the effects of the proposed CWF on listed species and their designated critical habitats and are working towards the development of a joint Biological Opinion (BO).

In addition to complying with ESA, DWR intends to obtain California Endangered Species Act (CESA) authorization from the California Department of Fish and Wildlife (CDFW) under Fish and Game Code section 2081(b) for incidental take related to the construction and operation of the CWF and modified operations of the SWP. DWR will submit an application which will include an analysis of the effects of the proposed action on CESA listed species. CDFW will review the CESA-specific analysis of the perceived impacts for state-listed species and may issue a permit if conditions in Fish and Game Code sections 2081(b) and (c) are met.

The purpose of this independent review is to obtain the views of experts not involved in the ESA consultation and 2081(b) permit on the use of the best available scientific information, as it pertains to aquatic ESA and CESA listed species (aquatic species) in the development of the NMFS/FWS BO and the CDFW 2081(b) permit."

End of quote.

1.2 Charge to the Panel, with Panel Responses

In this section, we state the Charge to the Panel, in bold. We also give a brief Panel response, in italics, to each of the specific Charge items. Details of Panel responses are given in Chapter 2.

The Charge was stated as follows:

The Panel will review 1) the draft BO analytical approach (AABO), 2) specific BA analyses (which have been agreed upon by the fisheries agencies and identified in the Panel charge), and 3) the approach to analyzing the effects to Longfin Smelt. Since these items will provide the basis of the joint BO and 2081(b) permit, the review should evaluate whether the items are of sufficient robustness and scientific quality to serve their intended purposes. The Panel members will have at least 30 days to familiarize themselves with the materials. The Panel will

also be given relevant background information to consider and will receive presentations from the relevant agencies at the public meeting.

Specific scientific questions for review of the AABO, specific BA analyses, and Longfin Smelt analytical approach:

BO Analytical Approach

1. How well is the AABO designed to adequately assess potential responses of the target listed species to the effects of the proposed action (i.e., both direct and indirect effects of the project)? In answering this question, please consider the following:

How well the analytical approach for salmonids incorporates the Viable Salmonid Populations framework presented in McElhany et al. (2000), "Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units", and aligns with viability assessment approaches in Lindley et al. (2007), "Framework for Assessing Viability of Threatened and Endangered Chinook and steelhead in the Sacramento-San Joaquin Basin".

Panel response: The viable salmonid population (VSP) framework (McElhany et al. 2000) and the manuscript by Lindley et al. (2007) are excellent documents to guide the AABO for salmonids. The AABO is generally patterned on these documents. However, available information is likely insufficient to adequately address all VSP criteria, leading to high uncertainty of the PA effects on species viability. In addition, the AABO needs to heed the uncertainty issues raised by the McElhany et al. (2000) guidelines for the VSP framework.

How effectively conceptual models for target aquatic species are incorporated into the AABO.

Panel response: This could be improved. Several conceptual models are presented in the draft AABO that outline the assessment approach (e.g., Fig. 2-1, 2-2) and show how impacts on individuals can lead to impacts on populations and ESUs. A conceptual

model for factors affecting salmon in the southern Delta was also provided to the Panel (labeled as Fig. 1-4 from an unnamed Bay Delta Conservation Plan (BDCP) document). What is missing is a detailed conceptual model and description of how each ESA-listed species uses the Delta, including factors affecting growth and survival during each life history stage.

How well the analytical approach for target aquatic species explains how the exposure, response, and risk to listed individuals, populations, and diversity groups resulting from project operations will be assessed, and whether quantitative and qualitative methods and risk assessment tools are used appropriately.

Panel response: The AABO needs to address how its decisions will be made in the face of the high uncertainties in its quantitative projections of PA effects.

Whether the approach for assessing effects provides a scientifically defensible approach for evaluating new adverse effects to aquatic species in the north Delta in addition to any changes in adverse effects at existing south Delta facilities, and what improvements could be made.

Panel response: The BO will draw from the BA projections of new, future adverse effects in the northern Delta due to the PA. These projections do use the best available science. However, the uncertainty of such projections is especially high because there is no local precedent for a project of this type and scale and because existing models of fish response are uncertain. In other words, the best available science regarding northern Delta effects is quite speculative. Because of this uncertainty, we recommend that the AABO describe an approach that includes both active and passive adaptive management.

<u>Supporting Analyses for Target Aquatic Species</u>

2. How complete are the selected target aquatic species analyses in the BA for evaluating the potential effects of the project on the target listed species? In answering this question, please consider the following:

Whether the appropriate analytical tools (i.e., models) were used for the selected analysis and what, if any, additional currently available tools should be used.

Panel response: The BA models represent the 'best science available' for predictive purposes. However, it is widely believed that mechanistic, process-based models, such as life cycle/population dynamics models for fish, are capable of extrapolating biological responses to novel environmental conditions, such as those projected to result from the CWF project. Process-based population models have indeed been developed for ESA-listed fish species in the Bay Delta system. And yet, the BA is unable to use these models, because of their quantitative immaturity and lack of supporting data. Instead the BA relies heavily on simplistic noisy regression models of fish responses, a model structure widely viewed as unreliable for extrapolations. In addition, fish response models are only available for selected ESA-listed species and selected life-history stages. These limitations underscore the Panel's concern with the uncertainties of the BA's projected fish responses to future PA and NAA scenarios.

Whether assumptions are plainly stated and scientifically sound, and whether analytical uncertainties and limitations of methods in the BA aquatic species analyses and Longfin Smelt analytical approach are clearly stated.

Panel response: The assumptions are often clear and sound, but we note several exceptions below. In addition, quantitative uncertainties of fish response models are often understated. As a result, projected similarities of NAA and PA effects are less reliable than they appear.

External forcings of climate and sea level are represented by the central tendency (i.e., the "Q5 climate change scenario") of several climate projections for 2030. Whether the assumptions of that characterization are adequately described in the BA. Note what, if any, additional analyses would help to incorporate effects of climate change.

Panel response: The application of the Q5 scenario is sensible and adequately described. However, the Panel recommends that climate projections be made beyond

2030, because by that time the project will have only recently become operational. We recognize the greater uncertainty of longer-term climate projections, but at least they might suggest whether future conditions will still be within the operating range of current hydrodynamic and fish response models. Furthermore, with increasing climate effects, the magnitude of changes will increase after 2030.

How well the analyses incorporate information from existing synthesis reports (e.g., Management Analysis and Synthesis Team, Long-term Operations Biological Opinions reviews, species recovery plans, 2010 State Water Resources Control Board flow criteria report, etc.) and from responses to recommendations of past independent reviews (e.g., BDCP Effects Analysis review and ICF/DWR responses, etc.)

Panel response: We note that several concerns identified in BDCP reviews (e.g., Parker et al. 2014) have not been resolved by the BA, such as: (1) substantial and understated uncertainties about project effects on ESA species, (2) the lack of an integrated or quantitative assessment of net effects, and (3) the use of "passive learning" instead of a rigorous, institutionalized active and passive adaptive management process.

How adequately the BA analyses and Longfin Smelt analytical approach support a scientifically defensible approach for evaluating new adverse effects to aquatic species in the north Delta, and how adequately they support evaluating any changes in effects at existing south Delta facilities. Note what, if any, additional or alternative analyses are needed. How well the Longfin Smelt analytical approach supports evaluation of combined project operations effects on the target listed species.

Panel response: The best available science is generally used by the BA. However, that science is at best speculative when applied to the magnitude and novelty of change envisioned for the northern Delta. Substantial uncertainties and knowledge gaps remain concerning Longfin Smelt.

1.3 Acknowledgements

The Panel appreciates and acknowledges the substantial effort made by the agency and technical team representative and contractors who prepared the extensive BA and BO documents. We also thank them for their quick responses to Panel requests for additional information. The Panel is also indebted to Cliff Dahm (Lead Scientist), Sam Harader (Program Manager), and the select staff from the Delta Science for their logistical and organizational support. We especially thank Lindsay Correa for patiently addressing our questions about the complex and subtle institutional context of the Bay Delta system, and to Yumiko Henneberry for her rapid and efficient handling of logistics and communications.

2.0 General Comments from the Panel

This section contains detailed comments from the Panel on the Biological Assessment (BA) and on the draft Analytical Approach for the Biological Opinion (AABO). Our comments include specific recommendations to the agencies, labeled ***in bold italics.*** Some of these recommendations could be addressed as part of the BO. However, we recognize that others can only be addressed over a longer term; during planning, construction, and operations of the Proposed Action (PA).

Citations of the form "BA 6-20" refer to page 20 of Chapter 6 of the BA. Likewise, the form "BA A.5.G-30" denotes page 30 of BA Appendix 5.G. Finally, "AABO-40" cites page 40 of the AABO.

2.1 Modeling of Hydrodynamics, Climate Change, and Habitat

The Panel believes that the PA will create more than an incremental change to the Bay Delta system. It will effect major changes in hydrodynamics and associated transport throughout the system downstream of the North Delta Diversion (NDD), with uncertain consequences for fish and their critical habitats. For example, the PA would reduce the Sacramento River sediment load by 10%, and turbidity is known to be a key abiotic habitat factor for Delta Smelt.

In this section, we discuss hydrodynamics, sediment transport, habitat, and climate-change issues of relevance to the PA.

2.1.1 Hydrodynamics

Model output from the water transport models at both the watershed level (CalSim-II) and the Delta level (DSM2) are used as input in many of the other models used in the BA. Therefore, it is important that these models be applied appropriately.

The CalSim-II model is the best tool available for flow-routing optimization because it is specifically designed for the Sacramento and San Joaquin watersheds and incorporates their specific reservoir operating criteria and regulatory restrictions. There is no alternative model that could be considered for this application. During the public portion of the review meeting, the calibration/validation of the CalSim-II model was questioned (Des Jardins 2016). The claims presented to the Panel related to the nuances in the validation process may be valid. However, the details of CalSim-II model calibration and validation are beyond the scope of this Panel's review. It may be of

benefit in the future to have the CalSim-II model verification reviewed by a group such as the California Water and Environmental Modeling Forum.

The DSM2 model is a valid approach to predict salt concentrations in the Delta when large numbers of simulations are necessary, assuming that the bathymetry is not altered from the configuration used in the current calibration and verification of the model. However, there are limitations to how the model results can be interpreted, especially when adding particle tracking simulations. Particle tracking limitations will be discussed in more detail in the Longfin Smelt section of this report (Section 2.4).

The multi-dimensional hydrodynamic models of San Francisco Bay and the Delta are powerful tools that should be used in some cases where the DSM2 has limitations. As an example, it was appropriate to use the UnTRIM model to predict salinity intrusion due to sea-level rise (see section 2.1.4 for more discussion.) Unfortunately, multi-dimensional models take longer to run than the 1-D DSM2 model. In addition, the multi-dimensional models are only available through consultants. Therefore, the use of the multi-dimensional hydrodynamic models is limited even though these types of models are the best available science to address some questions.

2.1.2 Sediment and water quality

Changing the primary point of diversion of water export of the Delta to three inlet facilities in the northern Delta along the Sacramento River rather than from the southern Delta will result in major change in the circulation patterns and associated transport of water and constituents throughout the entire Delta system. Three physical parameters of ecological importance that will be altered are the distribution of sediment, salinity intrusion, and the ratio of source waters (Sacramento vs. San Joaquin) in the central Delta.

The Panel is concerned that NDD operations will increase the sediment starvation that is already occurring in the Delta (Schoellhamer et al. 2013), where approximately two-thirds of the sediment that enters the Delta is deposited in and sustains its marshes, sloughs, and mudflats. More than 80% of this sediment load originates from the Sacramento River, with the remainder from the San Joaquin River (Wright and Schoellhamer 2005). Therefore, it is important to consider not only how much sediment is exported from the Delta as a whole, but also consider whether there are critical habitats in the region of influence of that export site. Based on current water circulation patterns, the suspended sediment in the southern Delta has a low potential of

being transported to the Cache Slough complex in the northern Delta, where large wetland restoration projects are being constructed. However, suspended sediment in the Sacramento River, where the proposed north Delta facilities will export water and sediment, is highly likely to be transported to the Cache Slough complex.

BA Appendix 3.B, Conceptual 1 Engineering Report, Volume 1, Section 6.1.2 describes the NDD sedimentation system that is designed to reduce sediment delivery through the dual conveyance system. It cites "normal settling depth and the design WSE depth that will enable sands and coarse silt materials (particle size between 1.75 mm and 0.075 mm) to settle in the basins". However, note that particle sizes 0.075-1.75 mm are usually considered to be all sand, not "coarse silt". Table 6.5 in that document provides estimates of sediment loading to each intake and Table 6.6, showing the river's actual sediment particle distribution, suggests that more than 61% will not settle in the basins. Thus, only about 40% of the sediment load captured by the NDD will be available for “recycling” back into the system, given the caveat that contaminant levels of the retained coarse materials would allow such reuse. Furthermore, the material that will be exported to the southern Delta through the PA’s dual conveyance system will be the fine suspended sediments that provide the greatest benefits through accretion in tidal wetlands, to sustain elevation increases commensurate with sea level rise (Swanson et al. 2015), further starving the northern Delta tidal marsh habitat of juvenile Sacramento Winter-run Chinook Salmon, as well as turbidity, a key abiotic habitat characteristic for Delta Smelt.

One of the key ecological gauges for the Delta is X2. This is the distance in kilometers from the Golden Gate to the 2 ppt isohaline. One of the limitations of this parameter is that it does not accurately communicate salt intrusion once X2 is greater than 81 km. This location (Sacramento River at Collinsville, 81 km upstream of the Golden Gate) is the confluence of the Sacramento and San Joaquin Rivers. For values of X2 greater than 81 km, the parameter really should be reported for each river stem as X2-SAC and X2-SJR because salt intrudes up the Sacramento and San Joaquin stems of the Delta differently depending on magnitude of the flow coming from the San Joaquin and the Sacramento. Therefore, for dry or critically dry conditions with X2 > 81 km, the comparison of X2_SAC and X2_SJR would better report differences salinity intrusion along the Sacramento and San Joaquin stems. For the NAA scenario, the primary water export is on the San Joaquin stem. In contrast, the PA scenario primary exports water from the Sacramento stem.

The Sacramento and San Joaquin Rivers have significantly different water qualities, and the distribution of these sources waters in the central Delta is highly dependent on pumping operations (Monsen et al. 2007). As the system is operated now, the Franks Tract region is currently dominated by Sacramento-sourced water. Mildred Island can be either Sacramento- or San Joaquin-sourced water depending on export pump rates and temporary barrier configuration. With the PA, the likely water source in Franks Tract will likely shift to San Joaquin-dominated water. This shift in water source can be easily simulated with Delta hydrodynamic models.

2.1.3 Habitat

The analytical approach, particularly as expressed in the BA, emphasizes the footprint of the PA installations as the primary areas of Delta habitat changes. However, the BO should apply equal consideration to potential systematic changes to tidal-fluvial inundation and salinity intrusion as a result of the NDD. The BO needs to assure protection and recovery actions for at-risk fish populations throughout the Delta to address indirect effects, such as maintenance and expansion of the fishes' habitats both within the Delta and downstream where salinity intrusion is an important habitat attribute. The only other habitat issue discussed In the BA was the potential inundation of "low floodplain habitat benches" as possible mitigation of fish habitat lost to NDD construction. Yet, the quantity and quality of fish habitat in the Delta and at the transition between the western Delta and upper San Francisco Bay (specifically Suisun Marsh), is fundamentally dependent on Sacramento River inflow that should be considered both under current Delta hydrogeomorphology as well as future conditions above and beyond NDD operations.

Specifically, the BO should provide evidence that NDD planning, operations and adaptive management (AM) monitoring will take into account flooding regimes of both existing and future tidal wetland habitat (e.g., EcoRestore restoration of over 30,000 ac in next five years) and salinity intrusion under predicted climate change scenarios (i.e., sea level rise in the Delta on the order of 43 to 179 cm from 2000 to 2100 (Swanson et al. 2015). See also Section 2.1.4 for discussion on the timeframe to consider NDD operations under accelerated sea level rise and other climate factors). Salinity intrusion should also be a primary habitat factor for four fish species of concern—for juvenile Sacramento River Winter-run and Wpring-run Chinook Salmon because their ocean-type life history behavior is usually associated with extensive rearing in oligohaline habitats of

the estuary until they have reached smoltification state, and for Delta Smelt and Longfin Smelt because spawning and rearing habitats are suspected to be associated and expanded by extent of X2 positions at the edge of the western Delta.

Hydrodynamic modeling of the broader Delta system's response to NDD should also inform the BO of the effect of the NDD operational (rule-based) scenarios on tidal-fluvial flooding regimes in regions of fish spawning and rearing. For instance, ecological monitoring in the Cache Slough region, and specifically at Liberty Island, indicates that Delta Smelt spawning and rearing may be important in that region. Some of the key questions to ask are: (a) Will the post-PA sediment load at Liberty Island be sufficient for wetland restoration? (b) How will the tidal range change in the region?, and (c) What is the effect of changes in circulation on the beach regions in Liberty Island? Understanding the potential hydrological changes to the flooding regime and salinity intrusion due to the NDD in sensitive seasons of the Delta Smelt life cycle is fundamental to the BO. Furthermore, cumulative changes due to large-scale tidal wetland restoration in that region, which could progressively alter the tidal prism, should be incorporated into that modeling.

Channel junctions that link the Sacramento River to the central Delta should also be considered critical habitat. Currently, the Sacramento River junctions at the Delta Cross Channel and Georgiana Slough are hydrodynamically critical junctions. In current operations, these junctions are located at the transition point between uni-directional flow and bi-directional flow. When the NDD starts operating, this junction area will likely have primarily a tidal bi-directional flow. Therefore, fish will experience this decision point multiple times, which could divert the fish into the central Delta where mortality is likely to be higher.

2.1.4 Modeling Climate Change

Several steps are necessary to incorporate climate change into the hydrologic and hydrodynamic modeling. The charge question only asked about one sub-step, the "Q5 climate change scenario" selection. However, it is important to understand that there is a full suite of inter-related modeling steps that must occur to incorporate climate change.

Step 1 - The BA used a "Q5 climate change scenario" to identify a sub-set of all available General Circulation Models (GCM) to use. The GCM models in this sub-set projected time series of precipitation and temperature at locations throughout the

watershed. The Q5 approach achieves the stated goal of capturing the "middle" (median) temperature and precipitation changes, projected by a large number of differing climate projections (Figure 5.A.A.1-1, from A.5.A-788). The Q5 box of selected GCM models captures reasonable middle-of-the-road variation around these medians. The idea of using "averages" from a large number of climate projections is reasonable. It assumes only that the 112 projections, taken as a group, are not biased - that is, that their average does indeed represent something close to what the future will be. The Q5 box defines a Q5 "sub-ensemble" of GCM runs (all the points inside the box). The Panel assumes that all required statistics defining the Q5 scenario (e.g., temperature and precipitation yearly time series) are then derived by averaging the corresponding statistics from only those GCM runs in the Q5 sub-ensemble.

Step 2 - In the BA, sea level is assumed to rise 15 cm at the Golden Gate in 2030. Sea- level rise is expected to alter salinity intrusion into the Delta. As a result, the X2-Flow relationship used in the CalSim-II (watershed flow routing optimization model) for current climate needs to be modified for the 2030 scenario.

Because the DSM2 Delta hydrodynamic model is a 1-D (i.e., channel model) with a seaward boundary at the western end of Suisun Bay, the DSM2 model cannot directly incorporate sea level rise. Instead, the UnTRIM, a commercial 3D hydrodynamic model that has a modeling domain extending from the Golden Gate through the Delta, was used to create datasets to “corroborate” the salinity intrusion results of DSM2 with the UnTRIM simulation results for a 15 cm rise in sea level (BA - A.5.B, Attachment 3). Note that during this modeling exercise, the UnTRIM model was also run to simulate salinity intrusion into the Delta for a range of sea-level rise scenarios. See in particular Figure 5.2-4 (BA - A.5.B, Attachment 2, p. 189).

After the DSM2 model was “corroborated” for 15 cm of sea-level rise, the DSM2 model drove a series of simulations to train an artificial neural net to create a relationship between flow and X2. This resulting flow-X2 relationship is how 15 cm of sea level rise is accounted for in the CalSim-II simulations.

Step 3 - The precipitation time series generated from the Q5 GCM models (Step 1) are downscaled to a regional watershed model. The Variable Infiltration Capacity (VIC) model then creates flow routing inputs for key rivers.

Step 4 - The CaLSim-II optimization operations model is then driven with flow inputs from the key rivers (Step 3), Delta X2-Flow criteria (Step 2), and other reservoir criteria and regulatory restrictions (specified in A.5.a.5).

Finally, the results of the CalSim-II model drive the DSM2 model and other ecosystem/fish models used in the BA.

The Panel recommends that the evaluation of the influence of climate change on the PA operations should be longer than 2030. The Panel recognizes that projections beyond 2030 are subject to rapidly increasing uncertainties. However, projecting only to 2030 does not evaluate how the project will operate under climate change conditions. The 2030 scenario is only just the start of PA operations since construction is expected to take a decade. The Panel also notes the NMFS policy guidance stating that, “When evaluating effects of the action in Sections 7 and 10 decisions, NMFS will use the time period corresponding to the duration of direct and indirect effects of the action” (Sobeck 2016). The NMFS policy also states that “NMFS consultations and permits covering a long time period during which climate change is likely to exacerbate the adverse effects of an action, should incorporate an adaptive approach that includes: adequate monitoring of climate and biological variables; identification of appropriate triggers related to those variables; and identification of protective measures that can be implemented without reinitiating when triggers are reached or, alternatively, triggers then inform the decision to reinitiate.**”**

As was just explained, a significant amount of modeling effort would be required to incorporate climate change for a different time period farther into the future (i.e., 2100) because multiple models would need to be adjusted. This modeling effort would take longer than the projected fast-track revision of the BO technical approach in summer 2016. Therefore, funds and personnel need to be committed to continue to develop these model simulations (e.g., DSM2 “corroboration” with NDD project operations and various levels of sea level rise, training of the artificial neural network model for other future time periods and multiple sea-level rise scenarios) as part of the Adaptive Management (AM) plan.

2.2 Effects on Salmonids

2.2.1 Winter-Run Chinook Spawning, Egg Incubation, and Alevins

The Winter-run Chinook Salmon Evolutionarily significant units (ESU) presently spawns in only one area (below Keswick Dam on the Sacramento River), indicating that the ESU is highly vulnerable to adverse effects (Lindley et al. 2007). The BA concludes that there is potential for changes in reservoir operations, instream flows, and water temperatures in the Sacramento River and American River in response to the PA. However, the BA (BA 5-179) did not describe the management guidelines and actions for these reservoirs that are linked to conditions in the Delta, such that flows released from the reservoirs would be altered in response to the PA. If these actions involve real-time management of the reservoirs, what are the conditions in the Delta that would cause change in water released from the reservoirs?

Sections 3.1.5 and 3.3.3 of the BA describe the real-time decision process, but there is no information to judge how effective this process would be under the PA. Given the lack of information on the real time process, including the effectiveness of current real-time management efforts, the BA did not consider the effects of real time management instead deferring such assessment to the future. The BA says that "the operating criteria will be periodically evaluated and possibly modified through the adaptive management process" (BA 3-97), however, it did not include details about monitoring plans and triggers (see Section 2.6).

We also note that Kneib et al. (2015) recommended development of a much more detailed temperature model for Shasta Reservoir to improve management of cold water releases into the Sacramento River to better support Winter-run Chinook Salmon.

2.2.2 Salmonid Survival Models

Trawl data show that peak catches of juvenile winter-run Chinook Salmon in the lower Sacramento River (Chipps Island and Sherwood Harbor) are closely associated with initial spikes in peak flow at or above 400 $m^3 s^{-1}$ at Wilkins Slough (del Rosario et al. 2013, Israel et al. 2015). Average residence time of juvenile Winter-run Chinook Salmon in the Delta appears to be 41 to 117 days, with longer apparent residence time for juveniles arriving earlier at Knights Landing (del Rosario et al. 2013). Departure date at Chipps Island was fairly consistent across the nine years of investigation (e.g., ~March). Researchers highlight the need for genetic analysis to identify juvenile Winter-, Spring-,

and Fall-run Chinook Salmon in the Delta but most studies rely upon non-genetic tools to identify Chinook Evolutionary Significant Units (ESUs). Accurate identification of Winter-, Spring-, Fall-, and Late Fall-run Chinook Salmon emigration through the Delta is critical for evaluating project impacts because the amount of water diverted varies considerably over the juvenile out-migration period (Figure 1, Section 2.2.5). The Panel suggests that genetic identification of Chinook Salmon ESUs could more accurately evaluate habitat utilization and migration patterns of each ESU in the Delta.

The Delta Passage Model, the Interactive Object-oriented Salmon Simulation model (IOS; Cavallo, et al. 2011) , and the Oncorhynchus Bayesian Analysis model for Winter-run Chinook Salmon smolts (OBAN; Hendrix 2008) should consider these findings on migration patterns. In addition, we suggest that the simulated survival estimates from the Perry (2010) model (Figures A.5.D-66 to 70) be double-checked, because we do not find it clear how the weighted, summed survival rates below about 0.10 shown on those plots could have been predicted from a model (Figure A.5.D-65) whose smallest possible predicted values within the 95%CI is about 0.10. Also, OBAN simply examined how the PA would alter water exports at the southern Delta relative to the NAA, while assuming that circulation patterns and physics remain unchanged. However, the PA will also effect major changes in hydrodynamics and transport downstream of the NDD, and these changes should be considered in the model.

The Delta Passage Model assumes a fixed time of entry to the Delta (peaks during mid-January and late February for Winter-run Chinook Salmon) whereas the IOS model allows timing to vary depending on "egg and fry rearing upstream" (BA A.5.D). Assumptions about time of entry of juvenile salmonids to the Delta and residence time in the Delta have important consequences for survival because project operations change month to month depending on the type of water year (Appendix 2). Most of the models do not incorporate the flow/migration timing relationship presented by del Rosario et al. (2013) i.e., the effect of peak flows on movement into the Delta.

The salmon survival models are based on acoustic tagging of large (>140 mm) late fall-run hatchery smolts emigrating through the Delta rather than on smaller fry migrants, parr migrants, and smolts that are produced by winter- and spring-run Chinook Salmon (BA A.5.D - 208). The text did not mention if it incorporated relatively new findings based on smaller Chinook Salmon, e.g., Buchanan et al. (2013: Fall/Spring-run hybrids), Cavallo et al. (2013; 86-121 mm Fall-run Chinook). As noted above, the modeling focus on exceptionally large hatchery smolts leads to considerable uncertainty

in how the PA affects other life stages that are critical to the viability of Winter- and Wpring-run Chinook Salmon. Use of the estuarine habitats and residence time will vary considerably with life history stage and species, with smaller, ocean-type life histories demonstrating greater and longer associations of shallow-water habitats in the Delta (e.g., Williams 2006).

The BA suggests that the survival model results for juvenile Winter- and Spring-run Chinook Salmon may be applicable to juvenile steelhead. This assumption in the BA may be too simplistic. Although steelhead smolts emigrate during winter and spring, as do most Chinook Salmon, they may have somewhat different migratory patterns that are not recognized in the BA analyses, including Table 5.4-1(BA 5-71). Steelhead reportedly occur in the Delta from October through July, which spans a longer period than Chinook Salmon. Furthermore, the rate of water diversion from the northern Delta, under the PA, is predicted to be highly variable from month to month depending on type of water year (see Appendix 2). The BA assumption that findings for Chinook Salmon represent PA effects on steelhead further increases the already high uncertainty in PA effects on salmonids.

2.2.3 Density Dependence

The VSP report by McElhany et al. (2000) recognizes the importance of density dependence when evaluating population viability. Compensatory density dependence occurs when there is competition for limited resources as the population grows. For ESA species, this form of density dependence can be very important because it provides population resilience, i.e., productivity (survival) is higher at lower abundances. In contrast, depensatory density dependence is destabilizing and highly undesirable, because lower abundance leads to a higher risk of further declines. For example, depensation may occur when a predator consumes a fixed number of prey such that a higher percentage of the prey population is killed at lower prey abundances.

A misconception is that density dependence is weak among ESA-listed species, whose abundance is low. This was the perception in the Columbia Basin when salmon were initially listed under the ESA. However, a review by the Columbia River Independent Scientific Advisory Board (ISAB 2015) found strong evidence for density dependence in nearly all populations that were examined. Compensatory density dependence was high, in part because habitat quantity and quality had declined and

many hatchery spawners supplemented the natural spawning populations. However, depensatory predation was observed in some areas.

A recent review of juvenile salmon foraging performance in estuaries revealed that density dependence was evident in estuaries that have lost wetland habitat (David et al. 2016), suggesting density dependence is likely an important factor in the Delta. High abundances of piscivorous fishes in the Delta, especially non-indigenous species, may contribute to depensatory mortality of ESA species. An important question is whether the PA may enhance abundances of predators that consume ESA-listed fishes.

2.2.3.1 Would the PA Cause Depensatory Mortality?

Examination of juvenile Winter-run Chinook Salmon survival in the Delta, based on the Delta Passage Model, suggests that the PA might cause depensatory mortality, which could destabilize the population. This potential adverse effect was not discussed in the BA but it should be evaluated in the BO, especially given the likelihood for a series of dry years that may help create depensatory mortality.

The BA projected that juvenile Chinook Salmon survival through the Delta under PA conditions would increase by about 80% in higher-flow years, ranging from 0.24 in critically dry years to 0.43 in wet years (BA 5-114). Survival during the PA was projected to be 7% less than that in the NAA during dry years and 2% less during wet years. In the mainstem Sacramento River (where survival tends to be higher), survival during the PA was projected at 8% less than that in the NAA during dry years and 4% less during wet years. In all water years, juvenile Winter-run Chinook Salmon survival was projected to be less during the PA compared with the NAA.

Greater adverse project effects during dry compared with wet water years is an important finding. Juvenile Chinook Salmon abundance entering the Delta is likely much lower during dry compared with wet years (e.g., Israel et al. 2015), and the PA is projected to kill a higher proportion of fish compared with the NAA, especially during dry years. Therefore, the PA appears to have a larger adverse effect during dry years when other factors are also contributing to low survival and abundance of fish entering the Delta. This relationship could have a destabilizing effect on the population depending on the magnitude of the effect.

The Panel recommends evaluation of the compounding effect of the PA and dry years, and the potential for depensatory mortality, using a series of continuous dry years. Drought often occurs for a number of consecutive years, as the

recent CA experience confirms, and climate change is likely to produce more frequent drought conditions (Dettinger and Cayan 2014, Romero-Lankao et al. 2014).

2.2.4 Effects at the North Delta Diversions

The Panel found the assumptions and rules about the vulnerability of Winter-run Chinook Salmon to be somewhat unqualified, and requiring more explicit distinction of life history diversity in the BO. It is particularly uncertain whether the ocean-type life history stage of this stock is appropriately addressed in designing the operational rules for NDD, rigorous consideration of northern Delta habitat impacts, or indicators and triggers for NDD impacts.

Whereas the size distributions and seasonal occurrence of Winter-run Chinook Salmon outmigrants is documented to be predominantly as small ("parr") juveniles that enter the northern Delta with early pulsed Sacramento River discharge, the median of the emigration often follows later in December to January in wet and above-normal years (del Rosario et al. 2013). These ocean-type juvenile salmon rear for extensive periods in tidal wetland and peripheral aquatic habitats of the Delta before emigrating to the Bay and ocean (Brandes and McLain 2000, Williams 2006), such that >50% of the cumulative catch emigrating from the Delta (i.e., at Chipps Island) may be up to 3-4 months from the time they entered the Delta (i.e., at Knights Landing), a significant portion thereof spent rearing in the Yolo Bypass in wet years (del Rosario et al. 2013).

The Panel recognizes considerable uncertainty about whether the operational rules for the NDD considered this often protracted demography of the Winter-run Sacramento Chinook migration to the Delta, or about the potential effects of major diversion on their rearing habitats within the Delta. We suggest that avoidance or minimization of deleterious effects to juvenile migrant and rearing Winter-run Chinook Salmon should be based predominantly on detailed real-time monitoring rather than statistical or categorical relationships between flow and fish abundance, preferably within an AM framework that includes active AM.

2.2.4.1 Fish Screen Effects

The BA (Chapter 5 and Appendix 5D) describes some of the characteristics of the northern Delta fish screens, but it does not mention whether or not the screens are designed to meet all of the criteria for salmonids as described by NMFS (2011). The

brief analysis examines potential impingement of Salmon assuming an approach velocity of 0.2 ft s^{-1} (i.e., the NOAA criterion), but NMFS (2011) describes a number of additional design criteria needed to protect salmonids. ***The Panel recommends that all fish screen criteria described by NMFS (2011) should be explicitly addressed in the BO.***

Sweeping velocity is discussed in the BA but there are no estimates of sweeping velocity along the river banks now and after construction of the very long fish screens. NOAA criteria recommend sweeping velocities of at least 0.8 ft s^{-1} and sweeping velocity must not decrease along the length of the screen. Will these criteria be met by the PA?

The BA concludes that the effects of NDD on impingement of juvenile salmonids is uncertain and states that this uncertainty would be addressed with monitoring and studies that examine impingement and passage time along the intakes.

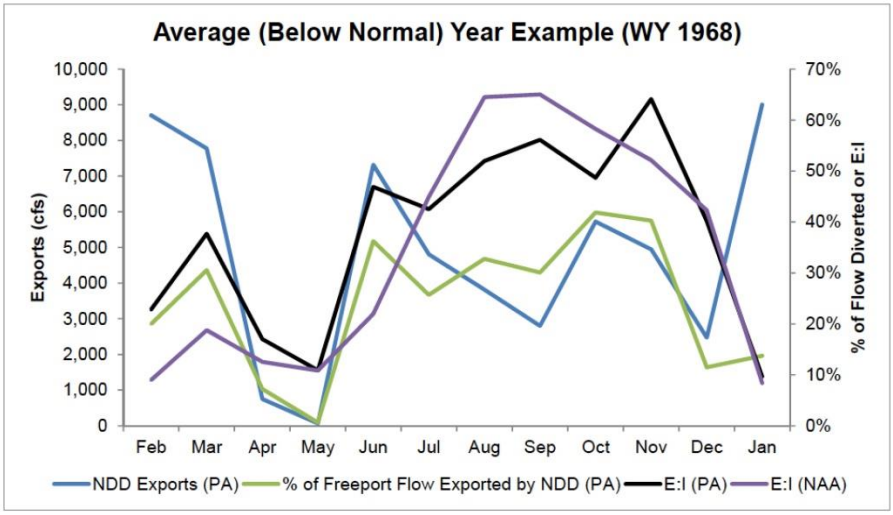
2.2.4.2 Predation Effects

The BA provides a reasonable conclusion regarding predation at the northern Delta water intakes: *"*Overall, there is potential for predation of juvenile salmonids along the NDD, which would constitute an adverse effect.*"* (BA 5-84).The BA analysis cites two studies for predation impacts, the field study at Glenn Colusa and a bioenergetic approach. Ultimately, the potential effect is highly uncertain because the predation will depend on local conditions and the responses of the ESA fishes and predators to those conditions. The effect of the NDD facilities and operation on predation at this location will depend on whether the intake structure and operation alter predator abundance at the intakes and whether juvenile fishes aggregate along the screens. Some aggregation of prey fishes is likely since water is drawn into the screens and most fishes are excluded. The BA proposes to reduce predator density at the screens. An experimental approach should be conducted under AM, starting with estimates of predatory fishes at the fish screen locations and experimental control sites prior to construction of the screens. This should be followed with sampling after construction to determine whether predator abundance has increased relative to control sites. Predator diet should also be examined.

2.2.5 Water Diversion Effects on Salmonid Critical Habitat

The proposed seasonal reduction in water discharge though the Delta provides an index for the degree to which critical habitat for ESA-listed salmonids in the Delta will

be altered by the PA. Figure 1 shows the percentage of total Sacramento River discharge that is expected to be removed from the northern Delta during an average "below normal" water year. In November, approximately 40% of the Sacramento River water is expected to be diverted by the PA. In November, moderate numbers of adult Winter-run Chinook Salmon, juvenile Winter-run and Spring-run Chinook Salmon, and small numbers of adult steelhead are likely to be present (BA 5, Table 5.4-1). The water removal rate is expected to decline to approximately 10% in December and January when abundance of juvenile Winter- and Spring-run Chinook Salmon increases. However, water removal increases to 20%-30% of the total river discharge in February and March when abundances of adult and juvenile Winter- and Spring-run Chinook Salmon and juvenile steelhead are expected to be relatively high (e.g., Williams 2006, del Rosario et al. 2013). The percentage of river water diverted each month varies considerably with the type of water year (see Appendix 2).



Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment. Note: E:I = exports to inflow ratio; the inflow (I) term for the PA is the Sacramento River downstream of the NDD; NDD exports are not included in the export (E) term for the PA.

Figure 7. Modeled Mean Monthly Exports by the North Delta Diversions and Percentage of Sacramento River at Freeport Flows Represented by these Exports, Water Year 1968.

Figure 1. Reproduction of Figure 7, Appendix 2. Estimated monthly diversion of Sacramento River water at the North Delta Diversions (NDD; blue line) as a percentage of total river discharge just upstream from the intakes (green line) during an average "below normal" water year. See Appendix 2 for additional analyses by water year type.

The quality and quantity of habitats available for Chinook Salmon and steelhead in the Delta depend on inflows from the Sacramento River (del Rosario et al. 2013). Increased flows often provide more rearing habitat and more migratory habitat, suggesting the northern Delta water diversion has the potential to significantly alter

habitat availability, and potentially quality, in some months depending on water year. As mentioned previously, salmon fry and parr migrants utilize shallow estuarine habitats more than yearling smolts, which tend to be farther offshore in the current. The effects of water diversion on habitat of salmon fry and parr migrants is complicated by the interactions between river flow, tide stage, salinity, and the locations of existing preferred habitats along the migratory corridor. The interplay among these complex interactions was not assessed in the BA.

The Habitat Suitability section of the BA (BA 5.4.3.1.2.2.1) briefly attempts to examine the effects of water diversion at the northern Delta intakes on water depth characteristics at artificial wetland and riparian benches, although not natural tidal wetlands. This simple approach does not account for observed preferred habitats along the migration corridor and other characteristics noted above. Nevertheless, the BA reported 19% to 29% lower riparian index during the PA compared with the NAA. Inundation of manufactured wetland benches did not differ between the two scenarios because the wetland benches were designed to be covered by water in nearly all water years, suggesting that the wetland depth index was not sensitive to flow conditions and was not a reasonable tool for evaluating project effects. Furthermore, the bench habitats represent only a small fraction of habitat that may be used by juvenile salmon as they rear and move downstream. ***The Panel recommends additional effort to evaluate PA effects on critical salmonid habitats, including natural and restoring tidal wetlands predictably under the large-scale influence of the NDD operations.***

2.2.6 Effects on Salmonid Diversity

McElhany et al. (2000) highlight the importance of maintaining population diversity when evaluating viability, but salmonid diversity is not fully evaluated in the BA. Diversity in the types of salmonid life history patterns (fry, parr, smolt migrants) is discussed above. Here we discuss diversity associated with migration timing. Migration timing is linked to life history types.

Juvenile Winter- and Spring-run Chinook Salmon and steelhead smolts are present in the Delta for up to ten months per year, although residence time is much less for individual fish. According to Table 5.4-1 (BA 5), juveniles from one or more of these three species are present in the Delta for all months except August. Diversity is represented in part by the broad period of juvenile outmigration that helps these species adapt to variable conditions in the ocean that can differentially affect salmonids

depending on when they enter the ocean (Johnson 2015). In other words, the tail ends of the migratory periods of each species are important to species viability even though the abundance of the juveniles at the extreme ends of the migration periods is small. ***To further evaluate PA effects on diversity, the Panel recommends evaluating water removal effects (up to ~40% of Sacramento River flow depending on month and water year) during tail end migration periods when juvenile salmonid abundance is low, in addition to when most juveniles are present in the Delta.***

2.2.7 Effects on Species that Interact with ESA-listed species.

NOAA Fisheries embraces ecosystem-based management (http://ecosystems.noaa.gov/), therefore the analytical approach to the BO should consider interactions between the ESA-listed species and other species that may be affected by the PA. Predation is likely a key source of mortality for ESA-listed fishes in the Delta. For example, non-native Striped Bass, a popular sport fish, is a significant predator on juvenile Chinook Salmon in the Delta (Lindley and Mohr 2003) and reduced flow may increase predation on salmon (Cavallo et al. 2013). Lindley and Mohr (2003) reported that entrainment at the southern Delta water diversion facilities and ecosystem changes have reduced the carrying capacity for subyearling Striped Bass, and have contributed to their decline from the 1960s to 1996. However, this trend could be altered if the PA does indeed reduce entrainment at the southern Delta facilities. ***Therefore, the Panel recommends evaluating the extent to which the PA may alter the abundance of Striped Bass and other predators that consume ESA-listed species.***

The BA states that Killer Whales ("Orca") would likely depend more on the relatively abundant hatchery Fall-run Chinook Salmon than the wild Fall-run or the ESA-listed Winter- and Wpring-run Chinook Salmon. According to the BA, approximately 20% to 60% of the hatchery Chinook Salmon have been released below the Delta where project effects would likely be minimal. Wild Fall-run Chinook Salmon reportedly represent only ~10% of all Fall-run Chinook Salmon harvested in the ocean fishery, indicating the wild component (which will be influenced by the project) is a small proportion of the total Fall-run Chinook Salmon.

Nevertheless, PA effects on wild Fall-run Chinook Salmon, an ESA candidate species, should be considered because some may be consumed by Killer Whales. This analysis should examine how the PA differentially affects fry migrants and parr migrants compared with smolt migrants, given that large smolt migrants have been the subject of

most investigations. Fry migrants and parr migrants are known to represent a significant portion of wild Fall-run Chinook Salmon (Miller et al. 2010, Sturrock et al. 2015), and it is likely that they may be more vulnerable to water removal in the northern Delta compared with smolt migrants. Timing of juvenile migration through the Delta and habitat requirements are likely to be different than smolts, indicating that the PA may have a different effect on fry and parr migrants compared with smolt migrants***. When evaluating the effects of the PA on Killer Whales, the Panel recommends evaluation of PA effects on wild fry, parr and smolt migrants, given that Fall-run Chinook Salmon are likely an important prey of Killer Whales.***

2.2.8 Applying the Viable Salmonid Population (VSP) Framework in the BO

The Viable Salmonid Population (VSP) framework (McElhany et al. 2000) and the manuscript by Lindley et al. (2007) are excellent documents to guide the analytical approach for salmonids. The Analytical Approach for the BO (AABO) also identifies the 2014 NMFS recovery plan for listed Central Valley Chinook Salmon and steelhead as an example of best scientific and commercially available data. VSP criteria include population abundance, productivity, diversity, and population spatial structure.

Although the AABO highlights the use of these approaches for evaluating the viability of salmonid populations, it does not describe the significant limitations of available data needed to apply these approaches when evaluating project effects. For example, a VSP approach should consider how the project might affect diversity and the spatial structure of the Evolutionarily Significant Units (ESU) and Distinct Population Segments (DPS). There are five populations of Spring-run Chinook Salmon, one Winter-run Chinook Salmon population, and four populations of steelhead remaining in the Central Valley. Each of the Chinook Salmon populations likely has multiple juvenile life history strategies. For example, based on otolith analysis of adult salmon, Sacramento Fall-run Chinook (non-listed) were shown to produce considerable proportions of fry migrants and sub-yearling parr migrants in addition to yearling smolts (Miller et al. 2010, Sturrock et al. 2015). Although Winter- and Spring-run Chinook Salmon may produce fewer fry and parr migrants compared with Fall-run Chinook, research on life history types of Winter and Spring-run Chinook is ongoing and will help identify the contributions of these life history types (R. Johnson, NOAA Fisheries, personal communication). Williams (2006) summarizes genetic analyses that differentiate Chinook Salmon ESUs

by size. ***The Panel recommends that the AABO describe how it will evaluate project effects on diversity and spatial structure.***

Evaluation of project effects on individual populations and life history types is difficult and this will lead to high uncertainty in the effects analysis. A key question is, to what degree will the PA affect fry and parr emigrants compared with large smolt emigrants (the life history type primarily evaluated in the BA)? The salmon survival models used in the BA primarily rely on acoustic tagging of large (>140 mm) hatchery Late fall-run Chinook and apply these findings to the evaluation of Winter- and Spring-run Chinook Salmon, which include juveniles that are much smaller than these tagged smolts, and to steelhead smolts. Sub-yearling fry and parr are known to rear in the estuary for longer periods of time than smolts. Seasonal use of the estuary also varies with species and life history type, and water removal by the project will vary with season. It is likely that smaller salmonids, which reside in the estuary for longer periods of time, are more vulnerable to reduced flows and related mortality factors (i.e., predators) than larger smolts (e.g., Cavallo et al. 2013), suggesting different effects on each life stage. The effect of reduced flows on residence time of each life history type and their migration route through the Delta is a key unknown because studies have focused on large hatchery smolts and because fish entering the interior Delta have greater mortality (e.g., Perry et al. 2013, Steel et al. 2013, Buchanan et al. 2013).

In short, the data are limited and the uncertainty is high, for applying VSP criteria to ESA-listed salmonids in the Delta. As we also note elsewhere, in such situations McElhany et al. (2000) recommend use of the precautionary principle and AM. ***The Panel recommends that approaches for using precaution and AM be described in the AABO.***

2.2.9 Increased Uncertainty When Using Surrogate Species

When discussing the availability of data, the draft AABO (p. 8) states *"Various sets of data and modeling efforts are useful to consider when evaluating the transition rates between life stages and consequences on population growth as a result of variations in those rates. These data are not available for all species considered in this opinion; however, data from surrogate species may be available for inference."* The AABO does not identify specific surrogate species or how it will determine the suitability of surrogate species for assessing incidental take, but it does reference the final rule describing the use of surrogates in Incidental Take Statements (80 FR 26832, May 11,

2015).

The use of surrogate species introduces additional uncertainty in the assessment of project effects on the ESA-listed species. Studies on the use of surrogate species have recognized this enhanced uncertainty and have emphasized the need to validate the use of surrogate species (e.g., Murphy et al. 2011). We anticipate that the draft BO will provide appropriate justification for the use of surrogate species.

The use of one life stage as a surrogate for other life stages having few data also requires greater discussion and justification. For example, most data for estimating survival of juvenile salmonids through the Delta involve large hatchery yearling Late fall-run smolts (>140 mm). These fish are not likely representative of smaller wild salmon smolts, and other emigrating life stages such as sub-yearling parr migrants and fry migrants that use estuarine habitats differently and for longer periods of time than large hatchery smolts (e.g., Williams 2006).

2.3 Effects on Delta Smelt

The BA for Delta Smelt assessed individual- and population-level impacts in a hierarchical structure that included assessments for each life stage (eggs/embryos, larvae/young juveniles, juveniles, migrating adults, spawning adults) in relation to the PA's construction and operation. The list of BA assessments was comprehensive and included the effects of impingement/entrainment, predation, turbidity, loss of suspended sediment/spawning substrate, contaminants, underwater noise, fish stranding, direct physical injury (from falling riprap, impingement on sheetpiles, entrainment by dredges, or from being struck by propellers), mitigation of harmful *Microcystis* (cyanobacteria) blooms, loss of phytoplankton within exported water, vegetation control, dredging, repair activities, habitat change, gate operations, loss of habitat at the construction site and barge landing areas, and cumulative changes.

The BA did not employ existing population/life-cycle models for the Delta Smelt (Maunder and Deriso 2011, Rose et al. 2013a,b) due to lack of information for properly parameterizing the models (M. Greenwood, April 5, 2016 public meeting). Moreover, the decision to not use these models is supported by Reed et al. (2014, p. 34), who stated "Mechanistic modeling exercises (e.g., Rose et al. 2013a) may help improve understanding of cause-effect mechanisms and help guide future research and monitoring; however, they are rarely sufficient to exclude the need for large-scale

experimentation to separate confounding factors, and are not currently suitable for use as management tools."

During the course of the hierarchical assessment of the above-listed potential impacts, the BA generated estimates of uncertainty or otherwise communicated awareness of considerable uncertainties that were associated with individual assessments. Upon reviewing these assessments, the Panel independently noted uncertainties that were associated with potentially beneficial impacts (positive impacts), potentially negative impacts, and relatively neutral impacts. In most cases, the BA recognized and acknowledged the same uncertainties as the Panel did. We discuss the most notable types of uncertainty in the subsequent sections, which are followed by a comparison of the approaches taken by the BA and the conceptual model for Delta Smelt (MAST 2015), and then provide observations on AM of Delta Smelt, including a list of concepts for new data collections that could reduce uncertainty or improve the conceptual model for Delta Smelt.

2.3.1 Uncertainties Associated with Positive Impacts on Delta Smelt

There were some assessments that could not fully capture potentially positive aspects of the PA due to uncertainty. Some of these shortcomings involved computational issues, such as noting that assessments of impacts at the Head of Old River (HOR) gate did not include real-time gate operations that could be actively managed to reduce negative impacts. Others involved larger issues such as entrainment, food-web interactions, and the control of toxic *Microcystis* blooms. Reduced predation at the southern Delta diversions (SDD) is another potentially positive outcome of the PA. Effects of the PA on predation risks are inherently difficult to predict, and are discussed separately along with other issues that relate to potential changes in the Bay Delta's food web.

The BA used similar approaches to assess entrainment at both the NDD and SDD, employing data and relationships that were specific to each diversion location. Accordingly, the BA noted that adult Delta Smelt entrainment risk at the SDD could not be directly modeled due to lack of relevant data for abundance and turbidity. Thus, the BA obtained alternative entrainment estimates from a regression model (USFWS 2008) as predicted from modeled Old and Middle Rivers (OMR) flow that was derived using CalSim-II. These predictions suggested a reduction in adult entrainment at the SDD under the PA with the high uncertainty of the estimates acknowledged by the BA's

authors (this regression model had $r^2 = 0.36$, exemplifying the "weak" models discussed in Section 2.5.2). The BA also noted the prospect of an overall increase in the Delta Smelt spawning-stock biomass as a beneficial result of reduced adult entrainment at the SDD under the PA. This potentially positive impact on the spawning stock appears reasonable but remains uncertain.

Various other mathematical approaches were applied to the prediction of entrainment risks for other life stages. In general, the entrainment modeling was afforded a great deal of effort with appropriate rigor applied when possible. Some of these efforts yielded inherently uncertain results due to limitations of the models used (e.g., poor regression fits/wide confidence limits around predictions, and the use of the DSM2 particle-tracking model without including real-time withdrawal management); as mentioned, these uncertainties were acknowledged by the BA's authors. Under many scenarios (month-year type combinations), estimates of larval entrainment were reduced under the PA, although there were also many scenarios where larval entrainment at the SDD was similar between the PA and the NAA. It should be noted that these modeling exercises were conducted in the absence of actual larval entrainment histories; most SDD entrainment involves larvae, which have not been monitored at the SDD (Kimmerer 2008). The general conclusion for entrainment at the SDD was positive, indicating salvage and population losses would decrease under the PA except during drier years, when northern Delta diversions would be small. Figure 6.1-9 in the BA compares estimates of entrainment reduction among year types, including graphical depictions of uncertainty.

The BA also considered the loss of phytoplankton within the exported water at the NDD, recognizing that the phytoplankton within Delta inflows contributes to the foundation of the Delta's aquatic food web. The BA estimated mean phytoplankton biomass diversions at the NDD would range 0-12% (minimum 5th to maximum 95th monthly percentile) and would rarely exceed a relatively low value of 5% of the Delta's standing stock of phytoplankton during any given month. However, the BA points out that the southern Delta is generally more productive than the northern Delta, and if southern Delta pumping becomes reduced under the PA, then phytoplankton production south of the Delta could be retained within the Delta as a whole, possibly yielding a net benefit to Delta secondary productivity, including productivity of Delta Smelt (BA 6-133). A more quantitative assessment of this apparent net benefit would be difficult, as it would be impeded by the limited quality and quantity of data related to phytoplankton

biomass and productivity near the SDD (M. Greenwood, April 5, 2016 public meeting). While there is considerable uncertainty in this conclusion, the position of the BA on this issue appears to be reasonable.

The BA suggests that the distribution of pumping between the NDD and SDD can be manipulated to reduce water-residence times in areas of the Delta where toxic *Microcystis* blooms form (BA 6 -172). This is a suggestion for ameliorating a current problem but there is no evidence that it will actually be successful.

2.3.2 Uncertainties about Negative and Neutral Impacts on Delta Smelt

Life-stage-specific impacts of construction and maintenance of the NDD, HOR gate, barge landing sites, and new Clifton Court Forebay facilities (construction, maintenance dredging, mechanical and electrical repairs, riprap replacement, vegetation control, etc.) were largely based on the extent of spatio-temporal exclusion between Delta Smelt distributions and these various PA activities. In other words, substantial impacts were not expected to occur whenever particular life stages, which have seasonally specific geographic distributions, were expected to be distributed far enough away from PA activities. Initially, this approach appears to be sound, yet it is flawed by logical circularity. In effect, the approach first assumes that the historical status quo represents the future condition—despite the imminence of substantial future change - and then uses this position to maintain that the future change will result in the historical status quo. Future change is potentially large, as the PA could result in >35% maximum diversions of Sacramento River flows during all except critically dry years (BA 6-69). The BA does not recognize the uncertainty in its assumption that future Delta Smelt distributions will be the same as those in the past. It should be noted, however, that the BA's claim that few adult Delta Smelt would be expected near construction sites (i.e., during the time period of construction) is reasonable because it applies to a time period that precedes the PA's export of water from the Sacramento River. That is, it is not subject to the above-mentioned flaw in the spatio-temporal exclusion approach.

The assessment of impacts of water-facility operations included both modeling and spatio-temporal exclusion considerations of life-stage-specific, individual- and population-level assessments for impingement and entrainment at the NDD. Delta Smelt >90 days old (>20-21 mm) were not believed to have strong, future screen-impingement risks at the NDD because they have historically occurred downstream of the three diversion points. The BA acknowledges that any individual juvenile or adult fish that

might occur near the NDD diversion points could be more vulnerable to impingement if they were to swim near the shoreline to avoid strong currents in the channel, thus causing them to swim closer to the diversion screens. The BA's evaluation of tidally assisted upstream movement by adults ("tidal surfing") identified this process as being limited to areas downstream of the NDD (i.e., limited by the upstream extent of sufficient tidal transport) and so the BA indicated most individuals would occur downstream of the diversion areas, resulting in a low population-level impact. However, future sea-level increases, combined with reduced river flows under the PA, may confound this aspect of the assessment by increasing the upstream influence of the tides (although concomitant changes to the Delta ecosystem would present a host of other challenges to ecosystem management by the time sea-level rise caused this to become a concern).

While it is understood that critical habitat effects are an element of adverse modification, it is also understood that fish responses to habitat changes may have large uncertainties. Uncertainties associated with future environmental conditions—even those involving relatively simple, abiotic conditions such as turbidity—are acknowledged in the BA. The BA's assessment of habitat impacts started with two abiotic habitat factors, salinity and turbidity, which had been combined by Feyrer et al. (2011) into an abiotic habitat index that can be modeled as a response to X2. The BA for Delta Smelt considered this model (details on BA 6.A-33) but also noted two concerns raised by an NRC review panel (NRC 2010), specifically that the Delta Smelt population response to X2 is statistically weak in both an empirical sense (i.e., in regard to data relationships) and due to the compounded uncertainty caused by linking two statistical models together. These observations undermine the rigor of the abiotic modeling exercise, as acknowledged by the BA's authors.

Another potentially negative impact that has great uncertainty involves turbidity. Delta Smelt abundance tends to be highest at turbidity levels in the range of 1-50 NTU. Turbidity in the Delta is influenced by river-borne loadings of suspended organic and inorganic particles, by local (within-Delta) production of living and nonliving organic particles, and by the transport and re-suspension of these materials by river flows, tides, winds, and three-dimensional density discontinuities within the water column. Given this complexity, there is no comprehensive turbidity model for the Delta. The BA notes that turbidity is difficult to forecast at the SDD, and therefore so is the Delta Smelt's generally positive response to turbidity.

A closely related concern—one that makes the preceding paragraph part of the negative uncertainty discussion— is the Grossman et al. (2013) finding that “Sediment concentrations in the Sacramento River have decreased by half from 1957-2001 and total suspended solids have decreased 50% from 1975-1995 (Schoellhamer et al. 2013).” The PA is expected to result in an additional 10% reduction in the Sacramento River suspended sediment load, which is substantial given the Delta Smelt’s widely accepted relationship with turbidity (Feyrer et al. 2007, Sommer and Mejia 2013). Primarily sand-sized particles will be retained at the NDD facilities, but particles of this size are not important contributors to turbidity, and so plans to re-introduce sediments retained at the NDD back into the Delta (BA 6 -172) are not relevant to restoration of lost turbidity. Instead, the finer sediments (those finer than sand) will be removed while in suspension within the exported water, but may possibly settle out of suspension as velocities decrease upon the diverted water’s entry into the Clifton Court Forebay. Re-introduction of sand back into the Delta may, however, be relevant to preserving spawning habitat, which is believed to be shallow, sandy, freshwater habitats (BA 6 -171).

BA assessments of population-level effects associated with the operation of Delta water-distribution systems (Delta Cross Channel, Suisun Marsh facilities, North Bay Aqueduct, other facilities) indicate that impacts should be similar or would not differ between the PA and NAA. It would first appear that impacts from continued operation of these systems would be largely secondary to impacts from the dual-conveyance facilities, yet the Suisun Marsh facilities are closely proximal to the area of highest abundance for sub-adult Delta Smelt, as indicated by the Fall Midwater Trawl Survey (Bever et al. 2016). This area of abundance extends from Suisun Slough through Grizzly Bay, Honker Bay and eastward into the area near the confluence of the Sacramento and San Joaquin Rivers, including Montezuma Slough. Any assumptions that Delta Smelt distributions will remain unchanged in this area under the PA should be avoided, and the effects of the Suisun Marsh water-distribution system on Delta Smelt need to be carefully monitored.

2.3.3 Uncertainties about Predation and Other Food-web Relationships Involving Delta Smelt.

The issue of relative predation risk is one of the most difficult challenges to the assessment, as indicated in the report by Grossman et al. (2013), who noted “stress caused by harsh environmental conditions or toxicants will render fish more susceptible to all sources of mortality including predation, disease or physiological stress.” This observation was echoed in the Interagency Ecological Program (IEP) Management Analysis and Synthesis Team (MAST) conceptual model (MAST 2015) as “prey may be more susceptible to predation if they are weakened by disease, contaminants, poor water quality, or starvation.” Thus, while predators are sometimes conspicuously attracted to elevated prey concentrations (e.g., near the SDD), diffuse predation mortality can also add up to large total mortality losses when factored across larger expanses of habitat, and such losses may be rooted in indirect habitat effects. In other words, predation may be the immediate cause of mortality for individuals that had already been weakened by other environmental conditions or disease. In fish, it is generally accepted that fast growth equates to lowered mortality risk and greater lifetime reproductive potential.

While it is a good idea to reduce Delta Smelt aggregations in areas where there is intense predation pressure, it should also be borne in mind that predation is not likely to be the single cause of long-term declining trends. The MAST conceptual model for Delta Smelt (MAST 2015) recognizes this, stating “Since predation is a natural part of functional aquatic ecosystems, predators are likely not responsible for long-term declines in populations of prey fishes, such as Delta Smelt, without some additional sources of stress that disrupt the predator-prey relationship (Nobriga et al. 2013).”

Prey relationships are also central to survival. The BA for Delta Smelt appears to under-emphasize this importance stating (6A-32): “The abiotic habitat index is based on the probability of presence of Delta Smelt given certain water clarity and salinity and does not explicitly account for other abiotic (e.g., water velocity, depth) and biotic (e.g., food density) factors that may interact with water clarity and salinity to influence the probability of occurrence. However, Delta outflow and its effects on X2 are habitat elements that the projects can directly influence, whereas the other habitat features are not.” By implying that the PA would not have an effect on food density, the BA’s position becomes misleading. The assumption that the abundance and distribution of estuarine prey organisms will not respond to altered freshwater inflows is not supported

(e.g., Flannery et al. 2002, Peebles 2005, Peterson 2003, and references cited therein). Even if X2 is kept the same, interaction between river flows and Delta geomorphology/hydraulics will be different between the PA and NAA, and an associated change in the distribution and abundance of prey should be anticipated rather than dismissed.

In a demonstration of the practical utility of their conceptual model, the MAST group asked why 2011 was a good year for Delta Smelt, and was able to infer good food availability during 2011 (an isolated wet year) as a contributor to the success of all life stages (MAST 2015). The authors also identified the lack of sufficient spatio-temporal data on prey abundance as a major information gap in understanding Delta Smelt abundance trends.

Declining turbidity is one well-documented, long-term trend in the Bay Delta estuary that is likely to have affected prey distribution and abundance. Turbidity has declined markedly at a decadal scale (Schoellhamer et al. 2013), and as a result more light can reach the bottom and submerged plants. Improvements to the light environment, such as this, have been associated with abrupt community change in favor of benthic organisms over planktonic/pelagic ones (Burghart et al. 2013 and references cited therein). In reference to Delta Smelt, MAST (2015) observed “The large proportion of benthic amphipods, cumaceans, and some cladocerans (*Camptocercus* spp.) in the diet is a notable change from Delta Smelt diet in the 1970s. Delta Smelt diets historically did include amphipods, notably *Corophium* spp. (Moyle et al. 1992), yet it was a small fraction of a mostly pelagic based diet. The considerable use of benthic invertebrates for food in recent years is believed to be in large part due to food limitation associated with the long-term decline and changes in composition of the pelagic food web (Slater and Baxter 2014).” The decadal-scale decline in copepods, which are important planktonic prey for multiple life stages of Delta Smelt, is described by Winder and Jassby (2011). Food limitation is now recognized as a principal stressor on Delta Smelt, as discussed by Sommer and Meija (2013). A more comprehensive description of these food-web alterations over time is provided by Durand (2015).

The Delta Smelt is positioned toward the bottom of the food web, where variations in biomass pathways (benthic vs. planktonic/pelagic) often have their greatest effect. There are exceptions to this trend, however. Threadfin Shad, for example, are positioned at a relatively low position within the food web, yet they are capable of regularly switching between planktonic and benthic feeding (Haskell 1959). Predators

such as Striped Bass that are positioned higher in the food web often integrate secondary production (prey) from whichever biomass pathway happens to be productive at the time, and as a result tend to be less vulnerable to changes in the relative dominance of one biomass pathway over another (Vander Zanden and Vadeboncoeur 2002, Rooney et al. 2006).

The nature of the Sacramento-San Joaquin estuary's changing aquatic food web has been the subject of considerable debate and discussion, which has resulted in a number of publications related to the decline of the Delta Smelt and other pelagic organisms since 2002 (Sommer et al. 2007). There are differing opinions on the cause of these declines, which translates into yet another form of uncertainty in the assessment of the PA's impacts.

2.3.4 Differences between the BA and the MAST conceptual model for Delta Smelt

Questions regarding whether the best available science was used in preparing the BA invite comparison between the approach taken by resource managers and the approach taken by researchers who use conceptual models to organize their studies. The most fundamental difference between the BA and the MAST (2015) conceptual model is that the BA, out of necessity, is dependent on defendable statistical relationships, models, computations, and direct interpretations of survey data in order to evaluate potential impacts. On the other hand, conceptual models may be largely based on similar types of information, but are allowed to extend beyond the limitations of defendability in order to continually organize the growing repository of synthesized concepts and inferred conclusions that are obtained from the literature and from discussions with other scientists. Conceptual models are more likely to use a weight-of-evidence approach that might be harder to defend (in a legal sense) than a straightforward statistical relationship might be, for example. Both approaches readily recognize where their respective uncertainties lie.

Of the two approaches, the conceptual model is much more process-based and explanatory, and is specifically geared towards facilitation of hypothesis development and testing. In their review of a draft version of the MAST conceptual model, Reed et al. (2012) recommended "The conceptual model in written and schematic form should continue to emphasize processes and their interactions over simple correlations, should ensure Delta Smelt vital rates remain central to thinking, and should be designed for routine use by scientists as an organizational tool and for testing hypotheses associated

with the AMP [adaptive management plan]." The emphasis on "vital rates" refers to growth, reproductive, and mortality rates, which determine the likelihood and magnitude of the present generation's contribution to future generations (i.e., what biologists call "fitness"). Relating habitat effects to fitness completes the argument for relevance within a scientific sense, if not a legal one (i.e., it addresses scientists' question "why is the relationship you are studying important?") In practice, various metrics that represent individual health or condition, such as instantaneous growth rate, size-at-age, or the extent of fat stores, can be used as proxies for vital rates that are difficult to measure directly. Again, this is based on the idea that a healthy, fast-growing fish is more likely to have reduced mortality risk and increased lifetime reproductive potential than an unhealthy, slow-growing one. The BA is thus more likely to value abundance-correlated habitat variables as potential statistical predictors of Delta Smelt abundance, and the conceptual model is more likely to value these variables as representatives of habitat processes that affect vital rates. In the latter case, the conceptual model serves as an organized platform from which hypotheses can be developed and tested with the purpose of identifying the habitat processes that most strongly influence vital rates.

Fish habitat includes both stationary habitat (marshes, mudflats, channels, etc.) and dynamic habitat (changing distributions of currents, water quality, predators, prey, competing species, etc.) that are constantly interacting with each other to influence fish vital rates. The fittest fish will be those that occupy habitats where growth is fast and mortality risk is low, but because feeding needs and predation risks typically change as fish grow larger, it is common for fish to occupy different habitats during different life stages or for fish to migrate seasonally. Fish such as Delta Smelt may also respond quickly to short-term (dynamic) changes in habitat quality. In recognition that some processes within the myriad stationary-dynamic habitat interactions are more direct in influencing vital rates than others, the MAST (2015) conceptual model states "The interplay between stationary and dynamic habitat components also helps explain the distribution and movement of Delta Smelt across its range, which cannot be understood —or managed— based on geography alone."

Conceptual models are intentionally flexible and are allowed to change as new information is obtained and assimilated. Since publication of the MAST (2015) conceptual model, Bever et al. (2016) have identified slow current speed as a third abiotic habitat factor that is positively associated with Delta Smelt abundance. While current speed may not be as predictively powerful as salinity and turbidity, the Delta

Smelt's positive association with slow current speeds is consistent with the Sommer and Maija (2013) position that the availability of zooplankton prey may be limiting Delta Smelt abundance, and that longer hydrodynamic residence times reduce washout and dilution of the zooplankton prey. They state "In general, phytoplankton and zooplankton levels are higher in small channels that are surrounded by dense emergent vegetation in Suisun Marsh (Rob Schroeter, U.C. Davis, unpublished data). This may be more a function of longer water residence time in these low-order channels..." In general, much of the area identified as having the highest abundance of sub-adult Delta Smelt is away from the estuary's primary conveying channel (i.e., high abundance is in the area from Suisun Slough through Grizzly Bay and Honker Bay, plus Montezuma Slough, Bever et al. 2016, Figs. 4 and 12). During low-flow periods, areas near the Sacramento-San Joaquin confluence may also have longer residence times. Sommer and Maija (2013) also suspected that prey export from adjacent marshes subsidizes Delta Smelt prey availability. The BA did not consider zooplankton retention effects, but if the viewpoints of Sommer and Maija (2013) are considered to be part of the still-evolving conceptual model, then zooplankton production and retention is a concern that should be carefully evaluated. When considered from this perspective alone, the PA could have a positive, negative, or neutral effect on Delta Smelt abundance.

For these reasons, the Panel recommends that the abiotic habitat effects of the PA be explicitly considered within the context of the new Bever et al. (2016) findings, while recognizing that this exercise cannot include turbidity due to lack of a turbidity model for the PA simulation (i.e., the abiotic station index of Bever et al. 2016 should be modified to include salinity and current speed, but not turbidity). We also recommend that the water-distribution system within Suisun Marsh be qualitatively assessed for its potential influence on the salinity, current speed, and turbidity within the high-abundance area for Delta Smelt, as described above and as identified in Figure 2. The Panel is referring to the latter assessment as "qualitative" in recognition of the difficulty of mathematically scaling the fine-scale water-management actions within Suisun Marsh to larger spatial and temporal effects within the high-abundance area.

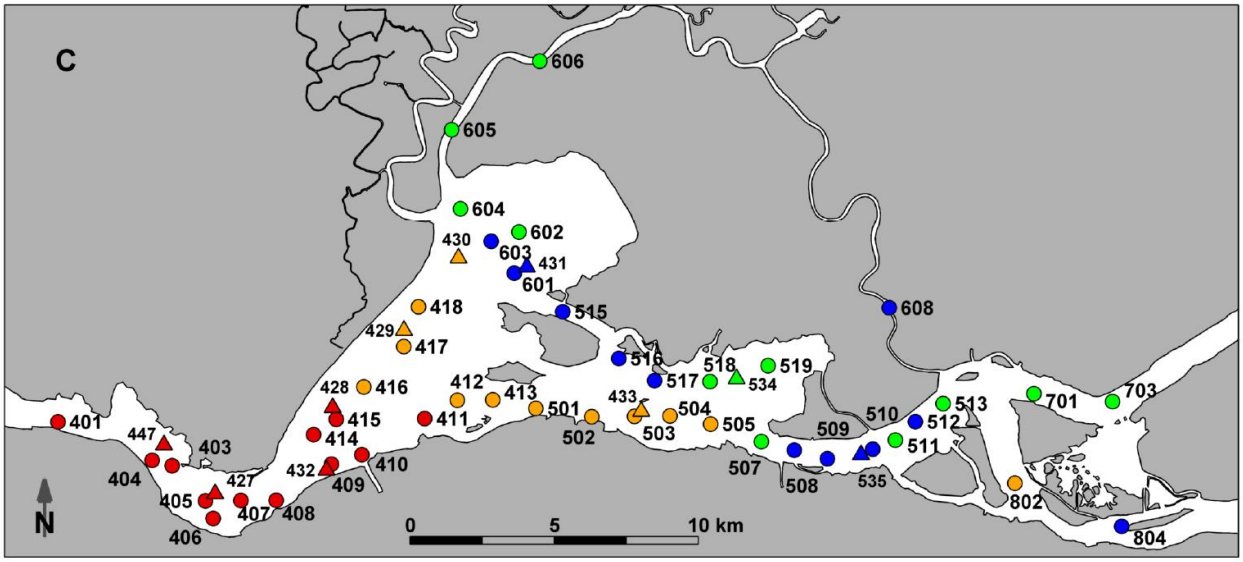


Figure 2. Reproduction of Figure 4C from Bever et al. (2016), indicating station indices for Delta Smelt catch from the Fall Midwater Trawl Survey. Relative Delta Smelt abundance is color-coded among stations in the highest abundance quartile (green), second highest quartile (blue), third highest quartile (yellow), and lowest quartile (red)—the highest historical abundances (1967-2012) were at stations coded green and blue.

2.3.5 Observations on Delta Smelt Adaptive Management (AM)

First, it should be recognized that the group of people with the most comprehensive insight into Delta Smelt biology is the Management, Analysis, and Synthesis Team (MAST) group of the IEP. As a team, they know more about Delta Smelt than the present Panel members do, and they are highly capable of forging ahead and setting new standards for best available science. In order for AM of Delta Smelt to be effective, the MAST team needs to be allowed to remain engaged and focused on the AM problem, and they must have long-term resources available that are adequate for answering key questions. The MAST (2015) conceptual model is not only an exceptional document; it is a convincing demonstration of the high level of coordination, cooperation, and thoroughness that the MAST team is capable of achieving. In the Panel's opinion, a project as important as WaterFix deserves the best ecological support possible and California is fortunate to have the MAST group available to provide this service.

Second, the use of any historical data needs to be explicitly qualified regarding its potential limitations. A number of investigations have analyzed the entire periods of record for monitoring time series (e.g., Miller et al. 2012). It is very ambitious to explain trends that are responses to decades of development in the Delta, its watershed, and San Francisco Bay. While de-convolving all of the various continuous, stepped,

punctuated, stochastic, and cumulative influences on the Delta's ecosystem would be ideal (e.g., Nobriga and Rosenfield 2016), there has been a clear limit on model precision at this lengthy historical scale, and this is what led Reed et al. (2014) to state "the rate of learning about the efficacy of alternate flow policies in the Delta will likely be very slow," and more specifically, that existing monitoring programs and associated models are not sufficient for use in passive, flow-based AM implementation for Delta Smelt. New types of information are needed, and efforts to collect this new information need to be carefully designed in order for the AM process to be efficient and effective. This process has already started, and the rate of learning has been increasing dramatically in recent years. A well-directed, methodical momentum needs to be maintained into the future. An example of a promising approach was taken by MAST (2015), who demonstrated a hypothesis-based investigation of 2011, which was an isolated, successful year for Delta Smelt. Notably, they intentionally restricted their investigation to passive variations among four recent years, which eliminated the confounding effects of the long-term changes to the Delta ecosystem. This approach, along with active AM experiments when feasible, is likely to continue to be productive. The MAST group envisions eventual combination of conceptual models with mathematical models to provide a substantial improvement on the guidance for AM of projects such as WaterFix.

Third, a very large number of future studies have been proposed at various times, but these need to be placed into an organized, hypothesis-driven structure (i.e., as provided by the Delta Smelt conceptual model) in order for these studies to be most effective. Lists of proposed studies occur in BDCP documents, in the MAST (2015, Table 10) conceptual model, and in the BA (Table 6.A-11, which was taken from the Collaborative Adaptive Management Team Fall Outflow Workplan). Combinations of studies will likely work best to fill information gaps in the Delta Smelt conceptual model. During the April 2016, Panel meeting in Sacramento, many specific studies were mentioned by presenters, guests, or the Panel members themselves. Some of these are redundant to the above lists, but are repeated here as a matter of record, with no particular emphasis or priority implied by the Panel:

- Underwater cameras for nonlethal monitoring (SmeltCam, Feyrer et al. 2013)
- DIDSON (acoustic video) for nonlethal monitoring in turbid waters
- Ecogeochemical forensics (stable isotopes, otolith microchemistry; making the most of incidentally collected Delta Smelt specimens)

- Turbidity studies
- BACI-design predator-prey studies at the NDD
- Environmental DNA (eDNA) for qualitative tracking of Delta Smelt habitat use, especially to help pinpoint spawning locations
- More diet studies of Delta Smelt and Delta Smelt predators
- Characterizing otolith-based growth rate/ microchemistry/stable-isotope differences between survivors (older individuals) and the original population (younger individuals) of the same cohort
- Direct measurement of vital rates as habitat quality metrics
- Studies of variation in size-specific fecundity (similar to what is also mentioned by MAST 2015)

In addition, the MAST (2015) suggests that concurrent zooplankton sampling should be "a routine part of the four major surveys monitoring Delta Smelt." Although some zooplankton sampling has been ongoing since 2005, the MAST (2015) authors noted a number of aspects that could be improved. Finally, Grossman et al. (2013) suggested a "more comprehensive food web modeling approach could be used to assess the role of predation on populations."

2.4 Effects on Longfin Smelt

Diverse opinions and considerable speculation characterize our understanding sources of mortality to Longfin Smelt. One direct source, entrainment in the southern Delta export facilities, and multiple indirect effects related to Delta outflow, food availability and spawning habitat, have been postulated as mortality factors and inhibitions to Longfin Smelt conservation and recovery. Perhaps a root cause of uncertainty is that a population-level context for Longfin Smelt abundance appears to be unreliable and take estimates seem best expressed as a proportion of an uncertain population. This is a precarious foundation for assessment of NDD impacts in preparing the BO.

The draft Analytical Approach for Longfin Smelt (AALS) suggests that entrainment at the export facilities has been relatively low during most water year types. However, this suggestion is uncertain because Longfin Smelt entrainment occurs during the same period as Delta Smelt and salmon, and because fish <20 mm in length are not

enumerated. Alternatively, some studies have argued that entrainment (or proxies thereof) is not a driver of population dynamics (MacNally et al. 2010, Thomson et al. 2010, Maunder et al. 2015).

Both the draft AALS and the proposed approach for Section 7 permit application utilize the Particle Tracking Model (PTM) capability to predict potential entrainment. This corresponds to Grimaldo et al. (2009) findings that adult Longfin Smelt salvage at the southern Delta export facilities was significantly negatively related to mean Old and Middle River flows in December–February. However, a number of concerns have been expressed about the DSM2-PTM methodology based on the frequency, location, and unresolved fate of particles from the 45 day PTM analysis (CDFW 11/3/2015 draft take analysis) as well as other model issues (See Section 2.4.1).

Other potential limiting factors on Longfin Smelt abundance relate to winter-spring outflow from the Delta where the Fall Midwater Trawl abundance index suggests that increased Delta outflow promotes conditions that increase survival of larvae and small juveniles during winter and spring, producing increased abundance during fall of the first year of life (Rosenfield and Baxter 2007). Several mechanisms are postulated including greater residence time in suitable feeding and rearing habitats with greater stratification (Kimmerer 2002, Kimmerer et al. 2009) and the increased availability of suitable spawning habitat (Grimaldo et al. 2014) in western reaches of the Delta such as adjoining Suisun Marsh. None of these hypotheses have been validated and some are confounded by other systematic changes such as the effects of non-indigenous clams on primary and secondary production. Alternative analyses have also suggested that Delta outflow effects may subsequently be tempered by density-dependent survival in the juvenile life stage in marine or mesohaline waters outside the Delta, which implies that small effects of slightly lower Delta outflow under the PA may not accumulate over time (Norbriga and Rosenfield 2016).

While there are intrepid efforts through monitoring, analyses and research to resolve the unknown aspects of the Longfin Smelt population and its limiting factors, the uncertainties remain daunting. This level of multifaceted uncertainty suggests to the Panel that the BA's conclusions of "very little difference in terms of predicted Longfin Smelt relative abundance between NAA and PA" in the Delta outflow relationship, or that "larval Longfin Smelt entrainment under PA would be less than under NAA" must remain speculative until smelt population dynamics is better understood. Given the persistent uncertainties about the risk and vulnerability of Longfin Smelt to the PA, the Panel

reinforces the BA's emphasis on real-time management and monitoring to minimize entrainment effects under the PA. In the interim, efforts to improve acknowledged inadequacies in monitoring design and research to fill the major gaps in Longfin Smelt life history need to be concerted.

2.4.1 Particle Tracking Model (PTM) issues for Longfin Smelt

The AALS had some very specific questions related to the DSM2 particle tracking modeling. A summary of those issues is as follows (Draft AALS, pg. 4):

> In comments provided on the 11/3/2015 draft take analysis, DFW had concerns regarding the frequency, location, and unresolved fate of particles from the 45 day PTM analysis. Regional density differences were taken into account, but not temporal (across survey) differences. Taking means of means reduces variability across water year types. Ideally CDFW desires bi-weekly injections, injection locations, number of particles injected, a greater temporal period for particle transport (i.e., 90 days), and additional flux locations to better illustrate the fate of unresolved particles (i.e., particles that do not reach Chipps Island or the CVP/SWP southern Delta export facilities) (CDFW notes that there is evidence (spring of 2012) that reduced southern Delta export pumping and low outflows in the hatching/larval period are capable of translating to increased juvenile salvage. Essentially, larvae may have been unable to exit the central and southern Delta because of low flows, and subsequently grew large enough to be counted in salvage (only fish 20 mm and larger are measured)). For this reason, CDFW suggests further exploration of the fate of unresolved particles from the PTM.

Before any more PTM modeling is done for this application, the results of this analysis need to be reviewed by hydrodynamic modelers to determine whether the particles are being stranded in the simulations due to model representations. Because the DSM2 model is a one-dimensional model, the open water regions of Franks Tract and Mildred Island are each represented as a continuously stirred tank reactor (CSTR). The DSM2 model has been calibrated such that the input/output from the CSTR can represent salinity intrusion into the Delta system. The use of the CSTR was not intended

to represent the actual circulation patterns in these open water regions. Therefore, if particles are getting “stuck” in the CSTRs, this is likely a limitation of the model representation of circulation in these regions. All the CDFW suggestions on page 4 (draft AALS) to improve the PTM results assume that the underlying transport physics are well represented. Unfortunately, this is likely not the case.

2.5 Estimating and Interpreting Quantitative Uncertainties

2.5.1 Quantitative Uncertainties in the BA

The BA compares the projected effects, on fish, of future scenarios for the NAA and the PA. The Panel believes that the BA strategy for making these comparisons does not adequately represent their quantitative uncertainties. We describe three main concerns by using the model predictions for the Longfin Smelt abundance index (BA, Appendix 4.A, Section 4.A.1) as an example. However, our concerns also apply to similar statistical models used throughout Ch. 4-6 of the BA.

All BA projections are subject to two general sources of uncertainty. The first source is that values of the Delta's environmental variables (flow, X2, temperature, etc.) are unknown for future years. The BA defines 82-year scenarios for NAA and PA that specify probable future values of these environmental variables. These future values are then used as inputs to fish response models. The resulting response-model predictions are then summarized over the 82-period, using boxplots of yearly point predictions grouped by water-year type (for example, Figure 4.A-1). The BA also presents exceedance plots showing the NAA versus PA distributions of point predictions over the full 82-year period (for example, Figure 4.A-2). The Panel believes that these plot formats do a good job of displaying the first source of uncertainty.

However, these boxplot and exceedance plot formats do not represent the second general source of uncertainty, namely, the uncertainty of any prediction made by a fish response model for a given set of environmental predictor values. The Panel’s first concern is that the boxplot and exceedance plot formats may be misinterpreted as representing the overall uncertainty of future fish responses to NAA and PA, which more realistically should include both the environmental and the model-prediction uncertainties. Below, we suggest how these plot formats might be restructured to include both sources of uncertainty. ***If both sources cannot be included, then we recommend that the boxplot and exceedance plot figure legends state that the plots exclude model uncertainty.***

2.5.1.1. Constructing confidence intervals

The BA does address the model prediction uncertainty of each fish response model, in all cases where those uncertainties can be estimated. The Panel approves of these efforts. For Figures 4.A-1 and 4.A-2, the fish response model is a simple linear regression, whose model-prediction uncertainty can be quantified using a confidence interval (CI) around each point prediction. The width of that CI is a function of the standard errors of the estimated regression coefficients, plus the square root of the model's mean-squared error (MSE), which measures the scatter of the model-fitting data around the estimated regression line (Neter et al. 1983). In Figure 4.A-7, such CIs are plotted as envelopes surrounding the projected 82-year time series of NAA and PA fish responses. This figure format has the advantage of displaying both the environmental and model-prediction sources of uncertainty.

However, the Panel's second concern is that the CIs in Figure 4.A-7 are too narrow, because they do not accurately represent the full uncertainty of regression model predictions. Our greatest concern here, and with other similar examples, is that the CIs describe only the uncertainty of the mean model response, that is, of the location of the regression line. Instead, the CIs should also include the MSE to represent the uncertainty of an individual prediction; they should be "prediction intervals" (Neter et al. 1983). Unfortunately, the regression model for Figures 4.A-1, 4.A-2 and 4.A-7 was obtained from a source (Kimmerer 2009) that did not report the MSE, which is needed to construct prediction intervals.

The Panel recommends that the BO authors obtain the full set of regression statistics for all regressions used in PA and NAA projections, so that true prediction intervals can be constructed for all figures like Figure 4.A-7 of the BA. Failing that, the legends on such figures should probably state that the plotted CI's are too narrow by an unknown amount, because they are not true prediction intervals.

Returning to the Panel's first concern, it should be possible to modify the boxplot format of Figure 4.A-1 to include both environmental uncertainty and model prediction uncertainty. One could replace each box with the mean, across all years in a year type, of the point predictions, and then bracket those means by approximate CIs that are based on both sources of uncertainty. We sketch three ideas for constructing such CIs:

1) Make the predictions using Monte Carlo simulation, with a random residual error (mean=0, variance = MSE) added to the regression model's prediction on each trial in each year.

2) From Figure 4.A-7, extract the largest upper confidence bound and the smallest lower confidence bound, among all years in a year type. Use these as the upper and lower bounds of the CI on all predictions for that year type. This might require a Bonferroni adjustment to control the family-wise confidence level for the multiple prediction intervals, across a year type, that this approach would encompass (Neter et al. 1983).

3) Insert estimates into the law of total variance ("Eve's law"): Var(Y) = E[Var(Y|X)]+Var(E[Y|X]). In this expression, Var(Y) is the estimation variance of the response predictions (Y) in a year type, which will include both uncertainty sources, and X is one year in a year type. The first term on the right-hand side can be simply approximated by the MSE, which is the same for all predictions. A more complicated and accurate alternative would be to calculate the mean, overall years in the year type, of the full model prediction variance for each year. This first term then quantifies model prediction uncertainty. The second term on the right-hand side is the variance of the point predictions, over the years in the year type. This second term quantifies environmental uncertainty. Once Var(Y) has been estimated, construct a symmetric 95% CI around the mean of the point predictions for the year type, using a half-width of 1.96*sqrt(Var(Y)).

2.5.1.2 Interpreting model predictions and confidence intervals

During the Panel's public meeting with agency representatives, a representative asked what purpose would be served by showing wider, albeit more realistic, CIs in Figure 4.A-7, and in similar figures elsewhere. Although he did not elaborate, his reasoning may have been as follows: The CIs for PA and NAA already show nearly 100% overlap in Figure 4.A-7 and similar figures elsewhere, and the same very high overlap would also be seen with wider, more-realistic CIs. Thus, it would seem that, even though they might become wider, the more-realistic CIs would still imply that the "true", real-world effects of PA and NAA on fish are predicted to be very similar.

However, the Panel's third concern is that the CIs in time series plots such as Figure 4.A-7 are not being interpreted rigorously. This misinterpretation becomes more serious for realistically wider CIs. To rigorously interpret the CIs, we recommend redrawing Figures 4.A-7 to 4.A-9, while omitting the solid lines showing the point (mean) predictions for PA and NAA. Those solid lines have little relevance, because all that we know, with 95% confidence, is that the "true" (real-world) PA value for any year will lie *somewhere* within the PA confidence bounds, and that the true NAA value for that year will lie *somewhere* within the NAA bounds. Thus, it is possible that true yearly values for PA lie near the bottom boundary of the CI for PA, while true NAA values lie near the top boundary of the CI for NAA. If more-realistic CIs are even wider than those in Fig. 4.A-7, then such large differences between the true PA and NAA values may be biologically significant, even though such differences lie entirely within the overlapping CIs for PA and NAA. In other words, if a fish response model makes very similar point predictions for PA and NAA, but that model has high prediction uncertainty, then we have little confidence that the real-world outcomes for PA and NAA will also be similar.

The Panel recommends that time series plots such as Figure 4.A-7 omit the solid lines depicting the point predictions from the fish response model, because the point predictions are unlikely to be the actual future outcomes.

Finally, we note a more subtle consequence of using weak regression models, such as the regression model with $r^2 = 0.36$ that was used to predict Longfin Smelt entrainment (Sec. 2.3.2). If a regression model has high uncertainty (low r^2), then its coefficients tend to be small in magnitude; in the extreme case of their statistical non-significance, the coefficients cannot be distinguished from having zero magnitude. And small regression coefficients imply that model predictions are not very sensitive to changes in the predictor variables. Thus, weak regression models will generally predict similar fish responses to the PA and NAA scenarios, even if those scenarios assume distinctly different values for flow, X2, temperature, and other environmental driving variables. In other words, the small differences between the point predictions for PA and NAA, which are evident in many plots like Figures 4.A-1, 4.A-2 and 4.A-7, may be largely due to the use of highly uncertain fish response models.

2.5.2 Confronting Uncertainty in the Analytical Approach for the BO (AABO)

The Panel's understanding is that the final BO will draw heavily on the methods and results of the BA. Thus, if the BA frequently underrepresents the uncertainties of its

model projections, the Panel is concerned that the BO developers may view uncertainty as a somewhat minor issue, and may also accept the BA models' point predictions as highly likely outcomes. The Panel sees evidence of this in the draft AABO, which mentions "uncertainty" only three times, two of which relate only to uncertain future climate. In particular, the conceptual model for determining a jeopardy opinion (Figure 1, AABO) makes no mention of uncertainty. We note that treating uncertainty as a minor issue is inconsistent with McElhany et al. (2000), whose guidelines for Viable Population Size, Critical Population Size and other VSP components all contain at least one guideline that specifically targets uncertainty.

The draft AABO may be trying to address uncertainty, albeit indirectly, with its intention to assess the "weight of evidence" for the effects of each action component (Table 2-1, AABO). However, although "weight of evidence" is an attractive concept, it is difficult to quantify in any objective way. ***The Panel recommends that the AABO describe how weights of evidence will be determined.***

The Panel also believes that the AABO needs to address uncertainty more directly when formulating its decision-making sequence for determination of jeopardy (AABO Table 2-2). At present, the decision sequence assumes that accurate True/False decisions can be made about the "likelihoods" of stressor occurrences, species exposures, species responses, and so forth. For the True/False decisions to be objective, such likelihoods should be quantified whenever possible. However, likelihood estimates will be highly uncertain in many cases. For example, due to model-prediction uncertainty, suppose that a likelihood (probability) is estimated to be 0.6 (likely), but the CI on that estimate ranges from 0.35 (unlikely) to 0.85 (likely). How would such a result be translated into a True/False decision about the likelihood? ***The Panel recommends that the AABO specify how decisions will be made when likelihood estimates, and projected changes in likelihood, are highly uncertain.***

2.6. Adaptive Management (AM)

According to Section 7 of the ESA, the USFWS and NMFS (the Agencies) must include in the BO a determination of whether or not the PA will lead to Jeopardy or Adverse Modification of Critical Habitat. The Panel suggests that such a determination must be based on (1) an accurate acknowledgement of the high degree of uncertainty regarding the effects of the PA; and (2) because of the legal obligation to err on the side of the species in cases where there is high uncertainty and insufficient data, a critical

examination of the extent to which the PA includes adequate provisions for responding to new information about its effects on the species and critical habitat in ways that will prevent jeopardy to the species and/or adverse modification of habitat.

Put differently, there are potentially three ways the Agencies can deal with the lack of certainty and data inherent in assessing the effects of the PA. The first two are clearly stated in the Section 7 Consultation Handbook. Where significant data gaps exist there are two options: (1) if the action agency concurs, extend the due date of the BO until sufficient information is developed for a more complete analysis; or (2) develop the BO with the available information giving the benefit of the doubt to the species, which could result in a jeopardy opinion preventing the PA from going forward. A third possible way to err on the side of the species in situations where uncertainty is high would be to go forward with the project (no jeopardy with Reasonable and Prudent Measures (RPMs), or Jeopardy with Reasonable and Prudent Alternatives (RPAs)) with a firm commitment and explicit plans to modify management as needed to avoid Jeopardy or Adverse Modification as new information becomes available, e.g. through adaptive management (AM) and, where AM is not practical or feasible, structured decision making and/or scenario planning (see Allen et al. 2011 and the special issue of *Journal of Environmental Management* in which it appears for a comprehensive overview of these different approaches to natural resource management decision making).

AM is an approach to natural resource management aimed at reducing uncertainty, building knowledge and improving management outcomes over time. It goes beyond a trial and error approach in that it involves careful articulation of goals, identification of alternative management objectives, hypotheses of causation and developing procedures for the collection of data followed by evaluation and reiteration (Allen et al. 2011).

AM is a form of structured decision making (SDM), which is an organized and transparent approach to making decisions by identifying and evaluating alternatives and justifying complex decisions (Allen et al. 2011). AM is more robust than SDM, however, because, when done correctly, it adds to the process iteration and theoretically results in higher order learning.

A distinction is often made between “active” and “passive” AM based on the way uncertainty is recognized and treated. In active AM, managers attempt to reduce uncertainty by deliberately probing for information to evaluate testable hypotheses about

the effects of interventions, while in passive AM, there is a lack of explicit experimentation and learning is a "useful but unintended byproduct of decision making" (Williams 2011). While both are useful for achieving management objectives in different contexts, they differ in the degree to which the objectives that guide decision making emphasize the reduction of uncertainty.

AM scholars generally agree that active AM is preferable, but realistically only feasible where both uncertainty and controllability are high, i.e., where the system can be manipulated to allow for structured experimentation. When uncertainty is high and controllability is low, developing and analyzing scenarios through "scenario planning" is generally considered more appropriate (Allen and Gunderson 2011, Peterson et al. 2013).

Scenario planning refers to a framework for developing more resilient conservation policies when faced with high uncertainty and high uncontrollability. Peterson et al. (2013) characterize a scenario in this context as "an account of a plausible future":

> "Scenario planning consists of using a few contrasting scenarios to explore the uncertainty surrounding the future consequences of a decision. Ideally, scenarios should be constructed by a diverse group of people for a single, stated purpose. Scenario planning can incorporate a variety of quantitative and qualitative information in the decision-making process. Often, consideration of this diverse information in a systemic way leads to better decisions. Furthermore, the participation of a diverse group of people in a systemic process of collecting, discussing, and analyzing scenarios builds shared understanding "(Peterson et al. 2013).

The Panel recommends that the BO includes a critical analysis and evaluation of the approach to AM proposed in the PA for two main reasons. First, best available science suggests that, where feasible, AM is the best way to deal with uncertainty and assess and respond to the effects of management actions so as to be able to address unexpected outcomes and the need for mid-course corrections, and to continue to learn and fill data gaps. This is the approach recommended in McElhany et al. (2000), and in numerous past reviews of the CVP/SWP, and precursors of the current PA.

Second, it is in the Agencies' best interest to work out the details of the AM program in the BO to avoid possible legal challenges. An adaptive management approach is legally mandated by the Delta Plan and it is generally expected by courts reviewing ESA decisions. Fischman and Ruhl (2015) investigated U.S. Federal Courts opinions published through January 1, 2015 to understand how AM has been judged in the courts and they identified three shortcomings in AM implementation that recur in judicial cases overturning agency decisions: (1) failure to establish objectives or failure to describe monitoring protocols for a plan or project; (2) failure to define decision thresholds in monitoring; and (3) failure to identify specific actions that will be triggered when thresholds are crossed.

These ideas have already been explored by courts in the context of the Bay Delta system. In a series of decisions regarding ESA compliance in the operation of the CVP between 2006 and 2011, Judge Wanger looked at how agencies may rely on AM to ensure that water operations will not "jeopardize the continued existence" of any listed species. He compared the conservation approaches of the FWS in regard to the Delta Smelt with NMFS approach in regard to the anadromous fishes. While both agencies employed AM, Judge Wanger upheld the NMFS approach and remanded the FWS plan. While the NMFS AM protocol contained definite, substantive criteria (e.g., temperature thresholds) that triggered revision of the water system operations to avoid jeopardy, the FWS approach failed to provide enforceable, precise criteria to serve as thresholds. The Judge also overturned the FWS adoption of "a procedurally elaborate" AM protocol identifying danger thresholds for the Delta Smelt because it failed to specify what alternative actions would be taken if the threshold was crossed, saying only that it would convene a working group to "consider" a range of operational changes in the water system. In contrast, the NMFS approach specified specific enforceable requirements that would be imposed if the system crossed thresholds for the anadromous fish (Fischman and Ruhl 2015).

Therefore, to ensure that the BO is in alignment with the best available science and is legally defensible, a management program that includes active AM, where feasible, along with passive AM, should be an integral part of the PA and should include explicit plans for ongoing monitoring of the status of the species and the direct and indirect effects of (1) the design of fish facilities (the footprint of the PA installation), (2) the operations (whether the PA is jeopardizing species or adversely modifying habitat),

and (3) restoration and mitigation activities (to determine how they are affecting the species and whether the PA is working to move toward recovery).

Based on the BA, it is clear that the action agency and applicant intend to employ an AM approach to the design and operation of the proposed facilities to prevent jeopardy and adverse modification throughout the life of the project and to the restoration/mitigation aspects of the PA to ensure that recovery is progressing. Chapter 3 of the BA has numerous references to AM and in each case the reader is referred to Section 3.4.7, Collaborative Science and Adaptive Management Program, for details. However, Section 3.4.7 simply states that the AM program "will be used to consider and address scientific uncertainty regarding the Delta ecosystem and to inform implementation of the operational criteria in the near term for existing BiOps … as well as in the future for the new BiOp and 2081(b) for this PA." (BA 3-72). What is unclear is exactly how AM will be structured, how it will be funded, and how it will be carried out. Directing explicit attention to the adequacy of AM plans in the forthcoming BO will be important because the Panel is in agreement that the treatment of AM in the BA is lacking in important details.

Since there is currently no mention of AM or even monitoring in the AABO, the inadequacy of the PA's plans for AM is likely to be overlooked unless the AABO is revised***. Therefore the Panel recommends that the Agencies articulate an explicit plan in the AABO for evaluating the adequacy of the plans for AM, based on best available knowledge regarding effective AM design and implementation.***

The next subsections describe features of a strengthened AM plan.

2.6.1. AM structure

The BA says AM for the PA "will build on CSAMP and CAMT". More details are needed in writing the BO. Will there be a new Delta AM team? What will be the criteria for selection to the team? Will there be independent review of the AM program? And how will the AM program be funded?

2.6.2 AM Process

The BO should provide more details about how AM will be carried out to reduce the chances of jeopardy or adverse modification related to (1) the design of facilities, (2) operations, and (3) restoration/mitigation. AM should also be used to flesh out conceptual models of species' life cycles that currently are incomplete or are missing

information. The approach to assessing future effects should include explicit commitment to taking advantage of surprise events to learn (floods, droughts, levee failure events, alternative operations such as the False River emergency barrier installation in 2015). In addition, baseline monitoring of water quality, water circulation (flow, velocity), fish population attributes (both of listed species and predator communities) at the NDD inlet locations should begin in 2016 so that the effects of the PA and the effectiveness of adaptive management approaches can be measured when the PA comes online.

In the context of the PA, an active AM approach would seek to learn more about and be responsive to both direct and indirect effects of the PA and would include:

- Clear objectives for each species
- Description of monitoring protocols
- Indicators and triggers for various anticipated impacts
- Establishment of decision thresholds based on monitoring data
- Specification of actions that will be triggered when thresholds are crossed.

The BA continually refers to Section 3.4.7 (Collaborative Science and Adaptive Management Program), and AM generally, but is lacking in details about monitoring plans and triggers. For example, Sections 3.1.5 and 3.3.3 of the BA describe the real-time decision process, aimed at responding to the potential for adverse conditions as they arise, but there is no information to judge how effective this process would be under the PA. The BA does not attempt to consider the effects of real time management, instead deferring such assessment to the future, saying that *"the operating criteria will be periodically evaluated and possibly modified through the adaptive management process"* (BA 3-97). We recommend that the real-time operational decision making process be linked more explicitly to a formal AM program.

As stated earlier in this report, the BO should describe the management guidelines and actions for reservoirs on the Sacramento and American Rivers that are linked to conditions in the Delta such that flows released from the reservoirs would be altered in response to the PA. If these actions involve real-time management of the reservoirs, what are the conditions in the Delta that would cause change in water released from the reservoirs?

In addition, baseline monitoring of water quality, water circulation (flow, velocity), fish population attributes (both of listed species and predator communities) at the NDD inlet locations should begin in 2016 so that the effects of the PA and the effectiveness of adaptive management approaches can be measured when the PA comes online.

2.6.3 Adaptive Management Challenges

*C*ompliance with the ESA through AM is difficult. The ESA assumes a "linear process of examination...a single, well-defined 'agency action,'" which is counter to the assumption of complexity, non-linearity, and uncertainty of AM. Laws and regulations associated with the ESA focus on preservation and minimization of human impact and persistence of certain individual species. They enforce a front-end approach where the underlying assumption is that people can predict outcomes of a certain action before that action has taken place. Trying to reconcile the two paradigms is difficult.

The Panel acknowledges the challenges associated with implementing active AM in the Bay Delta context. Numerous independent scientific review panels and other reports have commented on this over the years. The Panel also recognizes that the BO will not be able to pre-plan AM triggers for every decision; and that some potentially harmful effects will be easier to respond to than others. For example, unanticipated impacts related to flows may be more difficult to plan for and respond to than non-flow related impacts.

Finally, in the draft BO the Agencies should consider which aspects of the PA demand active AM to reduce the risk of jeopardy or adverse modification, and which aspects should be managed with other structured decision making approaches (Allen et al. 2011). As stated above, according to the best available science related to decision-making in complex adaptive systems, in cases where there is high uncertainty, low controllability, and high risk (e.g., where the remaining listed species are few in number), an experimental approach may not be feasible or appropriate (Allen and Gunderson 2011). In those cases, structured decision making involving scenario planning may be more appropriate than AM. The Agencies should commit to a process of determining when and in relation to which aspects of the PA AM is appropriate, and where it is not feasible or where the stakes are simply too high for an experimental approach. These determinations and their rationales should be clearly stated in the BO.

3. List of Panel Recommendations

The following table lists the Panel's recommendations, indicating their location (section and page number) in this report. Recommendations are numbered by their order of occurrence in the report, and the numbers do not represent their importance or priority for action. In the table, the Analytical Approach to the BO is designated "AABO".

Number	Recommendation	Section	Page
1	That the evaluation of the influence of climate change on the PA operations should be longer than 2030.	2.1.4	21
2	Evaluate the compounding effect of the PA and dry years, and the potential for depensatory mortality, using a series of continuous dry years.	2.2.3	25
3	That all fish screen criteria described by NMFS (2011) should be explicitly addressed in the BO.	2.2.4.1	27
4	Additional effort to evaluate PA effects on critical salmonid habitats, including natural and restoring tidal wetlands predictably under the large-scale influence of the NDD operations.	2.2.5	29
5	Evaluate water removal effects (up to ~40% of Sacramento River flow depending on month and water year) during tail end migration periods when juvenile salmonid abundance is low, in addition to when most juveniles are present in the Delta.	2.2.6	30
6	Evaluate the extent to which the PA may alter the abundance of Striped Bass and other predators that consume ESA-listed species.	2.2.7	30
7	Evaluate the PA effects on wild fry, parr and smolt migrants, given that Fall-run Chinook Salmon are likely an important prey of Killer Whales.	2.2.7	31
8	That the AABO describe how it will evaluate project effects on diversity and spatial structure.	2.2.8	32
9	That approaches for using precaution and adaptive management be described in the AABO.	2.2.8	32
10	That the abiotic habitat effects of the PA be explicitly considered within the context of the new Bever et al. (2016) findings, while recognizing that this exercise cannot include turbidity due to lack of a turbidity model for the PA simulation	2.3.4	43

	(i.e., the abiotic station index of Bever et al. 2016 should be modified to include salinity and current speed, but not turbidity). We also recommend that the water-distribution system within Suisun Marsh be qualitatively assessed for its potential influence on the salinity, current speed, and turbidity within the high-abundance area for Delta Smelt, as described above and as identified in Figure 2.		
11	That boxplot and exceedance plot figure legends state that the plots exclude model uncertainty, unless that uncertainty can be incorporated.	2.5.1	49
12	That the BO authors obtain the full set of regression statistics for all regressions used in PA and NAA projections, so that true prediction intervals can be constructed for all figures like Figure 4.A-7 of the BA. Failing that, the legends on such figures should probably state that the plotted CI's are too narrow by an unknown amount, because they are not true prediction intervals.	2.5.1.1	50
13	That time series plots such as Figure 4.A-7 omit the solid lines depicting the point predictions from the fish response model, because the point predictions are unlikely to be the actual future outcomes.	2.5.1.2	52
14	That the AABO describe how weights of evidence will be determined.	2.5.2	53
15	That the AABO specify how decisions will be made when likelihood estimates, and projected changes in likelihood, are highly uncertain.	2.5.2	53
16	That the BO includes a critical analysis and evaluation of the approach to adaptive management (AM) proposed in the PA.	2.6	55
17	That the Agencies articulate an explicit plan in the AABO for evaluating the adequacy of the plans for AM, based on best available knowledge regarding effective AM design and implementation.	2.6	57

3. References

Allen, C.R. and L.H. Gunderson. 2011. Pathology and failure in the design of adaptive management. Journal of Environmental Management 92: 1379-1384.

Allen, C. R., J. J. Fontaine, K. I. Pope, and A. S. Garmestani. 2011. Adaptive management for a turbulent future. J. Environ. Mgmt. 92:1339-1345.

Bever, A. J., M. L. MacWilliams, B. Herbold, L. R. Brown, and F.V. Feyrer. 2016. Hydrodynamic complexity to Delta Smelt (*Hypomesus transpacificus*) distribution in the San Francisco Estuary, USA. San Fran. Est. Watershed Sci. 14. Available at: http://escholarship.org/uc/item/2x91q0fr.

Brandes, P. L., and J. S. McLain. 2000. Juvenile Chinook salmon abundance, distribution, and survival in the Sacramento-San Joaquin estuary. Pp. 39-139 *in* Contributions to the Biology of Central Valley Salmonids, Fish. Bull. 179.

Brandon, T. O. 2015. Fearful Asymmetry: How the Absence of Public Participation in Section 7 of the ESA can make the Best Available Science Unavailable for Judicial Review. Harvard Environ. Law Rev. 39 at 311.

Brennan, M. J., D.E. Roth, M.D. Feldman, and A.R. Greene. 2003. Square pegs and round holes: Application of the "Best Scientific Data Available" standard in the Endangered Species Act, 16 Tul. Environ. LawJ. 387.

Buchanan, R. A., J. R. Skalski, P. L. Brandes and A. Fuller. 2013. Route use and survival of juvenile Chinook salmon through the San Joaquin River Delta. North Am. J. Fish. Mgmt. 33:216-229.

Burghart, S. E., D. L. Jones, and E. B. Peebles. 2013. Variation in estuarine consumer communities along an assembled eutrophication gradient; Implications for food web instability. Est. Coasts 36:951-965.

Cavallo, B., J. Merz, and J. Setka. 2013. Effects of predator and flow manipulation on Chinook salmon (*Oncorhynchus tshawytscha*) survival in an imperiled estuary. Environ. Biol. Fish. 96:393–403.

David, A. T. C. A. Simenstad, J. R. Cordell, J. D. Toft, C. S. Ellings, A. Gray, and H. B. Berge. 2016. Wetland loss, juvenile salmon foraging performance, and density dependence in Pacific Northwest estuaries. Est. Coasts 39:767-780. DOI 10.1007/s12237-015-0041-5

Del Rosario, R. B., Y. J. Redler, K. Newman, P. Brandes, T. Sommer, K, Reece, and R. Vincik. 2013. Migration patterns of juvenile winter-run-sized Chinook salmon

(*Oncorhynchus tshawytscha*) through the Sacramento–San Joaquin Delta. San Fran. Est. Watershed Sci. 11. :1-22. (http://escholarship.org/uc/item/36d88128)

Des Jardins, D. 2016. "Major Modelling Issues for the WaterFix Biological Assessment," Public comment and written comments submited to the Panel on April 5, 2016.

Durand, J. R. 2015. A conceptual model of the aquatic food web of the upper San Francisco estuary. San Fran. Est. Watershed Sci. 13. Available at: http://escholarship.org/uc/item/0gw2884c

Feyrer F., D. Portz, D. Odom, K. Newman, T. Sommer, D. Contreras, R. Baxter, S. Slater, D. Sereno, and E. VanNiewenhuyse. 2013. SmeltCam: underwater video codend for trawled nets with an application to the distribution of the imperiled Delta Smelt. PLoS ONE 8:e67829. doi: http://dx.doi.org/10.1371/journal.pone.0067829

Feyrer F., K. Newman K, M. Nobriga, and T. Sommer. 2011. Modeling the effects of future outflow on the abiotic habitat of an imperiled estuarine fish. Est. Coasts 34:120–128. doi: http://dx.doi.org/10.1007/s12237-010-9343-9

Feyrer F., M. Nobriga, and T. Sommer. 2007. Multi-decadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, U.S.A. Can. J. Fish. Aquat. Sci. 136:1393-1405. doi: http://dx.doi.org/10.1139/F07-048

Flannery, M. S., E. B. Peebles, and R. T. Montgomery. 2002. A percent-of-flow approach for managing reductions of freshwater inflows from unimpounded rivers to southwest Florida estuaries. Estuaries 25:1318-1332.

Fontaine, J. J. 2011. Improving our legacy: Incorporation of adaptive management into state wildlife action plans. J. Environ. Mgmt. 92:1403-1408.

Greenwood, M. 2016. Memo to the Independent Review Panel showing the effects of PA rules for water diversion on Sacramento River flow through the Delta. April 18, 2016.

Grimaldo, L. F., F. Feyrer, J. Burns, and D. Maniscalco. 2014. Sampling uncharted waters: examining longfin smelt rearing habitat in fringe marshes of the low salinity zone. Oral presentation at the Annual Bay-Delta Science Conference.

Grossman, G. D., T. Essington, B. Johnson, J. Miller, N. E. Monsen, and T. N. Pearsons. 2013. Effects of fish predation on Salmonids in the Sacramento River- San Joaquin Delta and associated ecosystems. Final report submitted to the California Department of Fish and Wildlife, Sacramento, CA.

Haskell, W. L. 1959. Diet of the Mississippi threadfin shad, *Dorosoma petenense* atchafalayae, in Arizona. Copeia1959:298-302.

Independent Scientific Advisory Board (ISAB). 2015. Density dependence and its implications for fish management and restoration programs in the Columbia River Basin. ISAB Document 2015-1. Prepared for the Northwest Power and Conservation Council. http://www.nwcouncil.org/fw/isab/

Israel, J., B. Harvey, K. Kundargi, D. Kratville, B. Poytress, et al., 2015. Brood year 2013 Winter-run Chinook salmon drought operations and monitoring assessment. U.S. Department of Interior, Bureau of Reclamation, Bay-Delta Office , and other agencies.

Johnson, R. 2015. Conserving Chinook dalmon at the southern end of their range: challenges and opportunities. Power point presentation. NOAA Fisheries and UC Davis.

Joly, J. L., J. Reynolds, and M. Robards. 2010. Recognizing when the "Best Available Scientific Data" isn't, 29 Stan. Environ. *L.J.* 247

Kimmerer, W. J. 2002. Effects of freshwater flow on abundance of estuarine organisms: physical effects or trophic linkages? Mar. Ecol. Prog. Ser. 243:39-55.

Kimmerer, W. J., E. S. Gross, and M. L. MacWilliams. 2009. Is the response of estuarine nekton to freshwater flow in the San Francisco estuary explained by variation in habitat volume? Est. Coasts 32:375-389.

Kimmerer, W. J. 2008. Losses of Sacramento River Chinook Salmon and Delta Smelt to entrainment in water diversions in the Sacramento-San Joaquin Delta. San Fran. Est. Watershed Sci. 6. Available at: http://www.escholarship.org/uc/item/7v92h6fs.

Kneib, R. T. , J. J. Anderson, J. A. Gore, N. E. Monsen, G. Schadlow, and J. Van Sickle. 2015. Independent Review Panel (IRP) report for the 2015 Long-term Operations Biological Opinions (LOBO) annual science review. Report to the Delta Science Program, Sacramento, CA.

Lindley, S. T., R. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento–San Joaquin Basin. San Fran. Est. Watershed Sci. [Internet]. Available from http://escholarship.org/uc/item/3653x9xc.

Lindley, S. and M. Mohr. 2003. Modeling the effect of striped bass **(***Morone saxatilis***)** on the population viability of Sacramento River winter-run Chinook salmon **(***Oncorhynchus tshawytscha***)**. Fish. Bull. 101:321**–**331.

Mac Nally, R., J. R. Thomson, W. J. Kimmerer, F. Feyrer, K. Newman, A. Sih, W. A. Bennett, L. Brown, E. Fleishman, S. D. Culberson, and G. Castillo. 2010. Analysis of pelagic species decline in the upper San Francisco Estuary using multivariate autoregressive modeling (MAR). Ecol. Appl. 20:1417-1430.

MAST (Management, Analysis, and Synthesis Team). 2015. An updated conceptual model of Delta Smelt biology: Our evolving understanding of an estuarine fish. Interagency Ecological Program for the San Francisco Bay/Delta Estuary, Tech. Rept. 90.

Maunder, M. N., R. B. Deriso, and C. H. Hanson. 2015. Use of state-space population dynamics models in hypothesis testing: advantages over simple log-linear regressions for modeling survival, illustrated with application to longfin smelt (*Spirinchus thaleichthys*). Fish. Res. 164:102-111.

Maunder, M. N., and R. B. Deriso. 2011. A state–space multistage life cycle model to evaluate population impacts in the presence of density dependence: illustrated with application to Delta Smelt (*Hyposmesus transpacificus*). Can. J. Fish. Aquatic Sci. 68:1285–1306.

McElhany P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt . 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept, Comm., NOAA Tech. Mem. NMFS-NWFSC-42. 158 p.

Miller, J.A., A. Gray, and J. Merz. 2010. Quantifying the contribution of juvenile migratory phenotypes in a population of Chinook salmon *Oncorhynchus tshawytscha*. Mar. Ecol. Prog. Ser. 408: 227–240.

Miller, W. J., B. F.J. Manly, D. D. Murphy, D. Fullerton, and R. R. Ramey. 2012. An investigation of factors affecting the decline of delta smelt (*Hypomesus transpacificus*) in the Sacramento-San Joaquin estuary. Rev. Fish. Sci. 20:1-19, doi: 10.1080/10641262.2011.634930.

Monismith, S., M. Fabrizio, M. Healey, J. Nestler, K. Rose, and J Van Sickle. July 2014. Workshop on the Interior Delta Flows and related stressors Panel summary report. Report to the Delta Stewardship Council Delta Science Program.

Monsen, N. E., J.E. Cloern and J. R. Burau. 2007. Effects of flow diversions on water and habitat quality: examples from California's highly manipulated Sacramento-San Joaquin Delta. San Fran. Est. Watershed Sci. 11 (3) Available at: http://escholarship.org/uc/item/04822861.

Moyle, P. B., B. Herbold, D. E. Stevens, and L. W. Miller. 1992. Life history and status of Delta Smelt in the Sacramento-San Joaquin Estuary, California. Trans. Am. Fish. Soc. 121:67–77.

Murphy, D. D., and P. S. Weiland. 2014. Science and structured decision making: fulfilling the promise of adaptive management for imperiled species. J. Environ. Stud. Sci. (on-line; DOI 10.1007/s13412-014-0165-0)

Murphy, D. D., P. S. Weiland, and K. W. Cummins. 2011. A critical assessment of the use of surrogate species in conservation planning in the Sacramento-San Joaquin Delta, California (U.S.A.). Conserv. Biol. 25:873–878. doi: 10.1111/j.1523-1739.2011.01711.x

National Research Council. 2010. A scientific assessment of alternatives for reducing water management effects on threatened and endangered fishes in California's Bay Delta. The Natl. Acad. Press, Washington, D.C.

Neter, J., W. Wasserman and M.H. Kutner. 1983. Applied Linear Regression Models. Richard D. Irwin Publishers, Homewood, IL.

NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid passage facility design. NMFS, Northwest Region, Portland, Oregon.

Nobriga, M. L., and J. A. Rosenfield. 2016. Population dynamics of an estuarine forage fish: disaggregating forces driving long-term decline of longfin smelt in California's San Francisco Estuary. Trans. Am. Fish. Soc. 145:44-58.

Nobriga, M. L., E. Loboschefsky, and F. Feyrer. 2013. Common predator, rare prey: exploring juvenile striped bass predation on Delta dmelt in California’s San Francisco Estuary. Trans. Am. Fish. Soc. 142:1563–1575.

Parker, A., C. Simenstad, T. L. George, N. Monsen, T. Parker, G. Ruggerone, and J. Skalski. 2014. Phase 3 review of the Bay Delta Conservation Plan (BDCP) Effects Analysis. Independent scientific review prepared for the Delta Science Program, CA.

Peebles, E.B. 2005. An analysis of freshwater inflow effects on the early stages of fish and their invertebrate prey in the Alafia River estuary. Technical report submitted to the Southwest Florida Water Management District, Brooksville, FL.
pelagic food webs in lakes. Ecol. 83:2152–2161.

Perry, R. W., P. L. Brandes, J. R. Burau, A. P. Klimley, B. MacFarlane, C. Michel, and J. R. Skalski. 2013. Sensitivity of survival to migration routes used by juvenile Chinook salmon to negotiate the Sacramento–San Joaquin River Delta. Environ. Biol. Fish. 96:381–392.

Peterson, M. S. 2003. A conceptual view of environment-habitat-production linkages in tidal river estuaries. Rev. Fish. Sci. 11:291-313, DOI: 10.1080/10641260390255844.

Reed, D., A. S. Leon, H. W. Paerl, E. B. Peebles, W. V. Sobczak, and E. B. Taylor. 2012. Delta Science Program independent science review; Fall Low Salinity Habitat (FLaSH) study synthesis – year one of the Delta fall outflow adaptive management plan. Technical report submitted to the Delta Science Program, Sacramento, CA.

Reed, D., J. Hollibaugh, J. Korman, P. Montagna, E. Peebles, K. Rose, and P. Smith. 2014. Delta Science Program independent science review; workshop on Delta outflows and related stressors. Technical report submitted to the Delta Science Program, Sacramento, CA.

Rooney, N., K. McCann, G. Gellner, and J.C. Moore. 2006. Structural asymmetry and the stability of diverse food webs. Nature 442:265-269

Rose, K. A., W. J. Kimmerer, K. P. Edwards, and W. A. Bennett. 2013a. Individual-based modeling of Delta Smelt population dynamics in the upper San Francisco Estuary: I. Model description and baseline results. Trans. Am. Fish. Soc. 142:1238–1259.

Rose, K. A., W. J. Kimmerer, K. P. Edwards, and W. A. Bennett. 2013b. Individual-based modeling of Delta Smelt population dynamics in the upper San Francisco Estuary: II. Alternative baselines and good versus bad years. Trans. Am. Fish. Soc. 142:1260–1272.

Rosenfield, J. A., and R. D. Baxter. 2007. Population dynamics and distribution patterns of longfin smelt in the San Francisco estuary. Trans. Am. Fish. Soc. 136:1577-1592.

Ruhl, J. B., 2004. The battle over Endangered Species Act methodology, 34 Environ. L. J? 555

Ruhl, J. B. and J. R. Salzman. 2006. In defense of regulatory peer review, 84 Wash., U. Law Rev. 1

Schoellhamer, D. H., S. A. Wright, and J. Z. Drexler. 2013. Adjustment of the San Francisco estuary and watershed to decreasing sediment supply in the 20th century. Mar. Geol. 345:63–71. http://dx.doi.org/10.1016/j.margeo.2013.04.007.

Sobeck, E. 2016. Guidance for Treatment of Climate Change in NMFS ESA Decisions. Natl. Mar. Fish. Serv.

Slater, S. B., and R. D. Baxter. 2014. Diet, prey selection and body condition of age-0 Delta Smelt, *Hypomesus transpacificus*, in the upper San Francisco Estuary. San Fran. Est. Watershed Sci. 12:23. Available from: http://escholarship.org/uc/item/52k878sb

Sommer T., and F. Mejia. 2013. A place to call home: a synthesis of Delta Smelt habitat in the upper San Francisco Estuary. San Fran. Est. Watershed Sci. 11. Available from: http://dx.doi.org/10.15447/sfews.2013v11iss2art4

Sommer, T., C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga, and K. Souza. 2007. The collapse of pelagic fishes in the upper San Francisco Estuary. Fish. 32:270–277.

stability of diverse food webs. Fisheries ew(6):270-277.

Steel, A. E., P. T. Sandstrom, P. L. Brandes, and A. P, Klimley. 2013. Migration route selection of juvenile Chinook salmon at the Delta Cross Channel, and the role of water velocity and individual movement patterns. Environ. Biol. Fish. 96:215–224.

Sturrock, A. M., J. D. Wikert, T., C. Heyne, A. E. Mesick, T. M. Hubbard, Hinkelman, P.K. Weber, G. E. Whitman, J. J. Glessner, and R. C. Johnson. 2015. Reconstructing the migratory behavior and long-term survivorship of juvenile Chinook salmon under contrasting hydrologic regimes. PLoS ONE 10(5): e0122380. doi:10.1371/journal.pone.0122380

Swanson, K. M., J. Z. Drexler, C. C. Fuller, and D. H. Schoellhamer. 2015. Modeling tidal freshwater marsh sustainability in the Sacramento-San Joaquin Delta under a broad suite of potential future scenarios. San Fran. Est. Watershed Sci. 13 *doi:* http://dx.doi.org/10.15447/sfews.2015v13iss1art3

Thomson, J. R., W. J. Kimmerer, L. R. Brown, K. B. Newman, R. Mac Nally, W. A. Bennett, F. Feyrer, and E. Fleishman. 2010. Bayesian change point analysis of abundance trends for pelagic fishes in the upper San Francisco Estuary. Ecol. Appl. 20:1431-1448.

USFWS (United States Fish and Wildlife Service). 2008. Formal Endangered Species Act consultation on the proposed coordinated operations of the Central Valley Project (CVP) and State Water Project (SWP). U.S. Fish and Wildlife Service, Sacramento, CA.

USFWS and NMFS. 1998. Endangered Species Act Consultation Handbook: Procedures for Conducting Section 7 Consultations and Conferences https://www.fws.gov/ENDANGERED/esa-library/pdf/esa_section7_handbook.pdf

Vander Zanden, M. J., and Y. Vadeboncoeur. 2002. Fishes as integrators of benthic and pelagic food webs in lakes. Ecol. 83:2152–2161.

Walters, C. J. 1986. Adaptive Management of Renewable Resources. McMillan, New York, NY, USA.

Westgate, M. J., G. E. Likens, and D. B. Lindenmayer. 2013. Adaptive management of biological systems: A review. Biol. Conserv. 158:128-139.

Williams, J. G. 2006. Central Valley Salmon: A perspective on chinook and steelhead in the Central Valley of California. San Fran. Est. Watershed Sci. 4:1-398.

Winder M., and A. D. Jassby. 2011. Shifts in zooplankton community structure: implications for food web processes in the upper San Francisco Estuary. Est. Coasts 34:675-690. Available from: http://link.springer.com/article/10.1007/s12237-010-9342-x#page-1

Wright, S. A., and D. H. Schoellhamer. 2005. Estimating sediment budgets at the interface between rivers and estuaries with application to the Sacramento–San Joaquin River Delta. Wat. Resource Res. 41(W09428). doi: http://dx.doi.org/10.1029/2004WR003753

Appendix 1 – Materials for CA WaterFix Aquatic Science Peer Review – Phase I

For Review:

1. NMFS Biological Opinion Draft Analytical Approach
    a. Draft analytical approach
    b. South Delta Conceptual Model

2. 2016 CWF Biological Assessment (BA) Sections for Review
    a. Chapter 6 (Delta Smelt Effects Analyses only)
    - Chapter 6: Effects Analysis for Delta Smelt
    - Appendix 5.A, CalSim II Modeling and Results
    - Appendix 5.B, DSM2 Modeling and Results
    - Appendix 5.G, Projects to Be Included in Cumulative Effects Analysis for the Conveyance Section 7 Biological Assessment
    - Appendix 6.A. Quantitative Methods for Biological Assessment of Delta Smelt

    b. Chapter 5 (Salmonids and Sturgeon Effects Analysis)

    Note: All methods sections listed can be found in Appendix 5.D Quantitative Methods and Detailed Results for Effects Analysis of Chinook Salmon, Central Valley steelhead, Green Sturgeon, and Killer Whale

    - Section 5.4.1.3.1.1.1 North Delta Exports: For overall species response to this component of the proposed action Methods: Section 5.D.1.1.1 North Delta Exports (for near-field effects only; other effects are in Sections 5.D.1.2 Indirect Mortality Within the Delta (Through-Delta Survival) and 5.D.1.3 Habitat Suitability)

    - Section 5.4.1.3.1.1.1 North Delta Exports and 5.4.1.3.1.1.1.3 Predation: For effects of intakes on predation and travel time

Methods: 5.4.1.3.1.1.1.2 Impingement, Screen Contact, and Screen Passage Time (assuming “travel time” = screen passage time)

There is no analysis of predation in Appendix 5.D

- Section 5.4.1.3.1.2.1 Indirect Mortality Within the Delta: For characterization of effects that are in-Delta yet beyond the immediate vicinity of the north Delta intakes

Methods: Section 5.D.1.2 Indirect Mortality within the Delta (Through-Delta Survival)

- Section 5.4.1.3.1.2.1.3. Through-Delta Survival: For consideration of effects on population of performance criteria of minimum 95% survival rate through north Delta intake reach

Methods: Section 5.D.1.2.2 Delta Passage Model, Section 5.D.1.2.3 Analysis Based on Newman (2003), Section 5.D.1.2.4 Analysis Based on Perry (2010), and Section 5.D.3 Life Cycle Models

- Section 5.4.1.3.1.2.2.1.1 Bench Inundation: For effects of habitat loss in north Delta due to operations of north Delta intakes

Methods: Section 5.D.1.3.1 Bench Inundation

- Section 5.4.2.1.3.1.1 Spawning, Egg Incubation, and Alevins: For effects of operations in upstream areas during summer and fall months, especially given inability of modeling to capture real-time management

Methods: Section 5.D.2.1 Water Temperature Methods and Section 5.D.2.2 Spawning Flow Methods

3. Longfin Smelt Analytical Framework and Effects Analysis

   a. Draft Analytical Approach
   b. 2081 Take Analysis
   c. Longfin Smelt Quantitative Analyses

d. PTM results

Background information:

Biological Assessment

1. 2016 CWF Biological Assessment

    a. **DSM2 Grid Version 2.0**

Federal Policies and Guidance

2. USFWS Section 7 Analytical Framework, p.138-139
3. Endangered Species Act Section 7 Consultation Handbook
4. 2008 USFWS Biological Opinion on the Long-Term Operational Criteria and Plan (OCAP) for coordination of the Central Valley Project and State Water Project
5. Designated Delta Smelt Critical Habitat Map
6. Designated Delta Smelt Critical Habitat
7. NMFS Aquatic Species Critical Habitat
8. Warranted But Precluded 12-Month Finding to Uplist Delta Smelt to Endangered Status

Research

9. Lindley et al. 2007
10. McElhaney et al. 2000
11. **2015 Final MAST report** "An updated conceptual model for Delta Smelt: our evolving understanding of an estuarine fish."
12. Final Report on Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem
13. Effects Analysis State Water Project Effects on Longfin Smelt, California Department of Fish and Game, 2009.
14. Nobriga, M. L., and J. A. Rosenfield. 2016. Population dynamics of Longfin Smelt in the San Francisco Estuary II: disaggregating forces driving long-term decline of an estuarine forage fish. Transactions American Fisheries Society 145(1):44-58

15. **FINAL REPORT:** A Synthesis of Delta Smelt Growth and Life-History Studies, Prepared for the California Department of Fish and Wildlife by: James A. Hobbs, Department of Wildlife, Fish and Conservation Biology University of California-Davis, December 2015.

Reviews

16. Independent Review Panel Report: BDCP Effects Analysis Review, Phase 3 - March, 2014
17. Report of the 2015 Independent Review Panel on the Long-term Operations Biological Opinions (LOBO) Annual Review (December 16, 2015)
18. Delta Smelt 5-Year Review

Supplemental Materials Requested by the Panel:

- **DWR Delta Simulation Model Grid Version 2.0**
- **2016 CWF Biological Assessment Appendix 5.B Figure 5.B 2-3**
- **2016 CWF Biological Assessment Appendix 5.B Figure 5.B.2-6**
- **Sobeck 2016**
- **20mm Longfin Smelt monitoring methods**
- **Fish Facilities Study Work Plan**
- **2016 CWF Biological Assessment Section 3.4.8**

Additional Materials Provided at the Review:

- **Mount et al., 2013**
- **Vogel et al., 2008**

Presentations:

- **Project Overview –BG Heiland (DWR)**
- **Endangered Species Act Overview: Section 7 Process and Biological Opinion –Jane Affonso (USFWS), Erin Strange (NOAA)**

- A Brief Overview of the California Endangered Species Act and Incidental Take Permitting –Shannon Little (CDFW)
- Status Update ESA Section 7 Consultation for California WaterFix –Kim Turner (USFWS)
- NMFS Biological Opinion Draft Analytical Approach for Salmonids and Sturgeon -- Cathy Marcinkevage (NOAA)
- Salmonids and Sturgeon Effects Analysis –Rick Wilder/Marin Greenwood (ICF)
- Delta Smelt Effects Analyses –Marin Greenwood (ICF)
- Longfin Smelt Analytical Framework and Effects Analysis –Marin Greenwood (ICF)
- Independent Science Panel Initial Recommendations

Public Comment:

- 2016 California WaterFIx Aquatic Science Peer Reivew –Doug Obegi, Natural Resources Defense Council
- Major Modeling Issues for the WaterFix Biological Assessment –Deirdre Des Jardins, California Water Research
- 2016 California WaterFix Aquatic Science Peer Review –State Water Contractors

Appendix 2. Memo from M. Greenwood on modeled Sacramento R. flows. See attached document, ICF_Hydrograph.pdf.

Panel note on Appendix 2:

In Appendix 2, there is subtle change noted in the figure notes that state the Sacramento Inflow is defined at a location south of the NDD withdrawal facilities rather than at its traditional location at Freeport. This change gives the impression that the NDD withdrawal is at a location above the Delta. However, the inlet locations are south of Freeport, in the legal domain of the Delta.

This concept is important for the CA Department of Water Resources' Dayflow program (http://www.water.ca.gov/dayflow/). The definition of the Sacramento inflow location in the Dayflow program, which is used to calculate Delta Outflow and OMR should not be changed, in order for comparisons of pre- and post-project to be done without confusion. In addition, this provides clarity in reporting the total export from the Delta from both the Sacramento and San Joaquin rivers. Once the NDD facility is operational, an additional term, NDD, the amount exported from the NDD facility, must be added to the Dayflow suite of calculations. The addition of the NDD term will be very straightforward to include since this program is simply a water mass balance calculation.

Memorandum

Date:	April 18, 2016
To:	Independent Review Panel, 2016 California WaterFix Aquatic Science Peer Review
From:	Marin Greenwood, ICF
Subject:	**Request for graphical representation of the effects on Sacramento flow of the rules for water diversion and the amount of water that will be diverted from the North Delta (Specific panel request #1)**

Introduction

This memorandum addresses the following specific request for information and materials:

1. *Request for graphical representation of the effects on Sacramento flow of the rules for water diversion & the amount of water that will be diverted from the North Delta.*
    a. *The long tables in Ch. 3 are too complicated to easily grasp.*
    b. *Request for hydro period graphs that simply capture the differences in relative water diversion from the Sacramento by the dual conveyance facility*
        i. *For a dry, average, wet, and extremely dry water year, provide the amount (cfs) of water that will be diverted each month. This should be presented in a series of graphs with month on the x-axis. A range in the diversion should be presented to reflect the various decisions that affect water diversion.*
        ii. *On the same hydrograph, show the diversion as a percentage of total water available in the Sacramento River at the diversion site*
    c. *For the same scenarios as the diversion at the dual conveyance facility, provide hydrographs for the Sacramento River below the diversion site, such as at Rio Vista or in the Cache Slough complex*
    d. *If reasonable, for the same scenarios above, show the position of X2?*

The memorandum includes information regarding the bypass flows as proposed and modeled, in addition to the above specific hydro period requests.

Bypass Flow Criteria

The Independent Science Panel found the tables explaining North Delta Diversion (NDD) bypass flow criteria (i.e., Tables 3.3-1 and 3.3-2 in the working draft Biological Assessment) challenging to interpret. As an example graphical representation of these criteria, Figure 1 illustrates the potential diversions that would be possible based on the bypass flow criteria during December-April, which is a period of particular management importance for outmigrating juvenile salmonids (e.g., Winter-Run Chinook Salmon). Note that other regulatory constraints affect the actual bypass flows (e.g., downstream water quality requirements), so that the actual percentage of flow diverted does not necessarily correspond to the amount allowable from the bypass flow criteria alone. This is illustrated in Figure 2 below. The regulatory criteria often controlling Delta operations are contained in the State Water Resources Control Board's (SWRCB) 2006 Water Quality Control Plan (WQCP) for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary , commonly referred to as D-1641 for the SWRCB's Water Right Decision 1641 from which the objectives were derived.[1] Among these criteria, which are intended to benefit a variety of in-Delta user groups, are flow and operational criteria intended to provide reasonable protection of fish and wildlife beneficial uses. It is important to note that the California WaterFix proposes to adhere to these objectives, as described in Chapter 3 of the working draft BA. Select important flow-based criteria from the WQCP are shown in Table 1. These provide important context for the specific hydro period graphs included in response to the Independent Science Panel's request.

Requested Hydro Period Graphs

The Independent Science Panel's request for representative hydro period graphs is addressed below based on CalSim-II modeling outputs of the proposed California WaterFix action scenario (proposed action, or PA) and, for context, the no action alternative (NAA). As described in the presentation to the panel, caution should be applied when examining individual years from CalSim-II outputs, for the purpose of the model is to provide longer term, planning-level comparisons (e.g., averages by water year types). In addition to the material requested by the panel, it is important to provide context for overall operational changes under WaterFix by also considering the role of south Delta exports. This is shown below in additional plots.

The selected example years were chosen by examining the mean water year (February-January, per the CalSim-II modeling) Sacramento River at Freeport flow. The following years were selected:

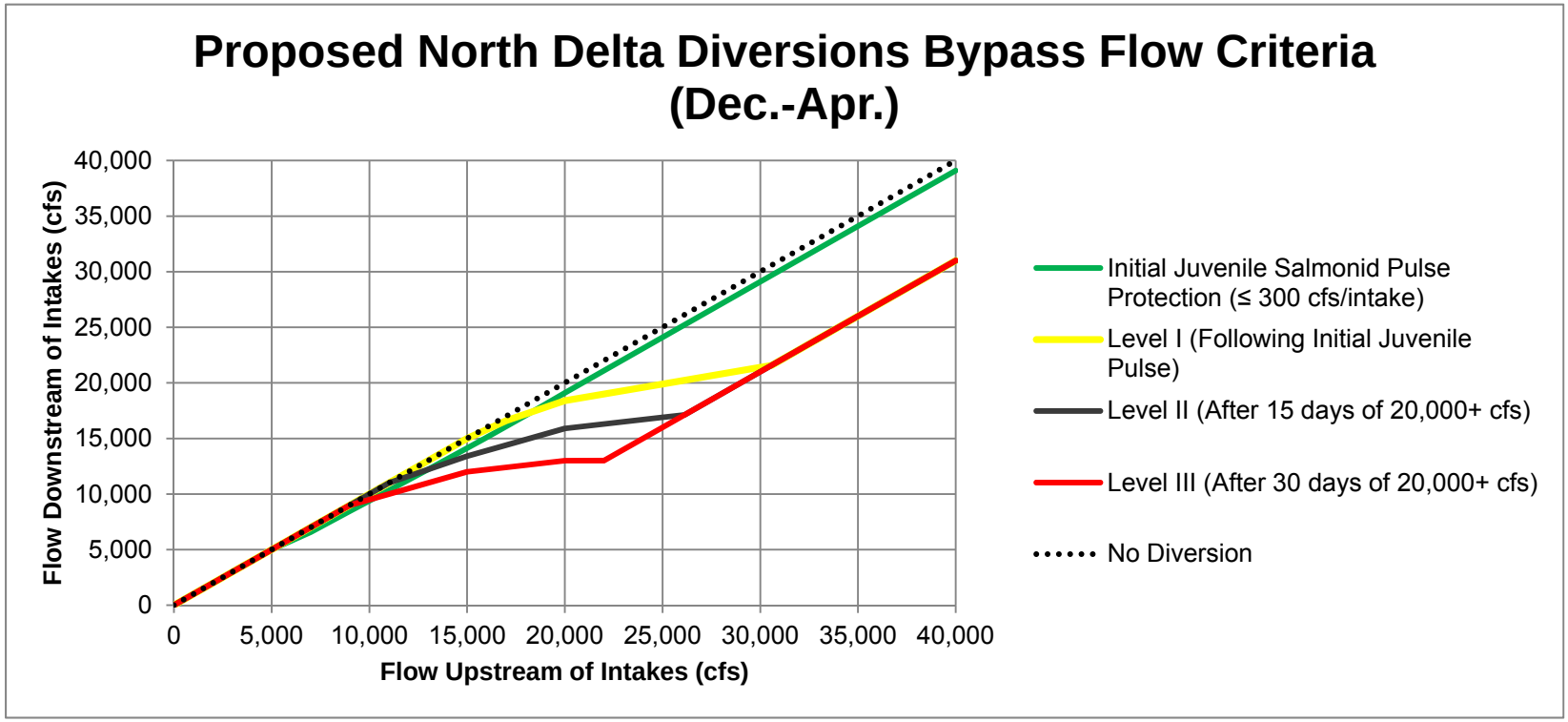
- Extremely dry year: the critically dry year of 1924 (mean Freeport flow = 9,345 cfs) (Figures 3 and 4)

[1] State Water Resources Control Board. 2006. Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. December 13. Division of Water Rights, State Water Resources Control Board, Sacramento, CA. Available: http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/2006wqcp/index.shtml

- Dry year: 1989 (mean Freeport flow = 16,003 cfs) (Figures 5 and 6)
- Average year: the below normal year of 1968 (mean Freeport flow = 21,927 cfs) (Figures 7 and 8) and the above normal year of 1980 (mean Freeport flow = 21,768 cfs) (Figures 9 and 10)
- Wet year: 1996 (mean Freeport flow = 36,368 cfs) (Figures 11 and 12)

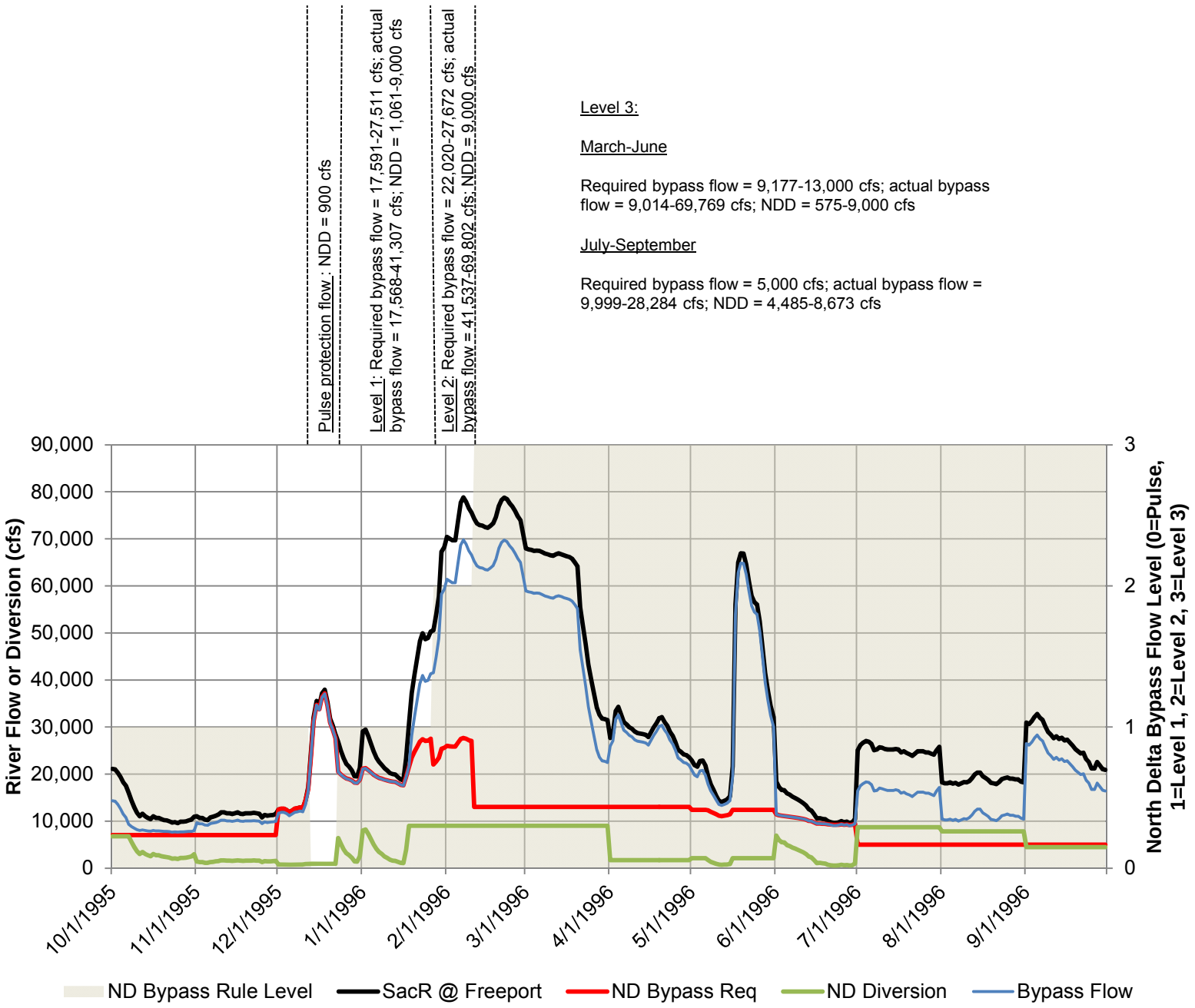
Each example year has two plots below, per the panel request and also to provide the important context for the effects of dual conveyance operations. The first plot includes the mean monthly water flow exported by the NDD, in addition to the percentage of Sacramento River flow upstream of the NDD (at Freeport) that this flow represents. The first plot's export flow axis is scaled to 10,000 cfs in order to allow the different years to be easily compared, in relation to the maximum possible 9,000-cfs diversion. Also included on the first plot is the export to inflow (E:I) ratio, which is a measure of water exported divided by water inflowing to the Delta. This ratio is included to recognize that with implementation of dual conveyance, a certain amount of export pumping would be shifted from the south Delta to the north Delta, so that south Delta exports under the PA would appreciably less than under the NAA. As noted on the first plot, the inflow (I) term for the PA is the Sacramento River downstream of the NDD (i.e., accounting for the water exported by the NDD); NDD exports are not included in the export (E) term for the PA (Figures 3,5,7,9,11).

The second plot for each example year includes the mean monthly flow in the Sacramento River at Rio Vista (for PA, as requested) and X2, the position of the 2-ppt near-bottom isohaline, with X2 shown for both the PA and NAA scenarios in order to emphasize that X2 is dependent on both south and north Delta exports. SWRCB WQCP outflow-based objectives occur year-round for the reasonable protection of fish and wildlife beneficial uses (Table 1); these are met under the PA and NAA (Figures 4, 6,8,10, 12).



Source: Adapted from Greenwood and Chilmakuri (2014: http://www.eposters.net/pdfs/habitat-restoration-and-water-diversion-effects-of-the-proposed-bay-delta-conservation-plan-on-the.pdf)

Figure 1. Proposed North Delta Diversions Bypass Flow Criteria (December-April example).

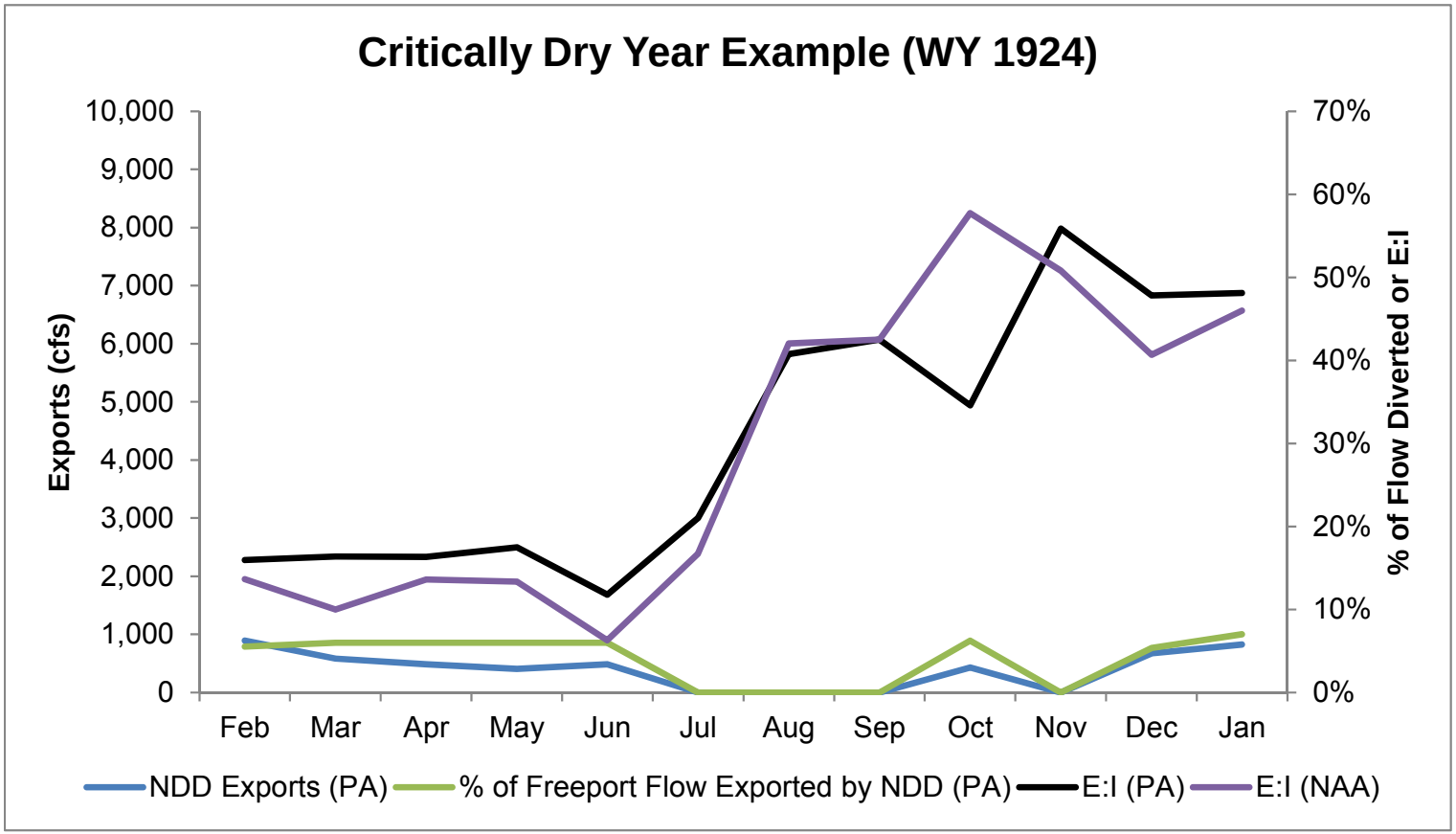


Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment. Note: the grey shading indicates the bypass rule (0=pulse/low level pumping, 1=level I, 2=level II, and 3=level III). 'SacR @ Freeport' = flow upstream of the NDD. 'ND Bypass Req' = the required bypass flow based on the criteria/rules (see Tables 3.3-1 and 3.3-2 in the working draft Biological Assessment). 'ND Diversion' is the water exports by the NDD. 'Bypass Flow' is the flow that was modeled to have been bypassed (i.e., occurred just downstream of) the NDD.

Figure 2. Example Year Daily Patterns and Operation of the North Delta Diversions

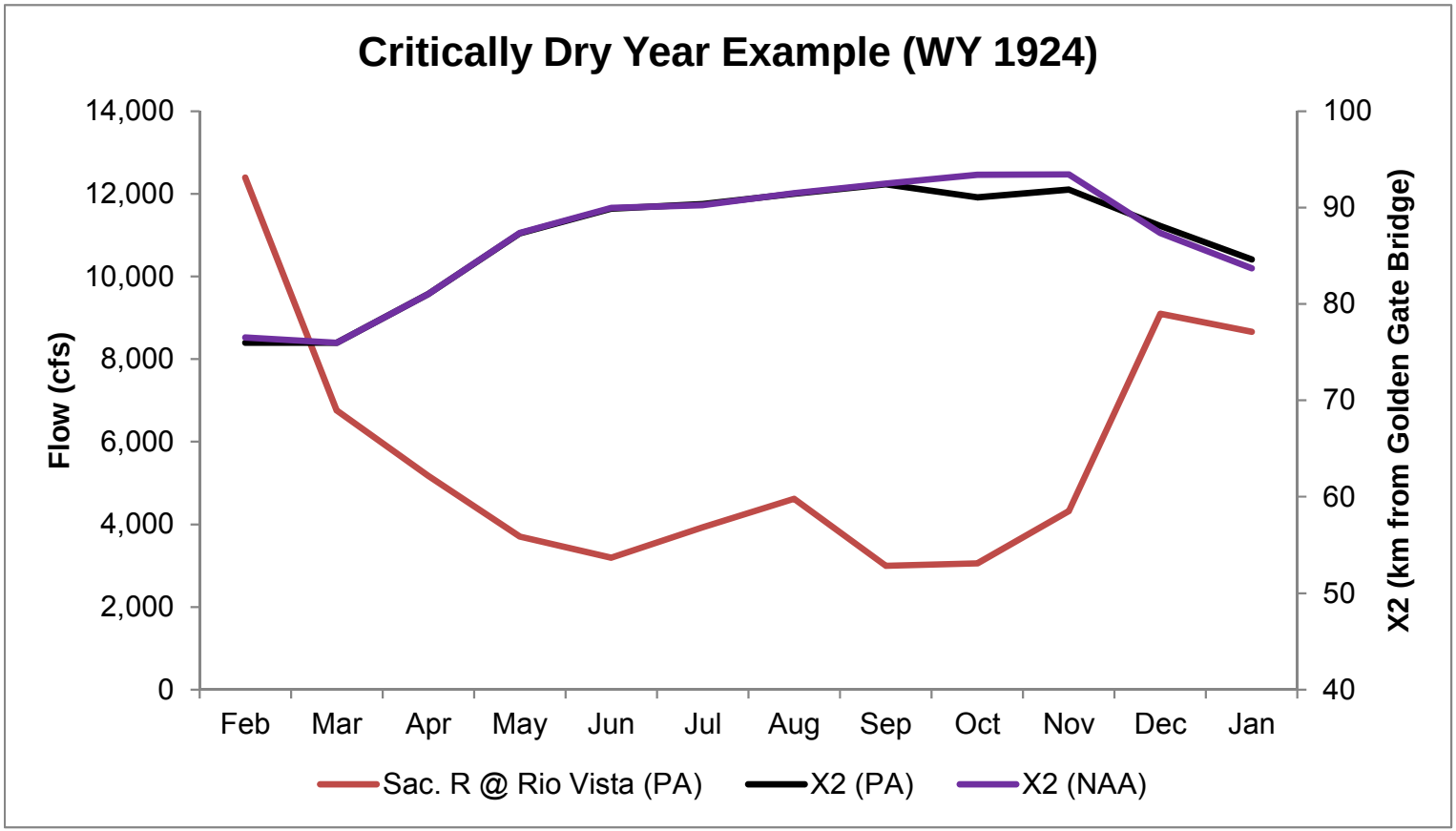
Table 1. Selected Flow-Related Water Quality Objectives for Fish and Wildlife Beneficial from the SWRCB (2006) Bay-Delta Water Quality Control Plan.

Objective	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SWP/CVP Export Limits					1,500 cfs							
Export/Inflow (E:I) Ratio	0.65	0.35					0.65					
Min. Delta Outflow	4,500-6,000 cfs						3,000-8,000 cfs					
Habitat Protection Outflow		7,100-29,200 cfs										
Rio Vista Flows									3,000-4,500 cfs			



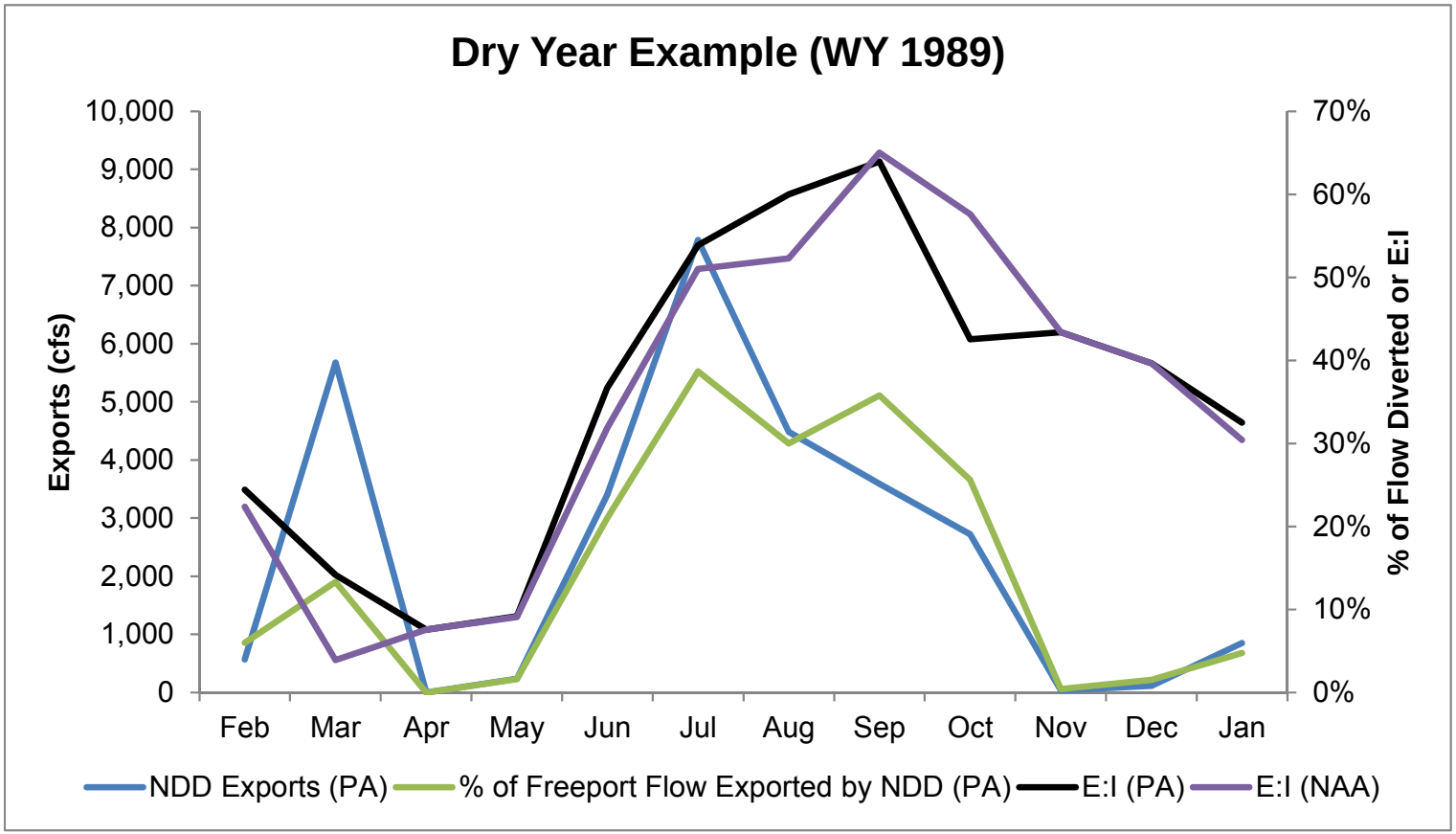
Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment. Note: E:I = exports to inflow ratio; the inflow (I) term for the PA is the Sacramento River downstream of the NDD; NDD exports are not included in the export (E) term for the PA.

Figure 3. Modeled Mean Monthly Exports by the North Delta Diversions and Percentage of Sacramento River at Freeport Flows Represented by these Exports, Water Year 1924.



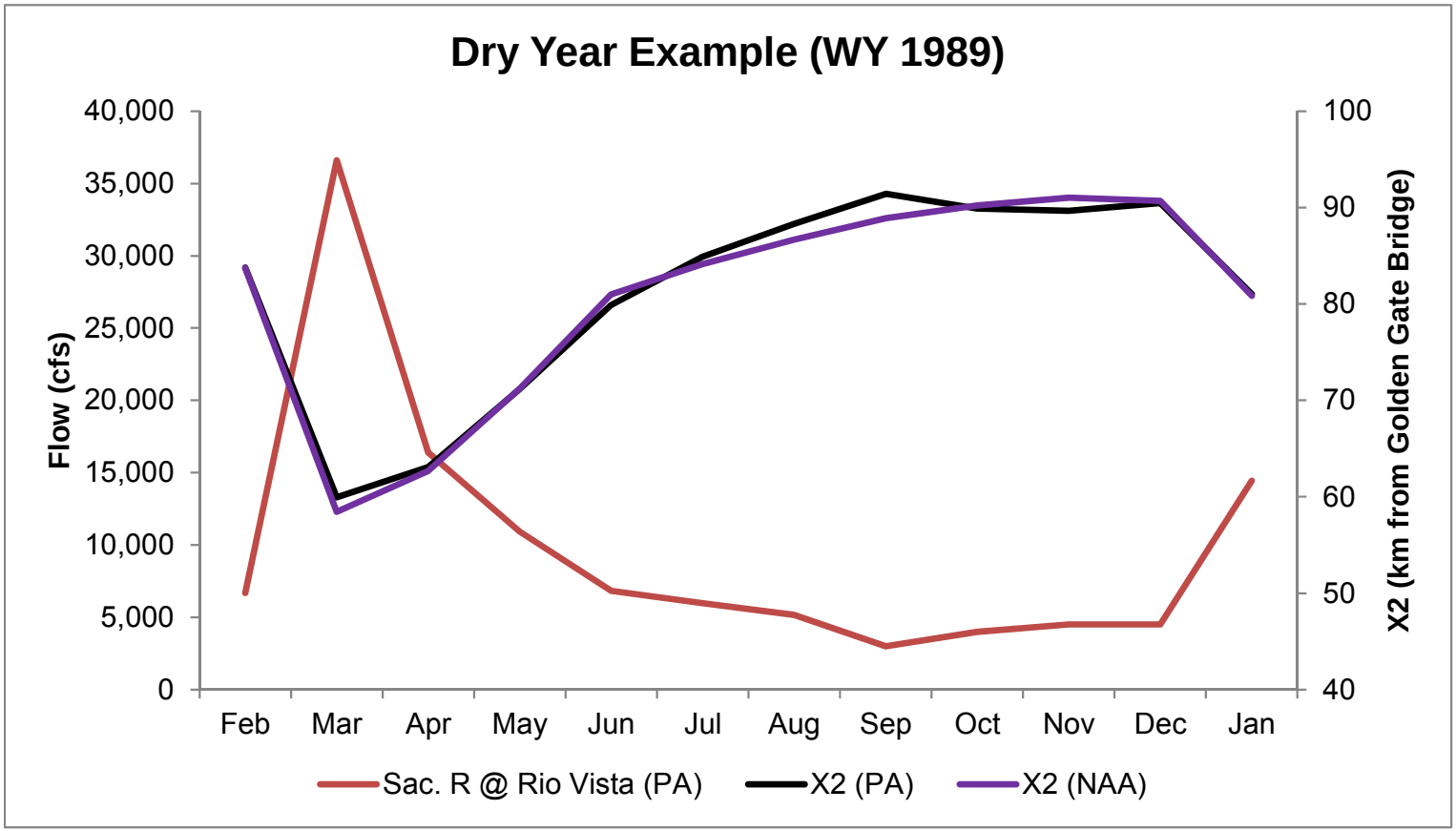
Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment.

Figure 4. Modeled Mean Monthly Sacramento River Flow at Rio Vista and X2, Water Year 1924.



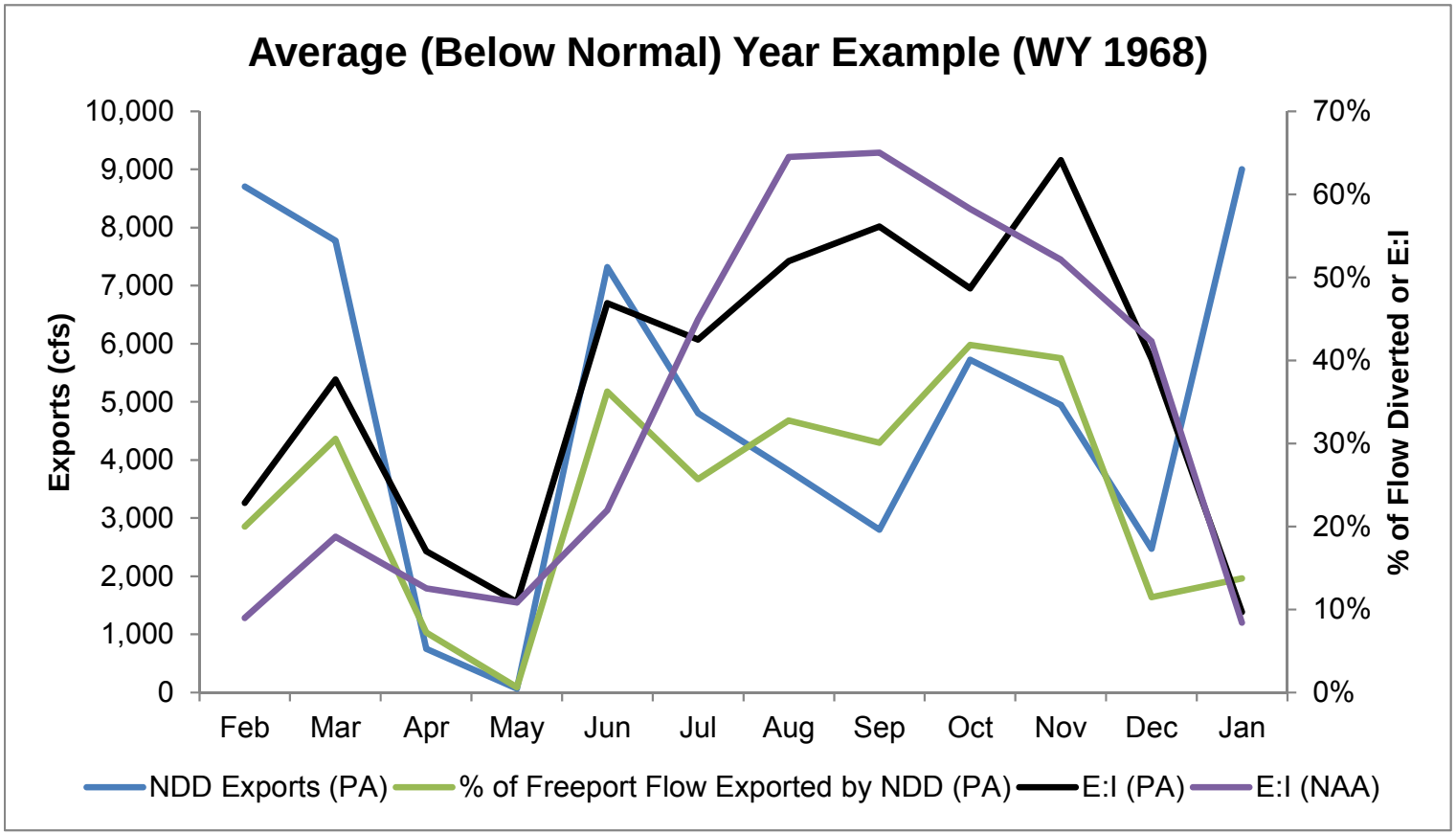
Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment. Note: E:I = exports to inflow ratio; the inflow (I) term for the PA is the Sacramento River downstream of the NDD; NDD exports are not included in the export (E) term for the PA.

Figure 5. Modeled Mean Monthly Exports by the North Delta Diversions and Percentage of Sacramento River at Freeport Flows Represented by these Exports, Water Year 1989.



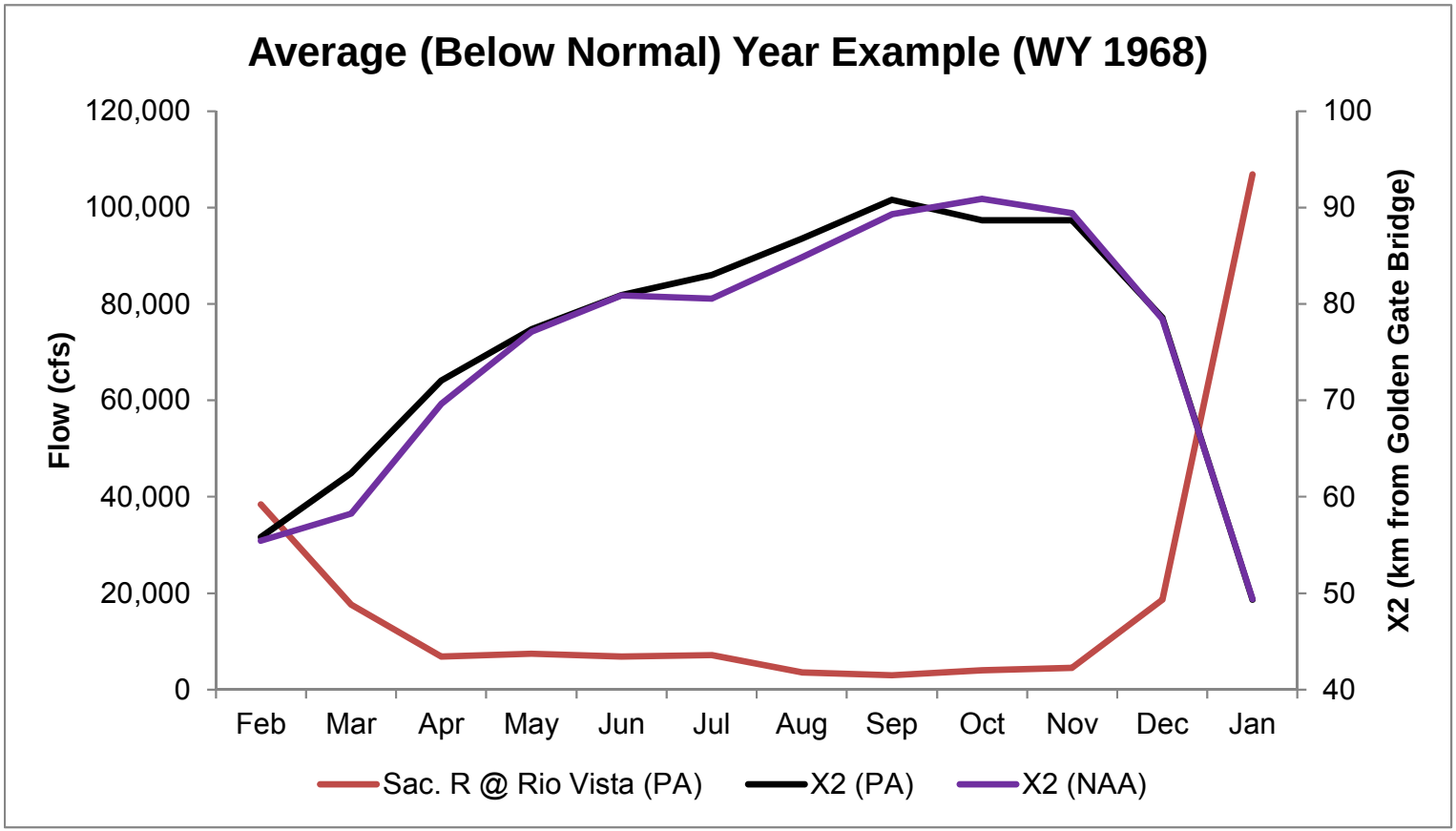
Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment.

Figure 6. Modeled Mean Monthly Sacramento River Flow at Rio Vista and X2, Water Year 1989.



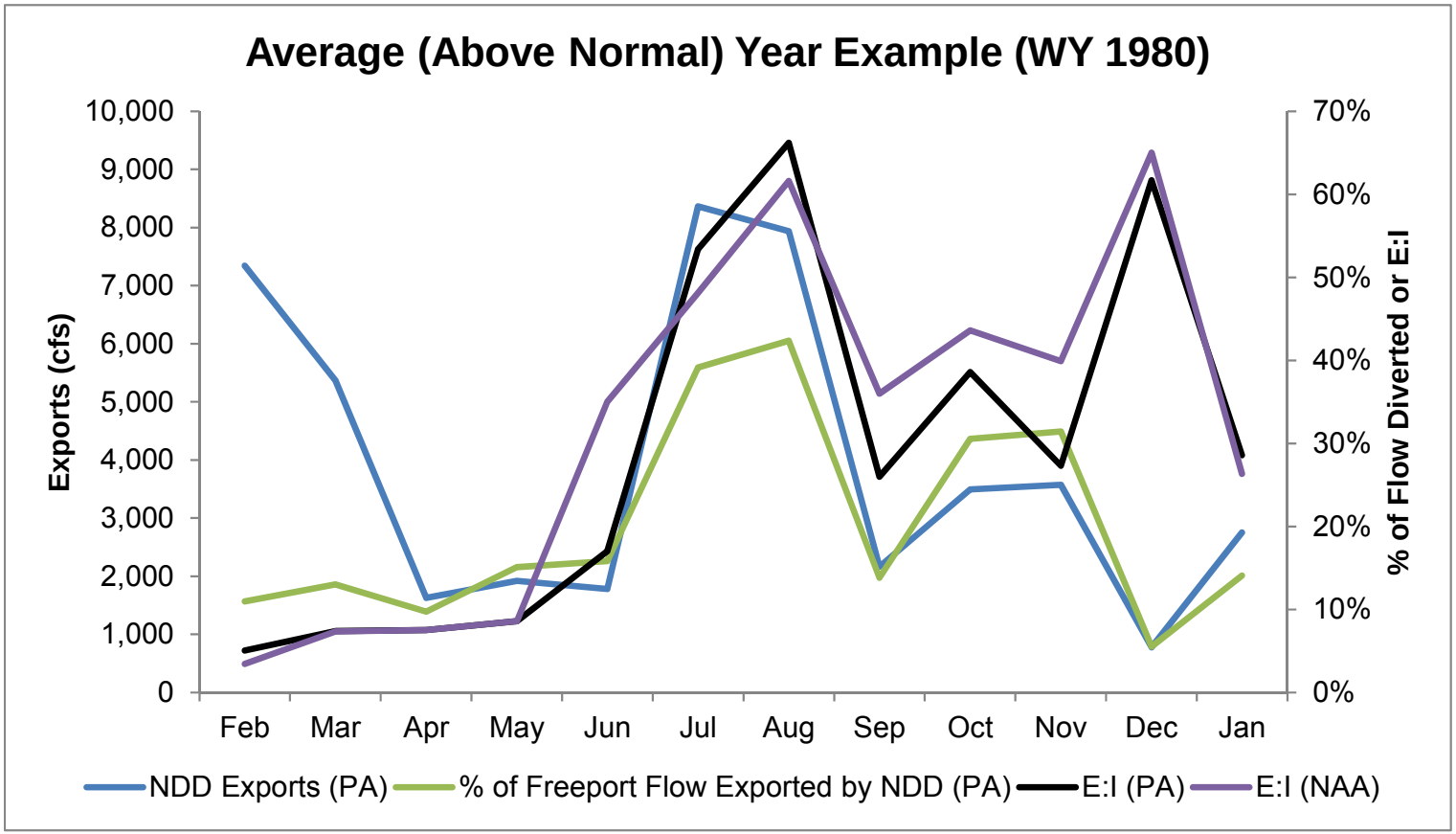
Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment. Note: E:I = exports to inflow ratio; the inflow (I) term for the PA is the Sacramento River downstream of the NDD; NDD exports are not included in the export (E) term for the PA.

Figure 7. Modeled Mean Monthly Exports by the North Delta Diversions and Percentage of Sacramento River at Freeport Flows Represented by these Exports, Water Year 1968.



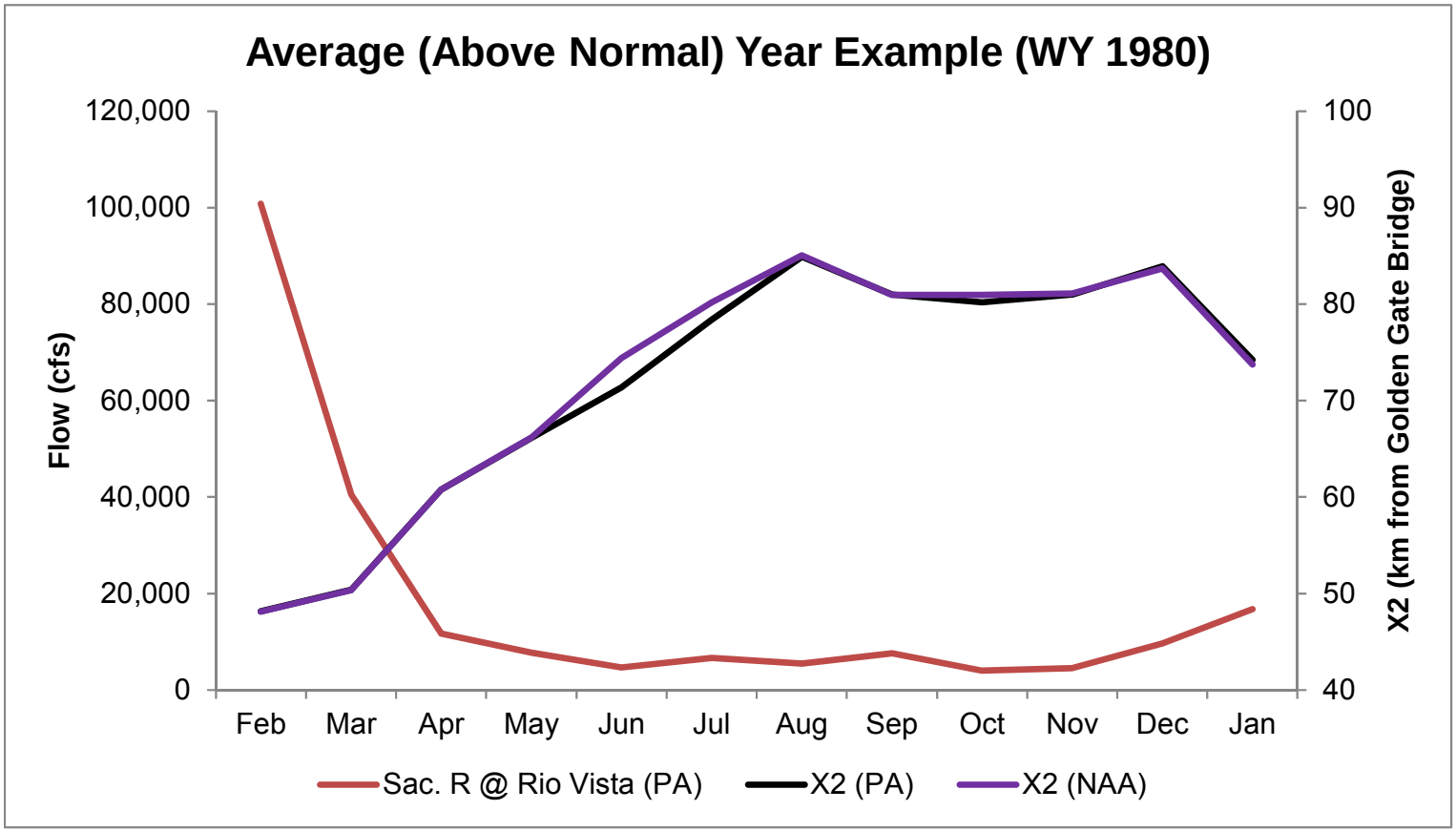
Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment.

Figure 8. Modeled Mean Monthly Sacramento River Flow at Rio Vista and X2, Water Year 1968.



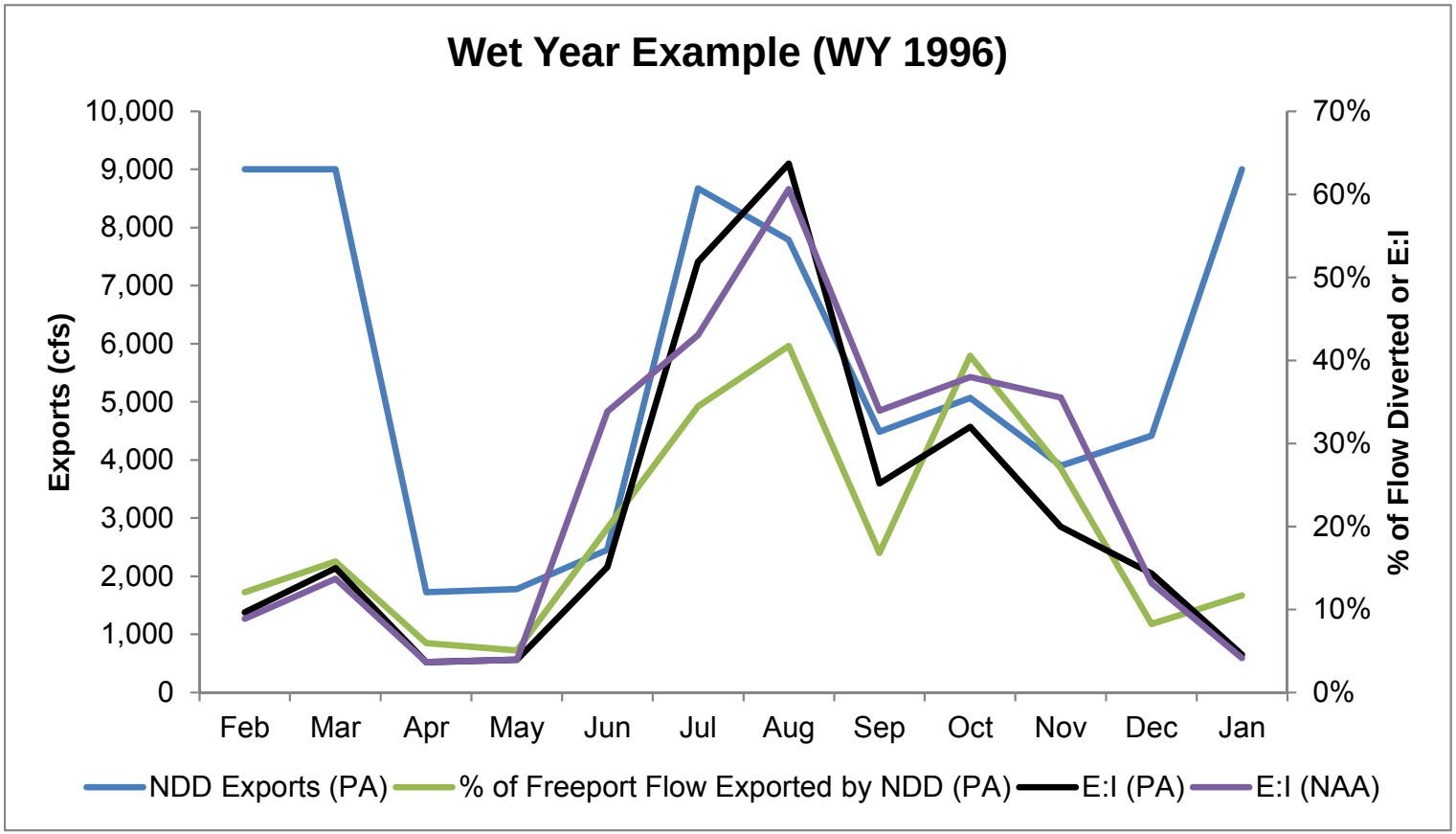
Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment. Note: E:I = exports to inflow ratio; the inflow (I) term for the PA is the Sacramento River downstream of the NDD; NDD exports are not included in the export (E) term for the PA.

Figure 9. Modeled Mean Monthly Exports by the North Delta Diversions and Percentage of Sacramento River at Freeport Flows Represented by these Exports, Water Year 1980.



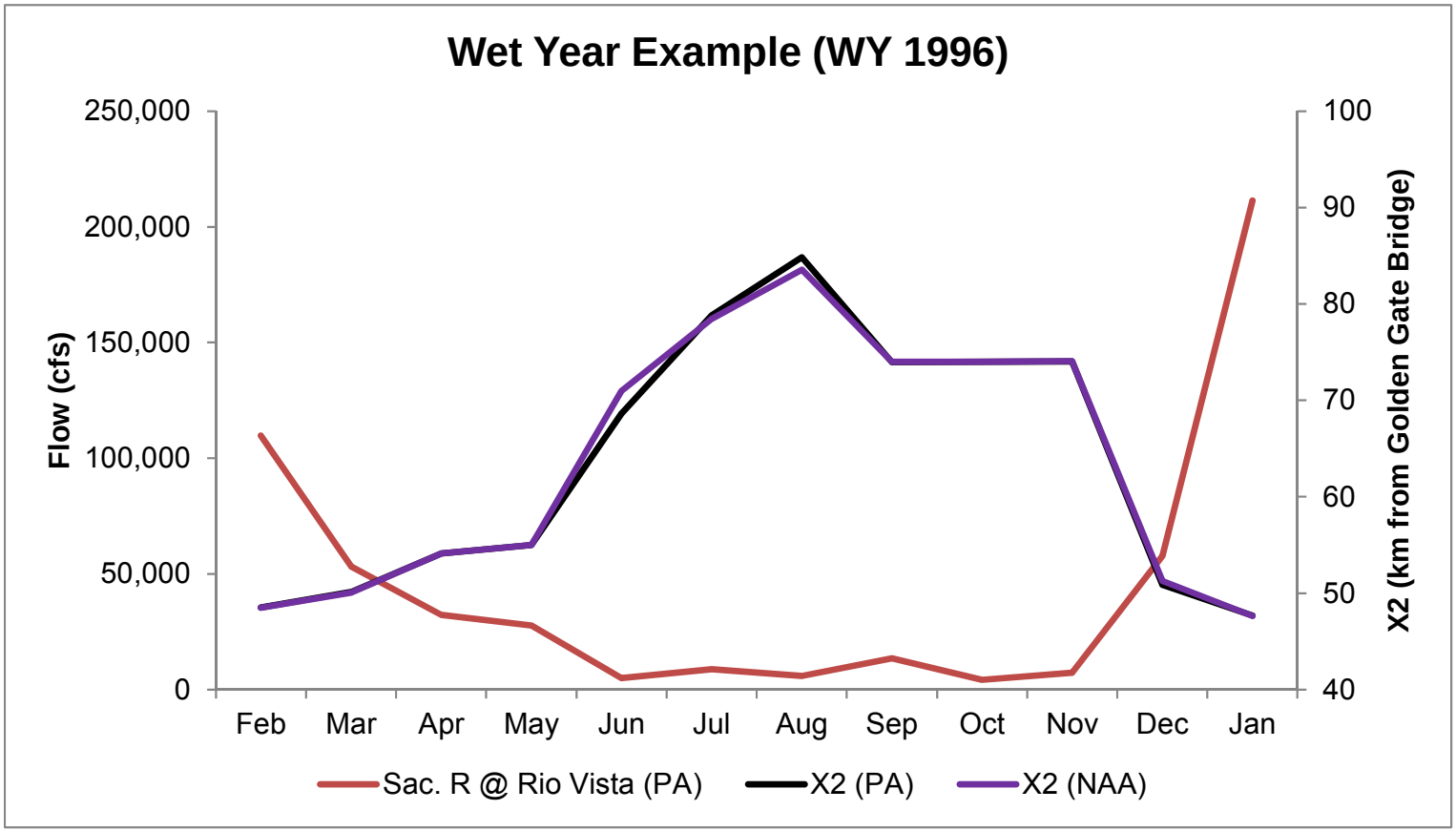
Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment.

Figure 10. Modeled Mean Monthly Sacramento River Flow at Rio Vista and X2, Water Year 1980.



Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment. Note: E:I = exports to inflow ratio; the inflow (I) term for the PA is the Sacramento River downstream of the NDD; NDD exports are not included in the export (E) term for the PA.

Figure 11. Modeled Mean Monthly Exports by the North Delta Diversions and Percentage of Sacramento River at Freeport Flows Represented by these Exports, Water Year 1996.



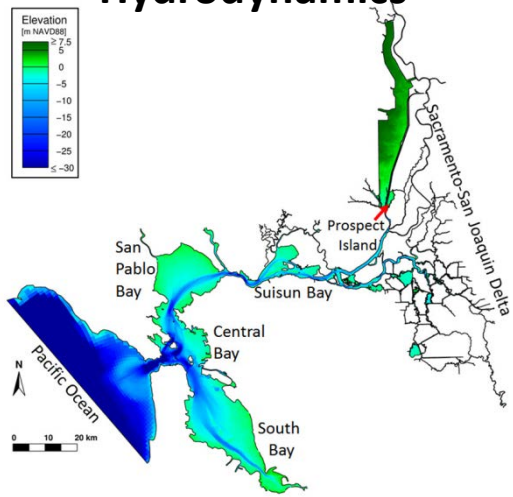
Source: Created by ICF from CalSim-II modeling undertaken for the working draft Biological Assessment.

Figure 12. Modeled Mean Monthly Sacramento River Flow at Rio Vista and X2, Water Year 1996.

EXHIBIT 19

Evaluation of the Effects of Prospect Island Restoration on Sediment Transport and Turbidity

Hydrodynamics



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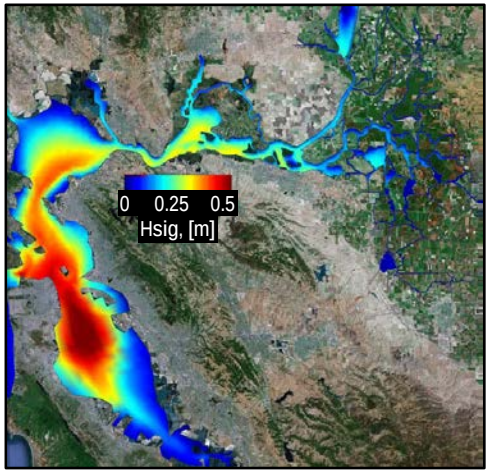
Waves



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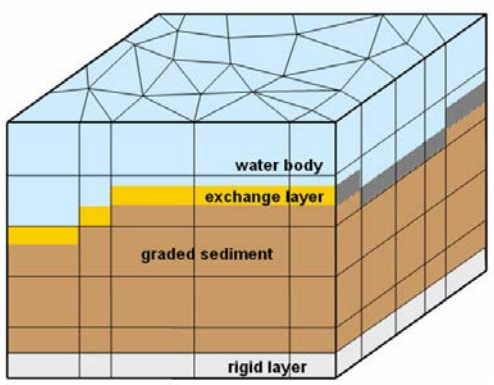
Sediment Transport



Michael MacWilliams, Aaron Bever, Noah Hume, Erik Loboschefsky, Stuart Siegel

February 26, 2014

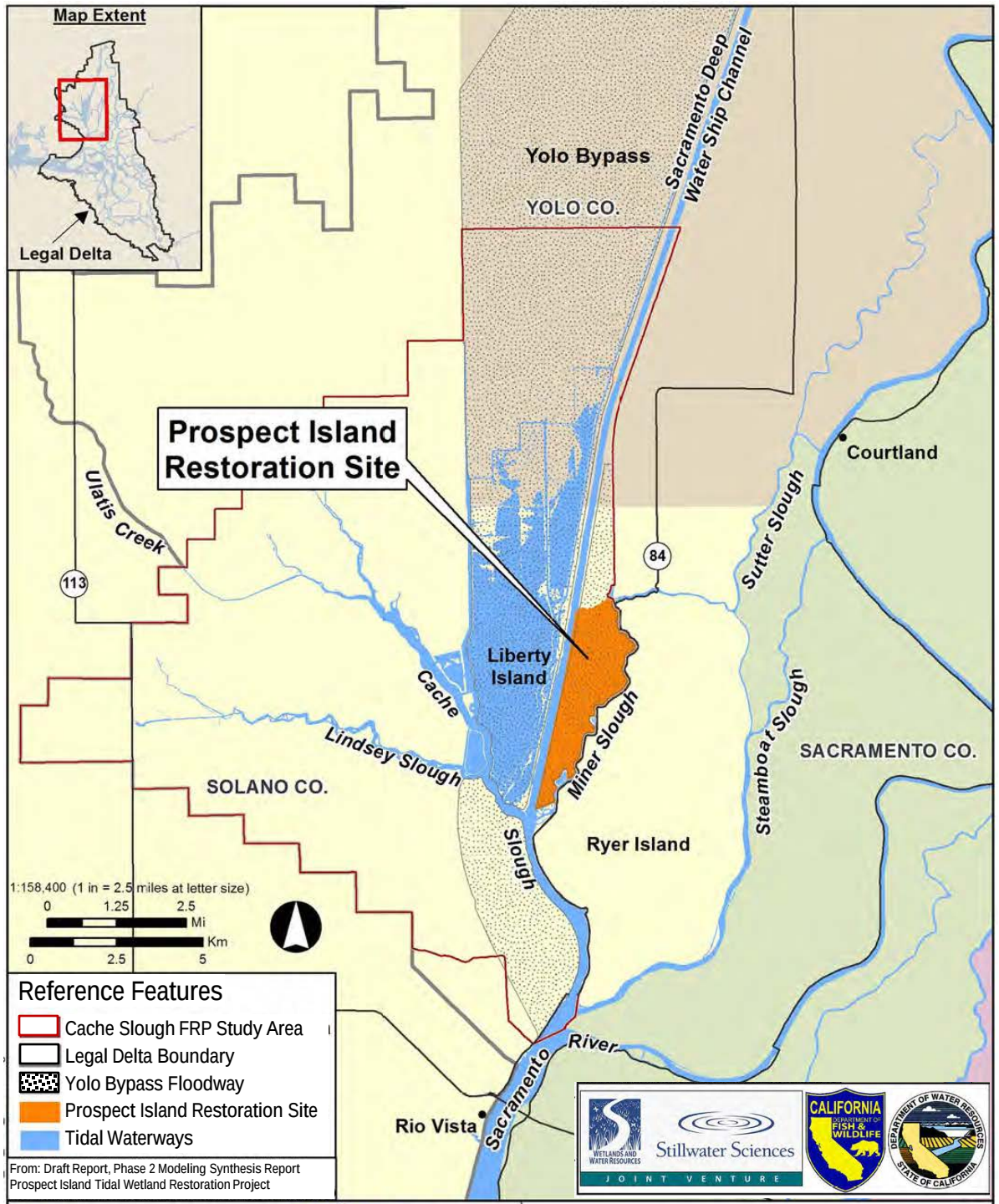
Wetlands and Water Resources Stillwater Sciences JOINT VENTURE

DELTA MODELING ASSOCIATES

Department of Water Resources State of California

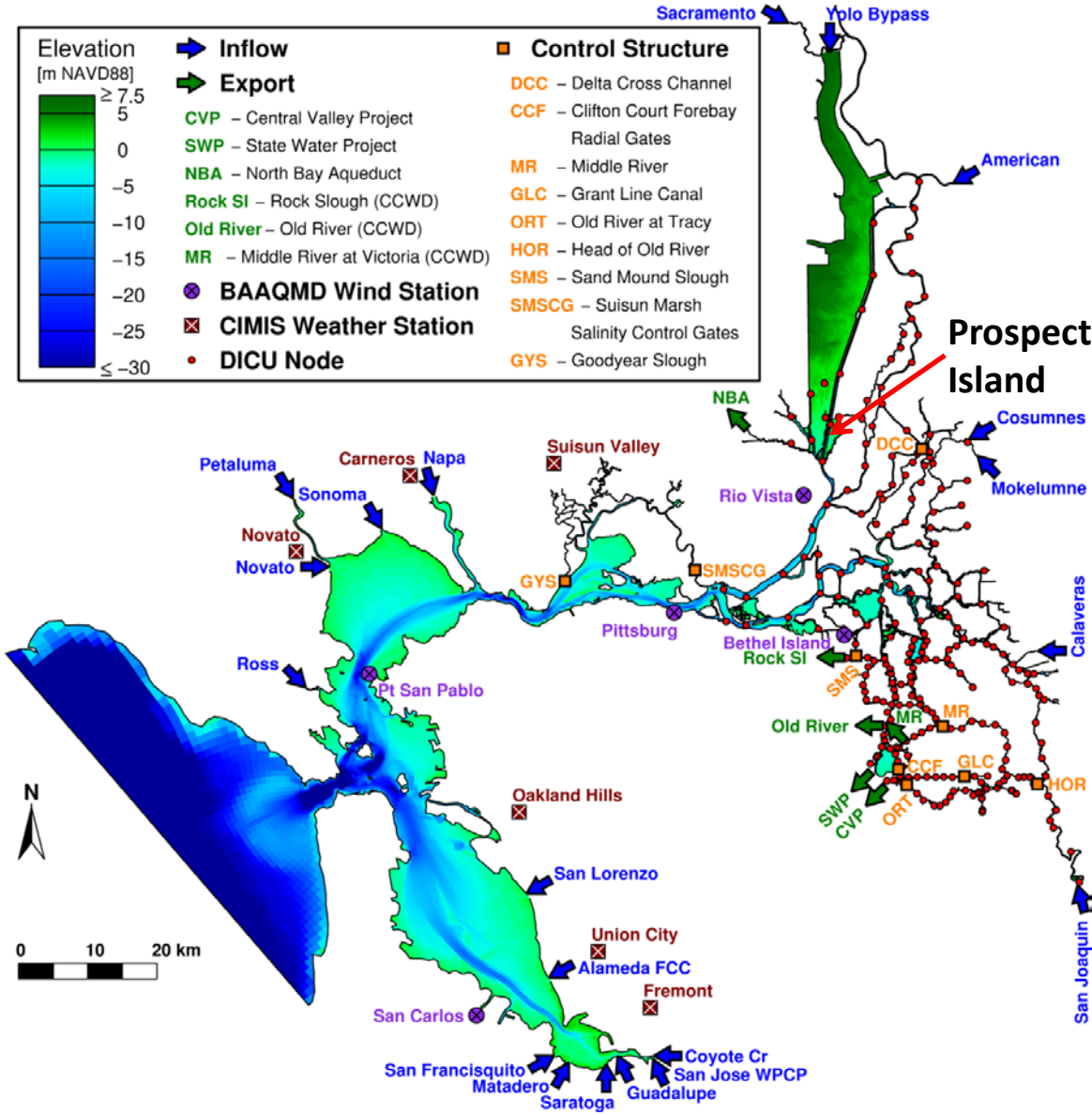
Prospect Island Tidal Habitat Restoration Project

- Joint effort by California DWR and California Department of Fish & Wildlife.
- Restore up to 1,600 acres to freshwater tidal wetland.



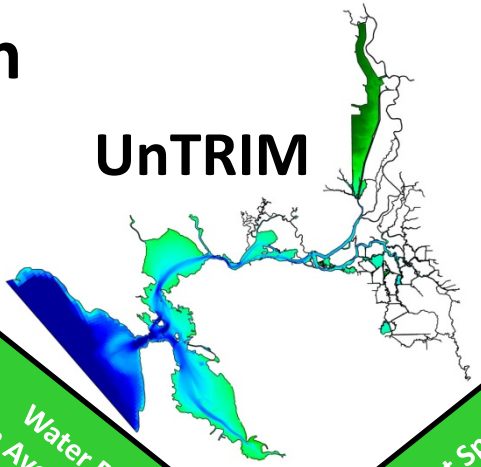
UnTRIM San Francisco Bay-Delta Model

- Applied to evaluate sediment transport near the Prospect Island Habitat Restoration Project for a suite of restoration scenarios.
- Compare how two different breach configurations affect regional turbidity and sediment deposition within Prospect Island.



UnTRIM-SWAN-SediMorph Model Coupling

UnTRIM



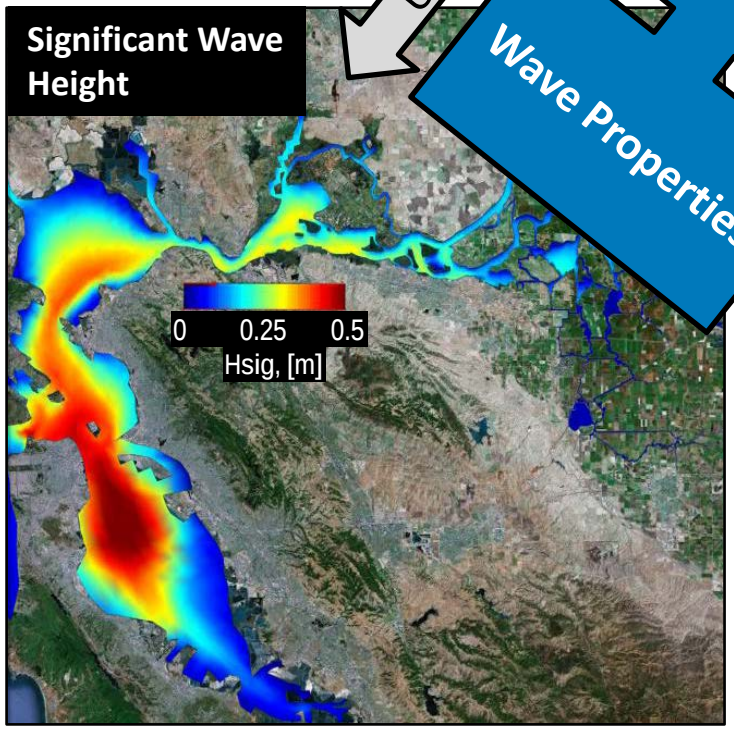
User Specified Time-step

Every Modeled Time-step

Water Depth
Depth Averaged Currents
Bottom Friction
Wind Speed/Direction

Current Speed
Suspended Sediment Concentrations
Wave Properties

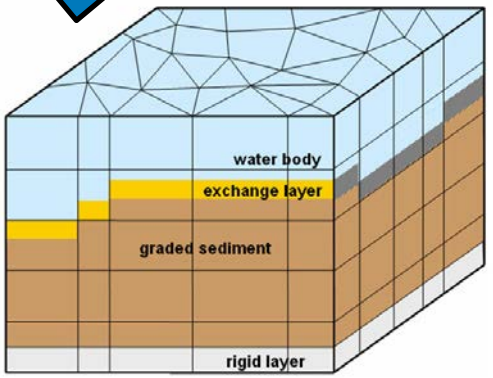
SWAN



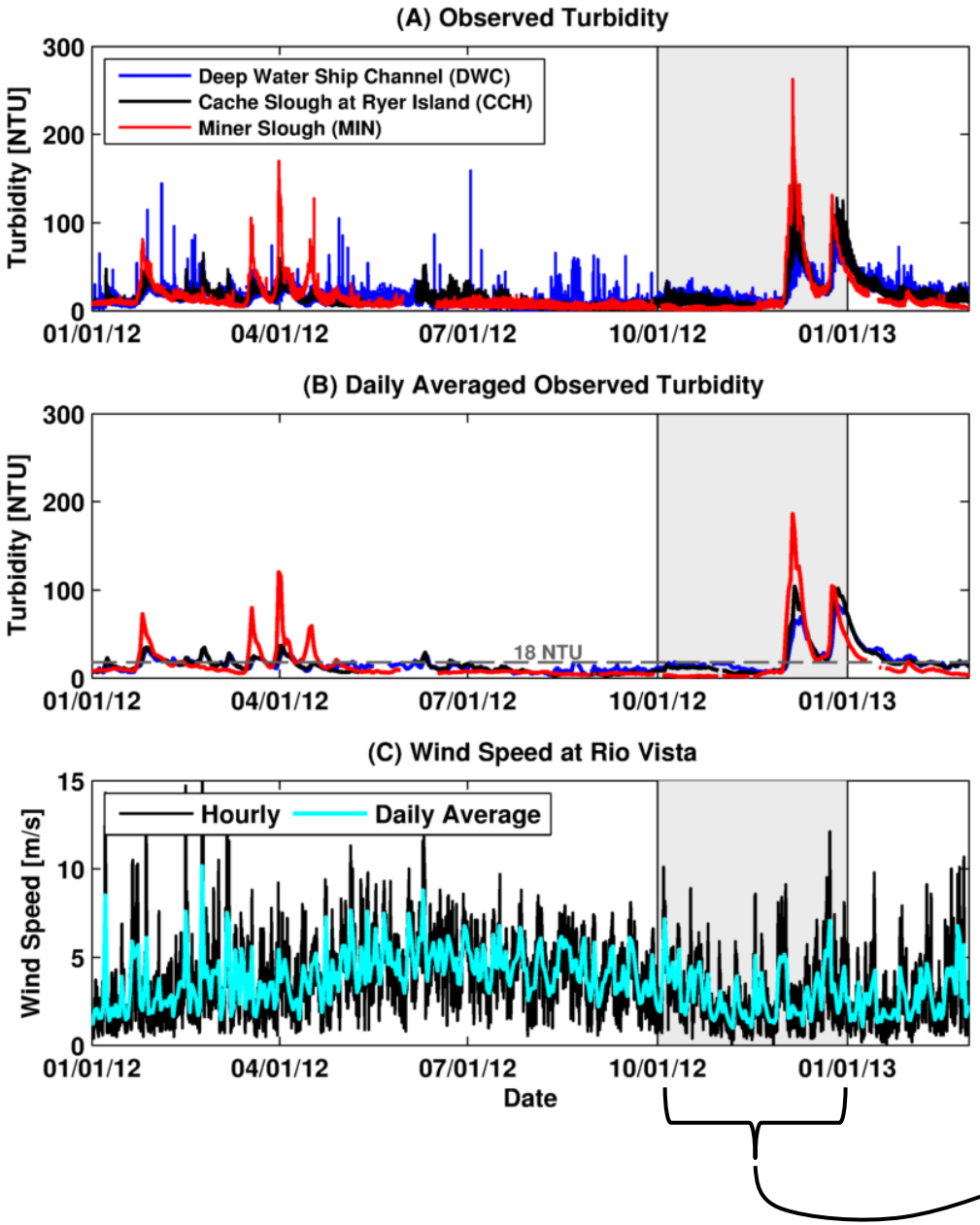
Wave Properties

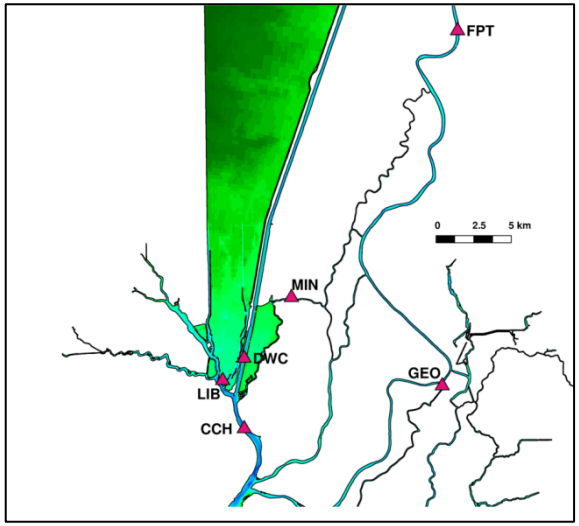
Net Erosion/Deposition
Seabed Elevation Change

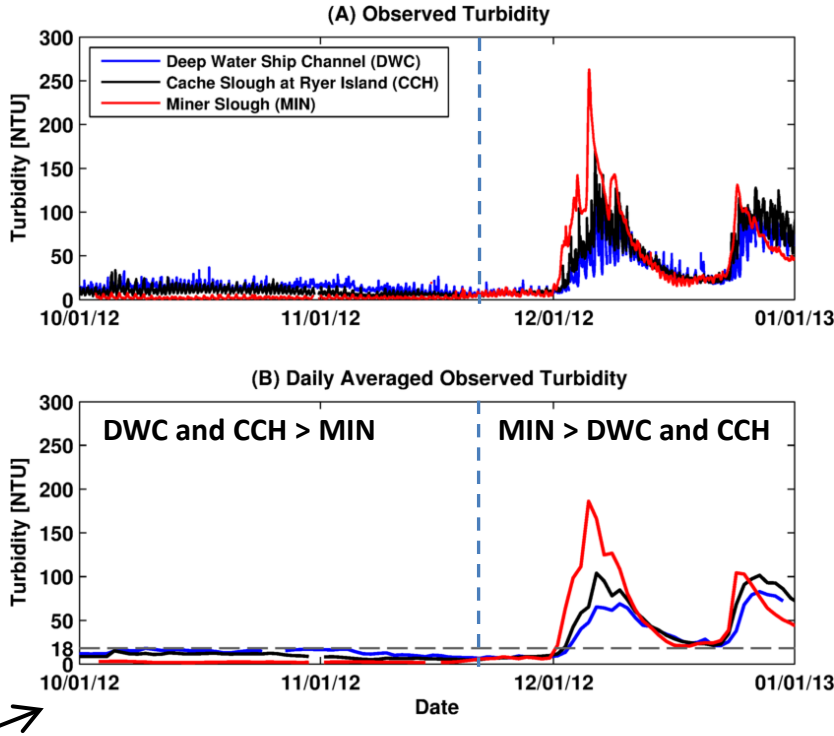
SediMorph



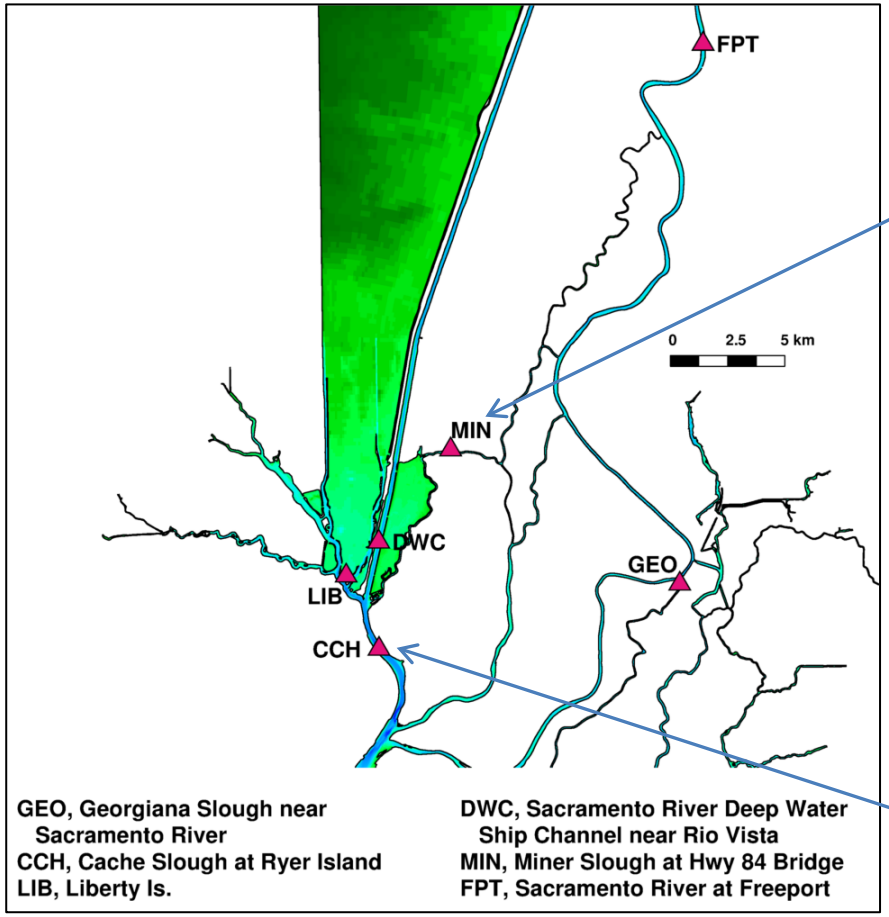
Observed Turbidity Around Prospect Island

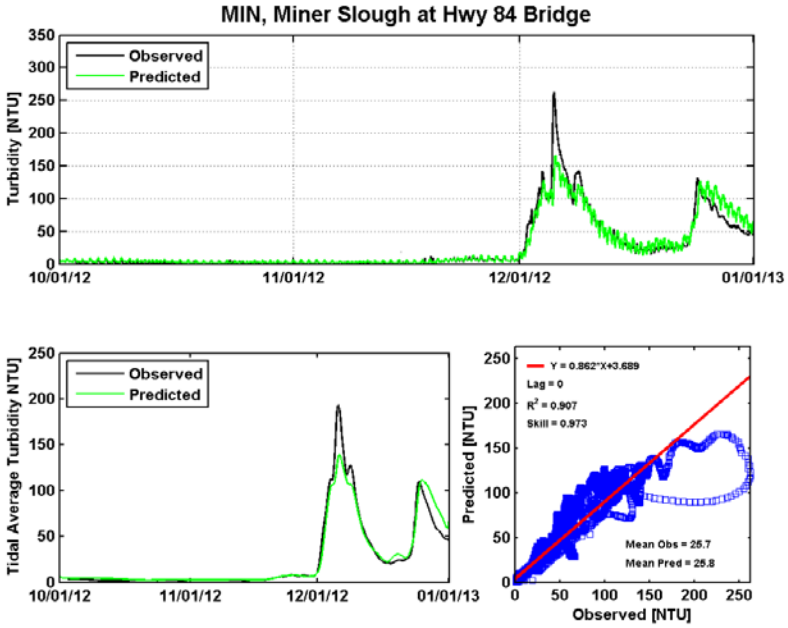


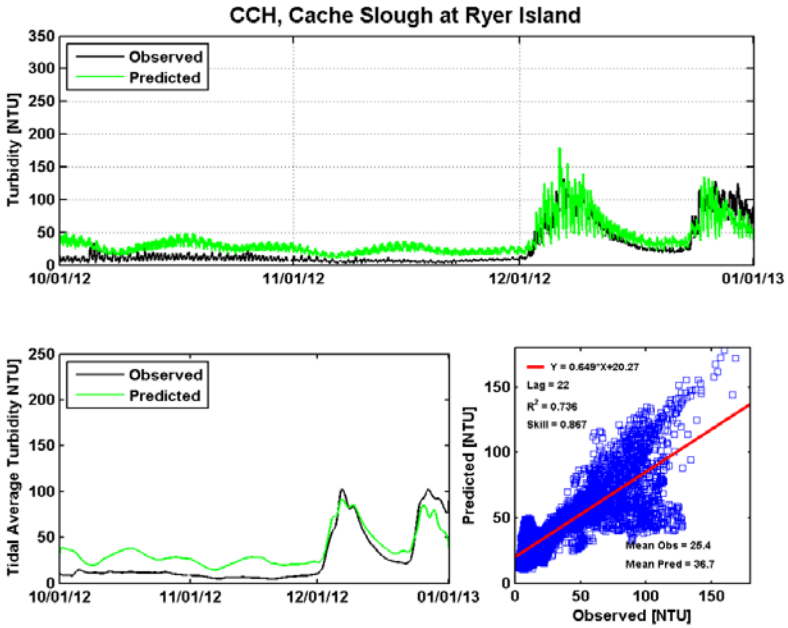




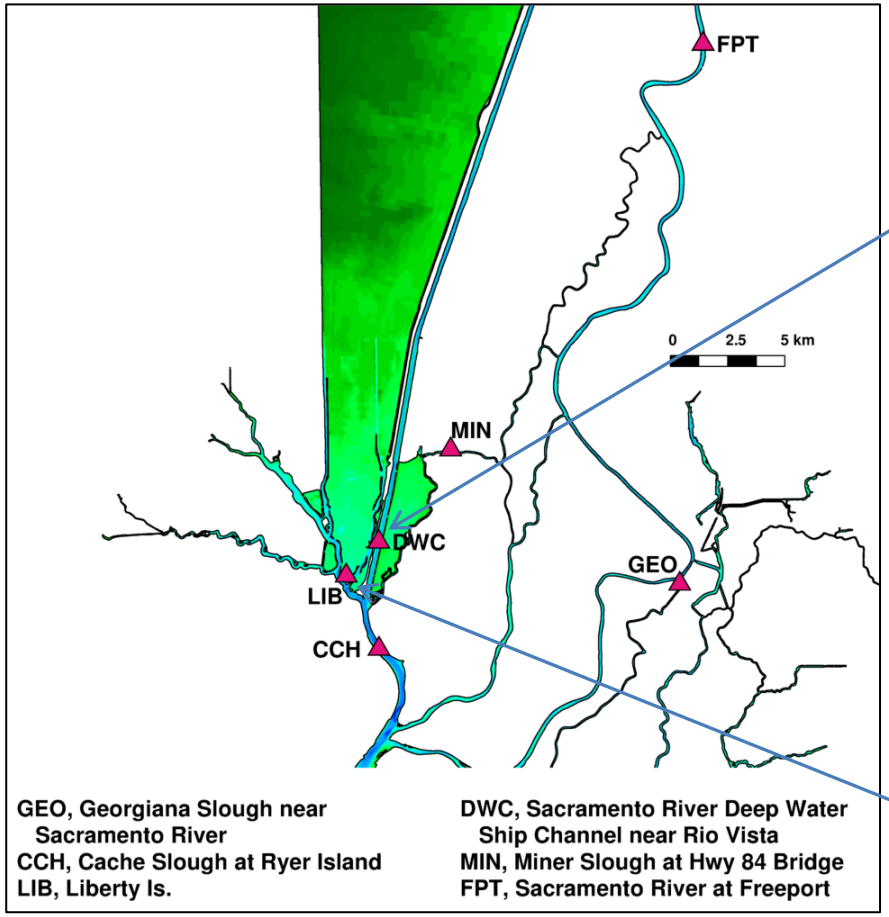
Suspended Sediment Validation Around Prospect Island

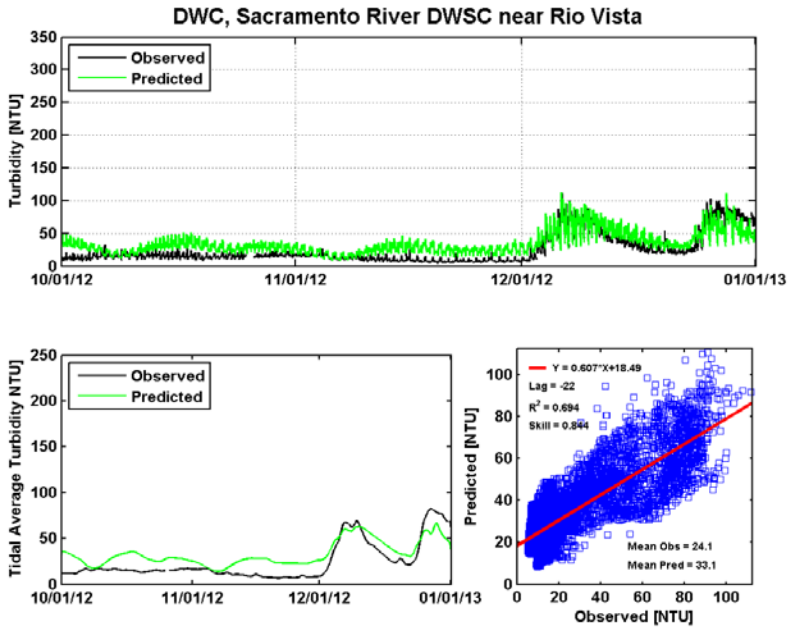


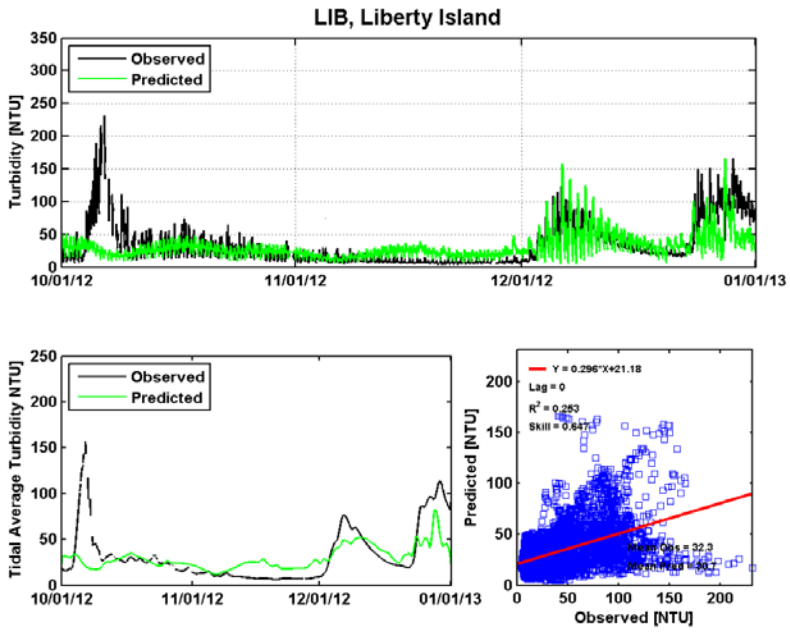




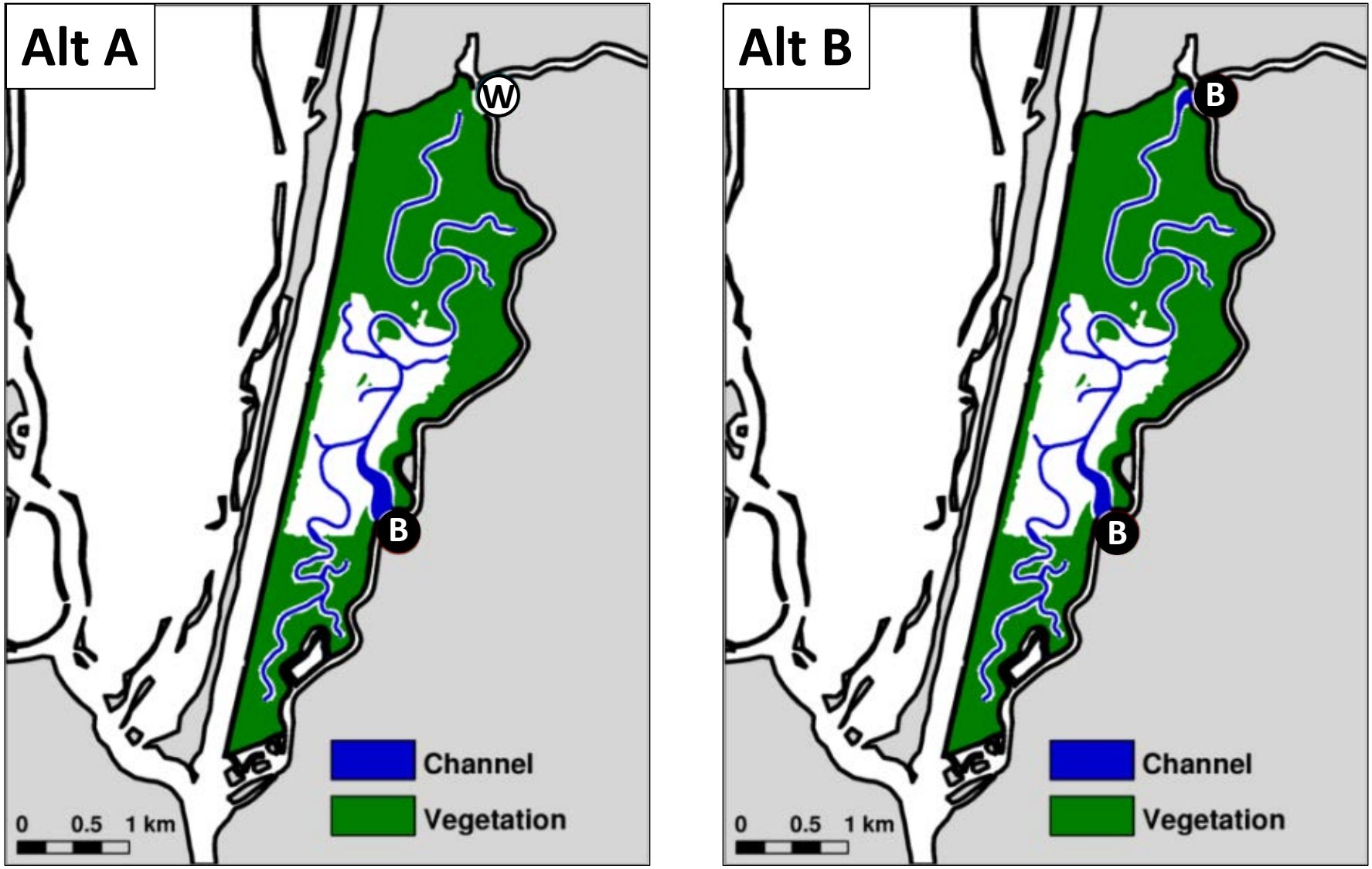
Suspended Sediment Validation Around Prospect Island





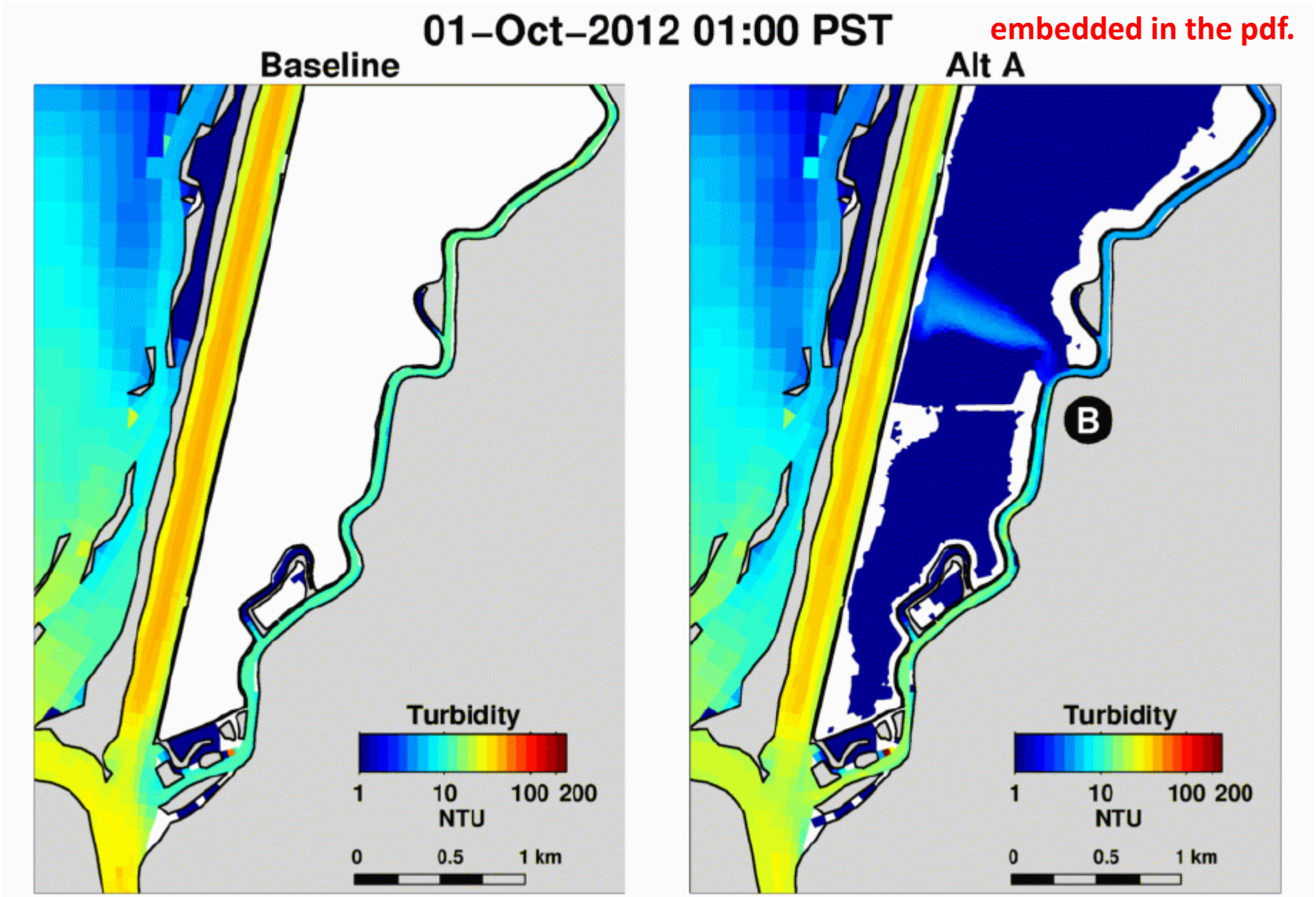


Comparison of Two Restoration Alternatives

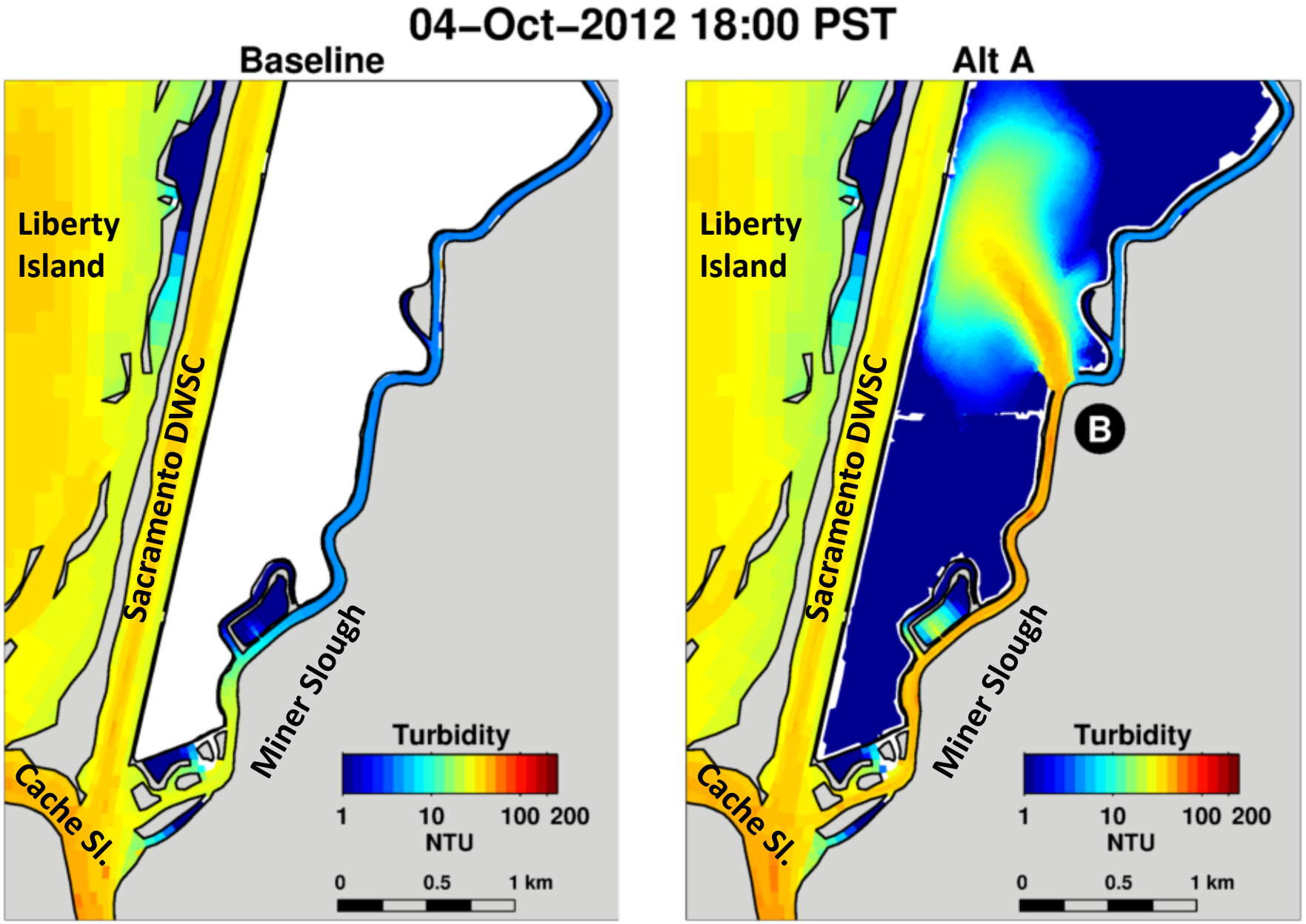


Predicted Turbidity: Low Delta Outflow

Note: This slide was an animation which is not embedded in the pdf.

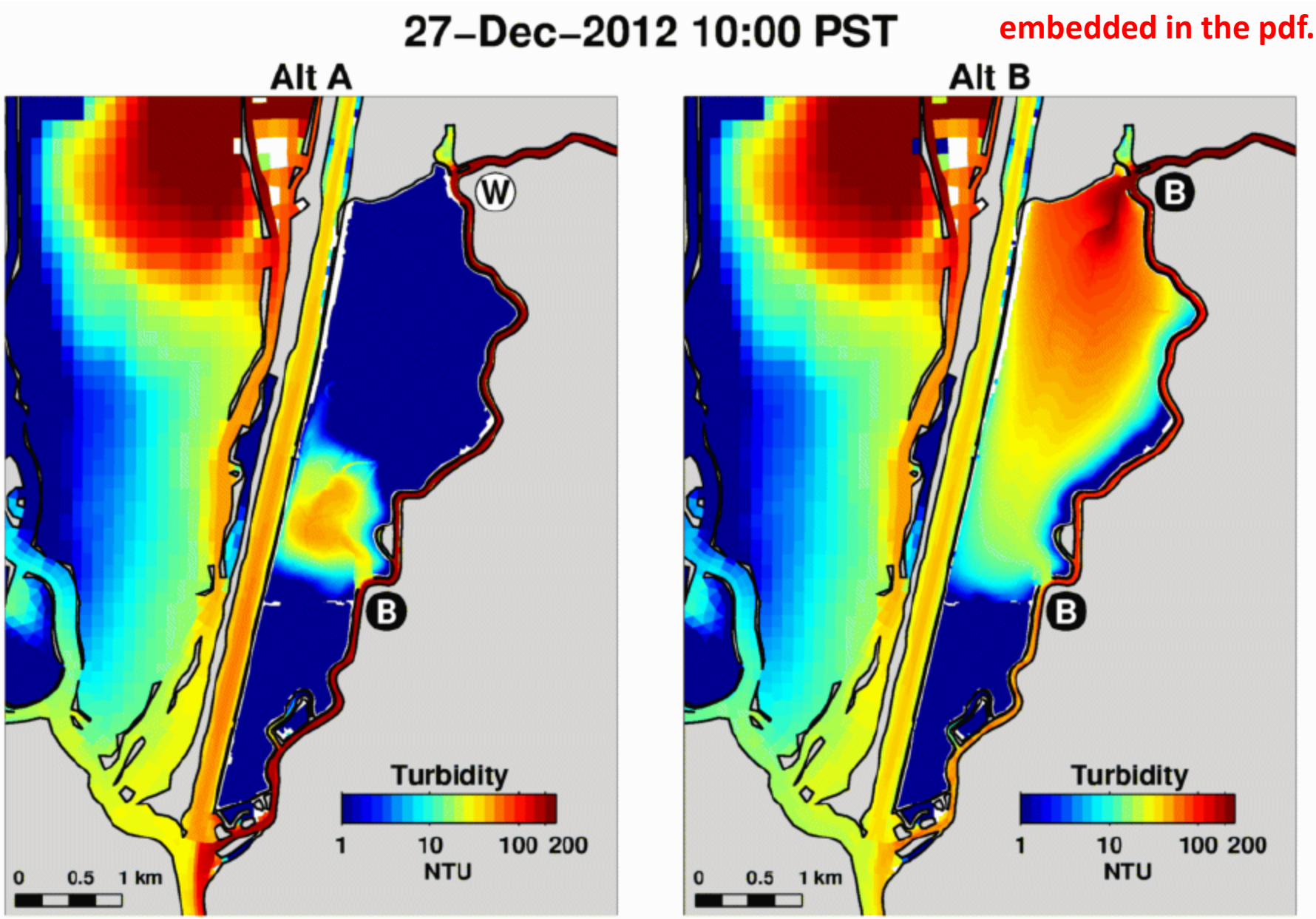


Predicted Turbidity: Low Delta Outflow

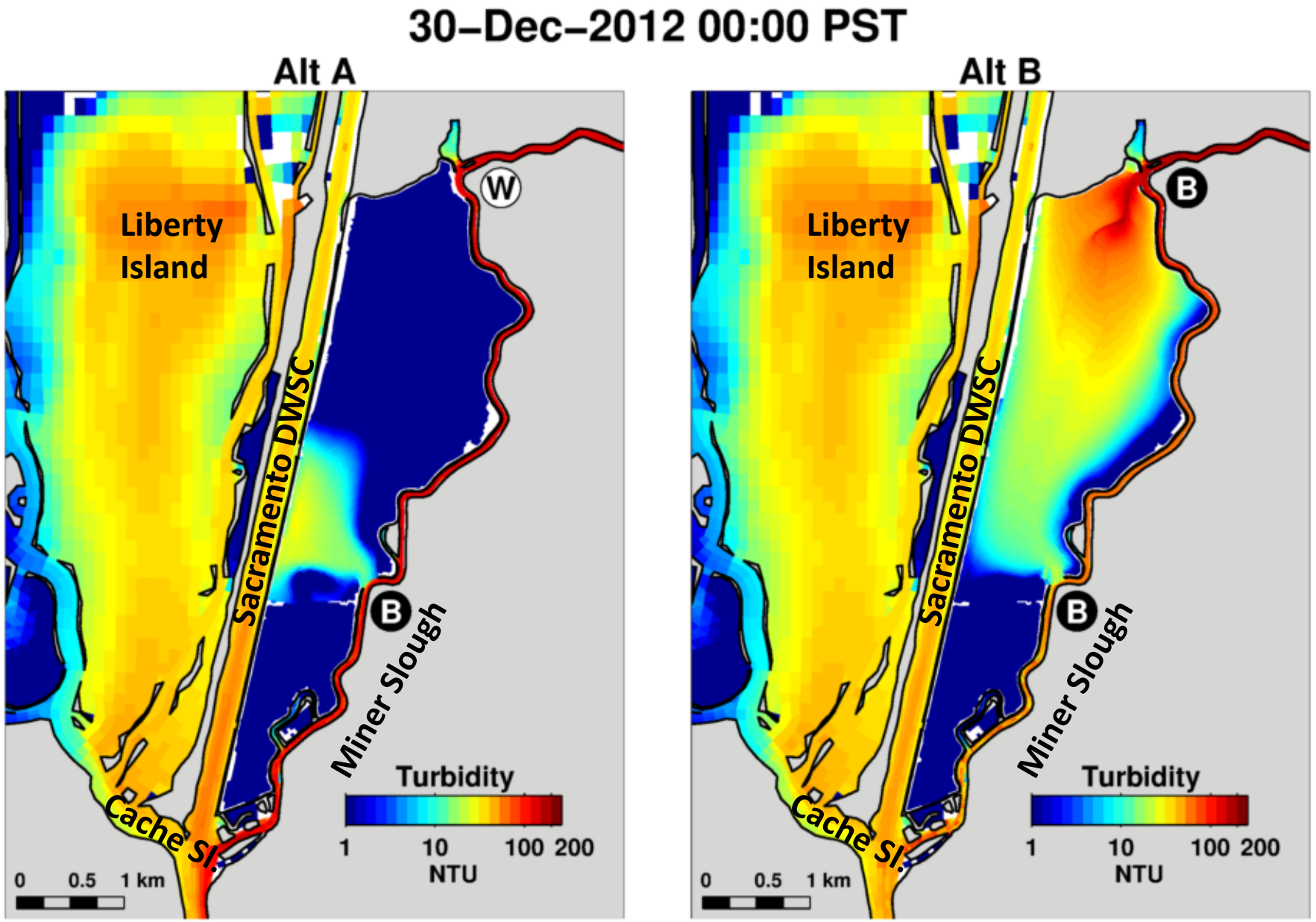


Predicted Turbidity: High Delta Outflow

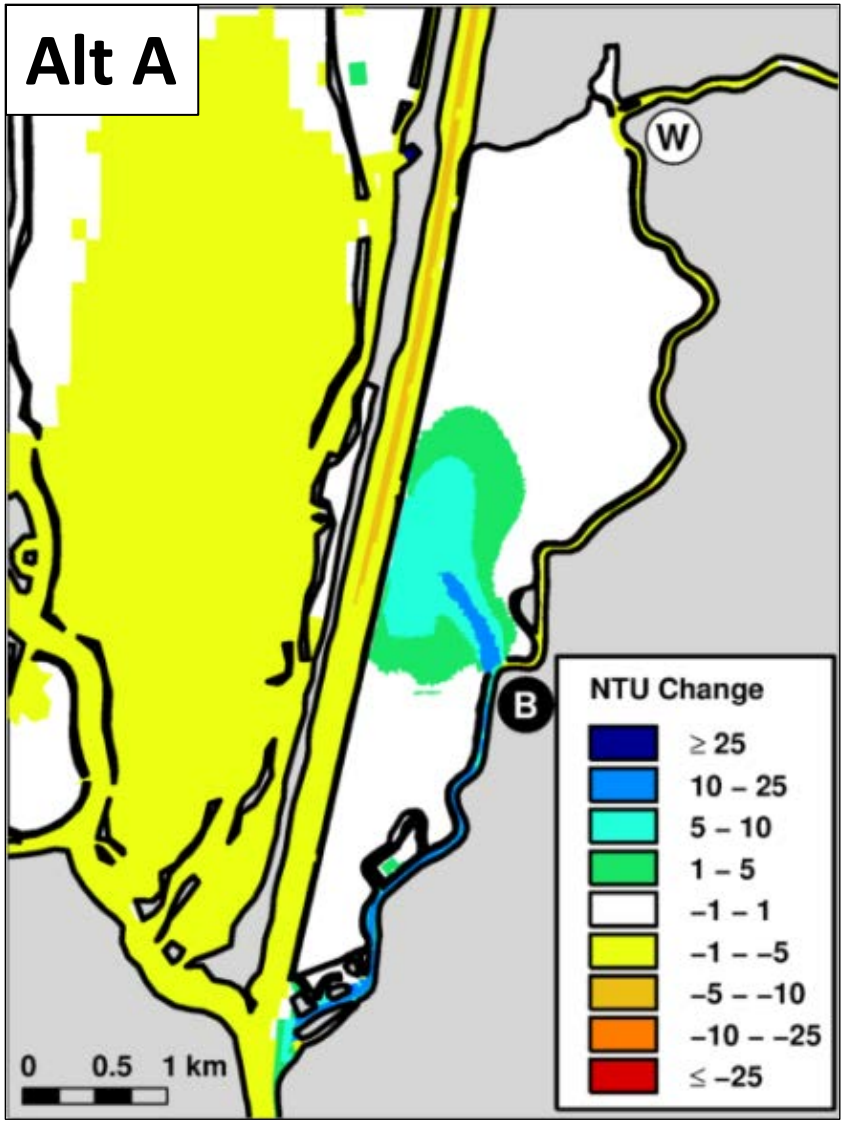
Note: This slide was an animation which is not embedded in the pdf.

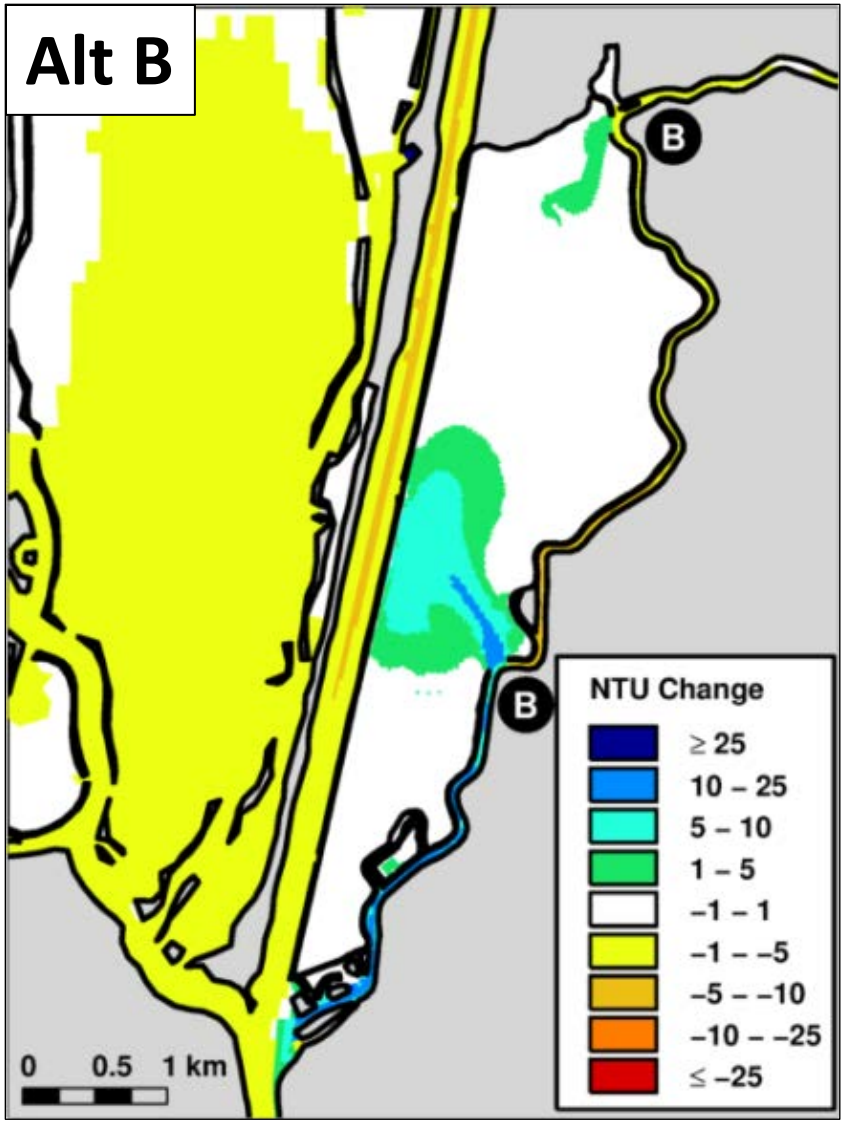


Predicted Turbidity: High Delta Outflow

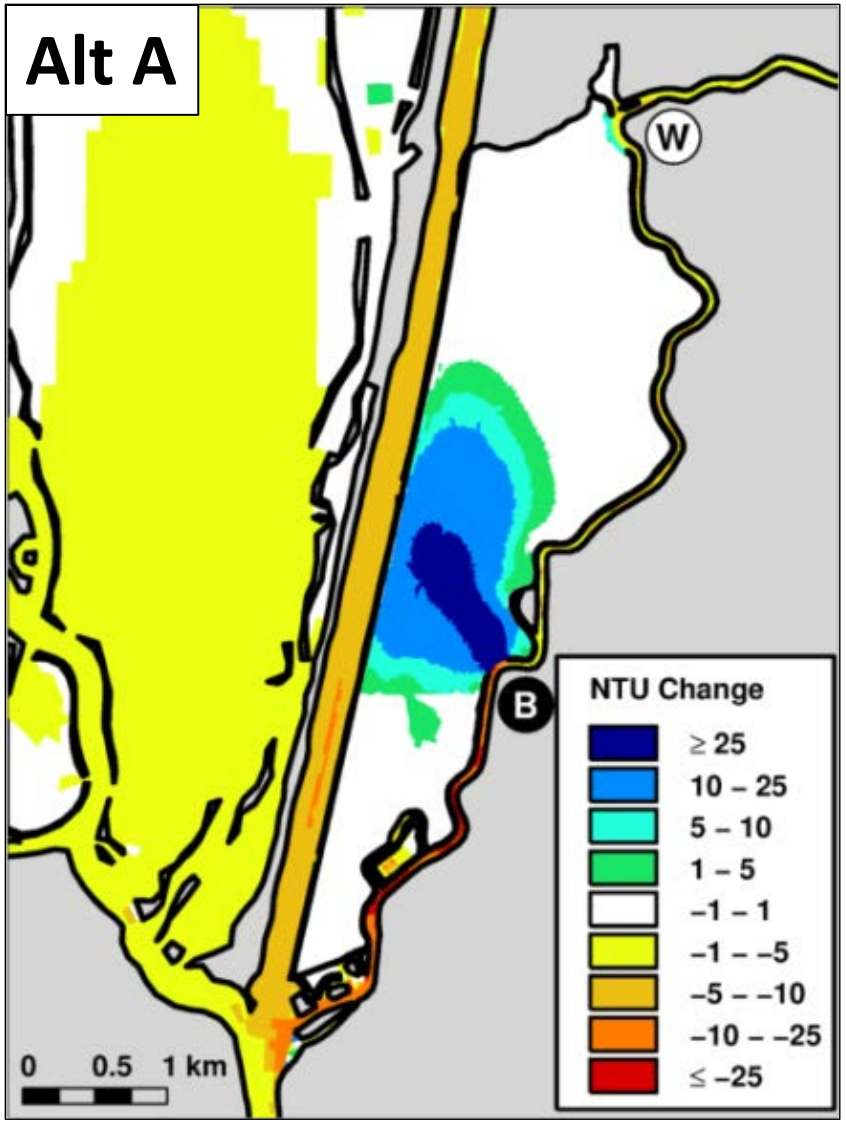


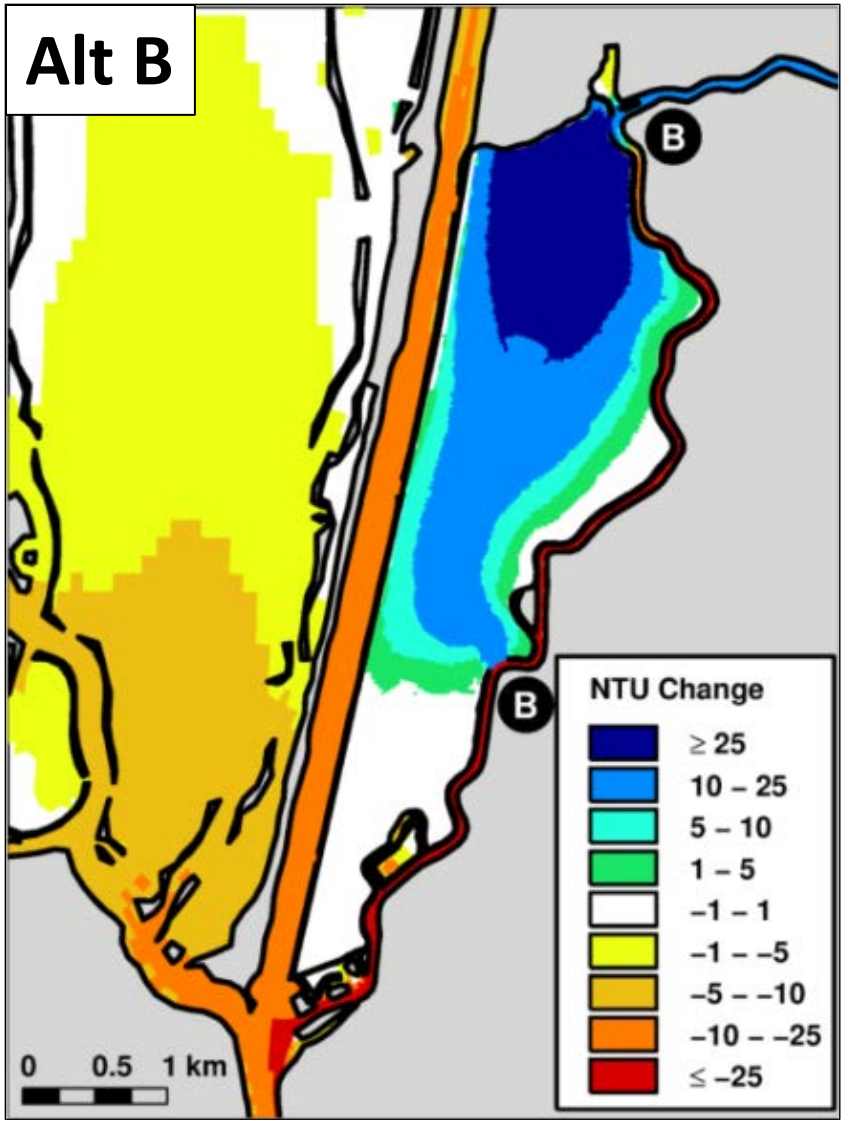
Predicted Turbidity Change Relative to Baseline
Low Delta Outflow: Monthly-Average October 2012



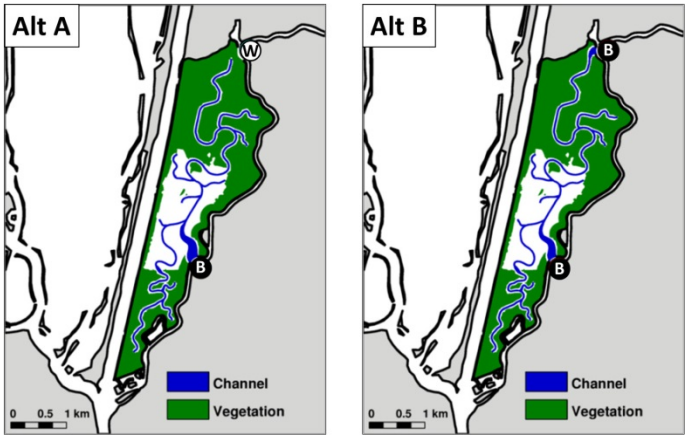


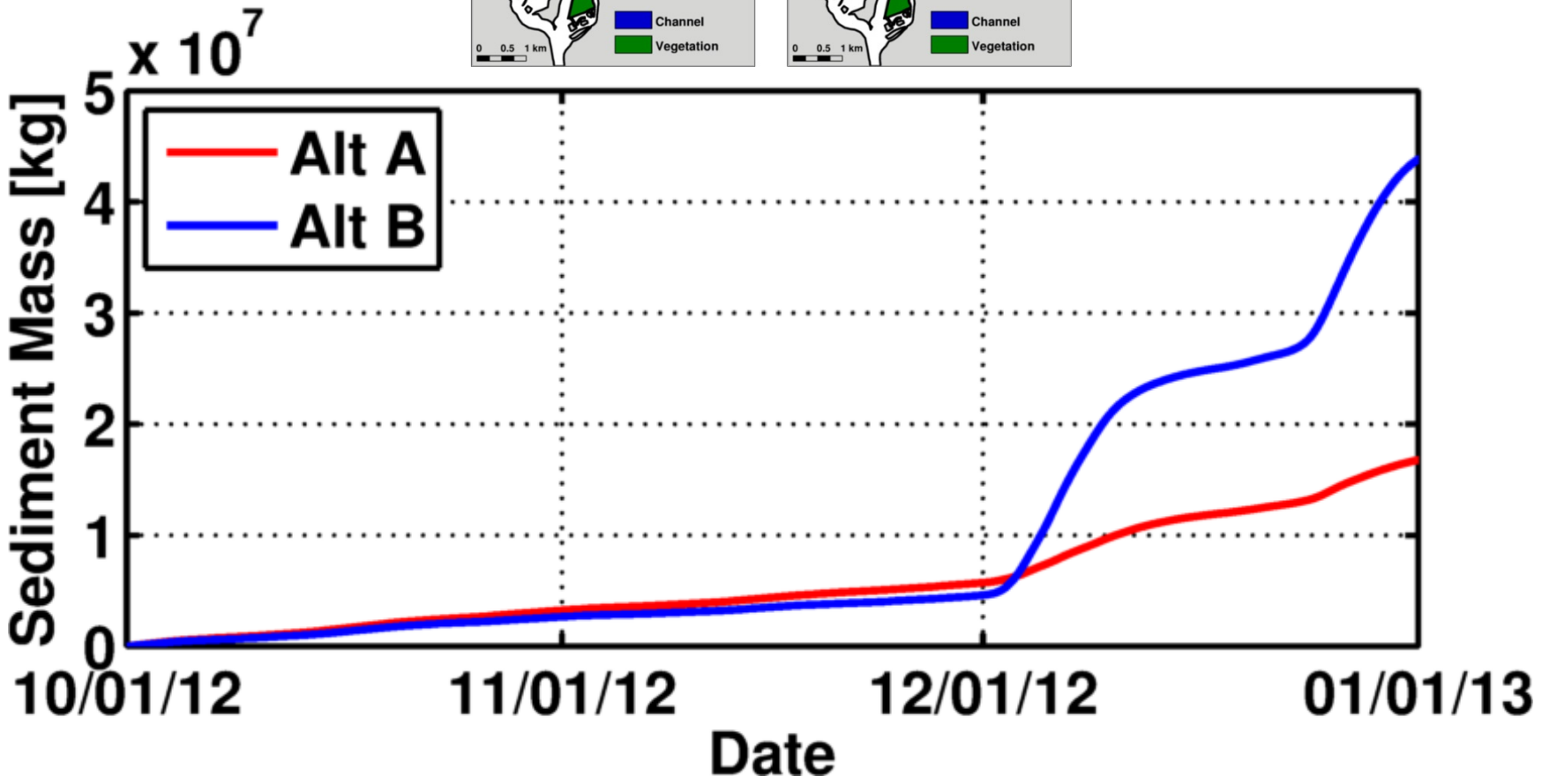
Predicted Turbidity Change Relative to Baseline
High Delta Outflow : Monthly-Average December 2012



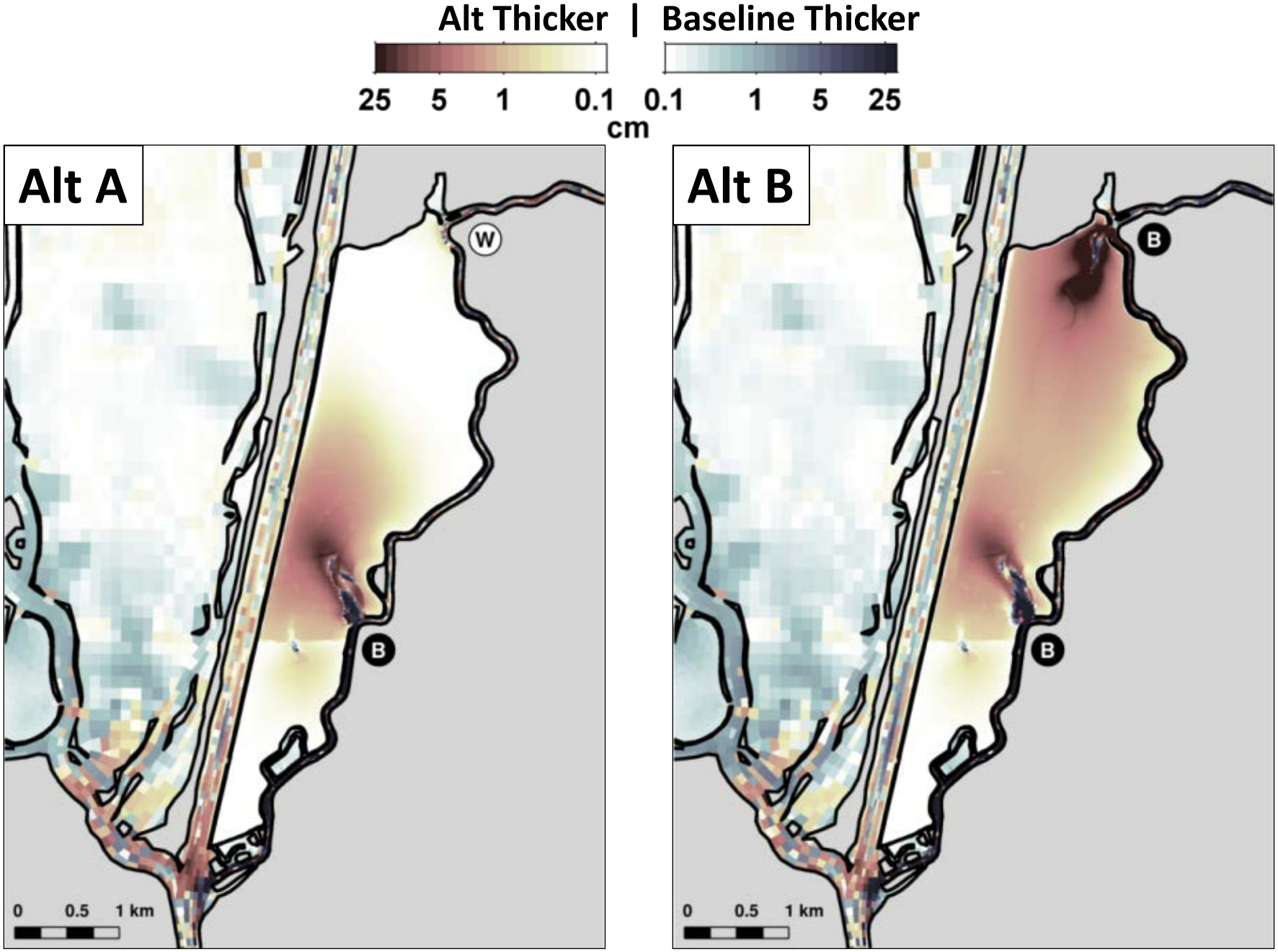


Cumulative Sediment Mass Transported Into Prospect Island





Sediment Deposition Relative to Baseline



Conclusions

- UnTRIM Bay-Delta model applied to simulate hydrodynamic, wave and sediment transport changes resulting from tidal restoration of Prospect Island.
- During low Delta outflow conditions (Oct-Nov 2012):
  - Turbidity in Miner Slough typically lower than Cache Slough Complex.
  - Higher turbidity water transported up Miner Slough into Prospect Island on flood tide.
  - Some of this sediment deposited in low energy environment inside Prospect Island.
- During high Delta outflow conditions (Dec 2012):
  - Turbidity in Miner Slough typically higher than Cache Slough Complex.
  - Some sediment from higher turbidity water in Miner Slough is deposited within Prospect Island before reaching Cache Slough.
  - North breach results in the largest effect on regional turbidity and the most sediment trapping during first flush.
- Uncertainty in model predictions needs to be taken into account when analyzing the results:
  - Largest uncertainty in assessments based on absolute turbidity values.
  - Less uncertainty in relative differences between restoration alternatives.

Acknowledgments

Prospect Island Expertise:

Noah Hume (Stillwater)

Melissa Carter (WWR)

Stuart Siegel (WWR)

Chris Enright (DSC)

Erik Loboschefsky (DWR)

SediMorph:

Holger Weilbeer (BAW)

SWAN:

Ed Gross (RMA)

Jeremy Bricker

Sediment Data and Discussions (USGS)

Tara Morgan-King

Scott Wright

Greg Schellenbarger

Maureen Downing-Kunz

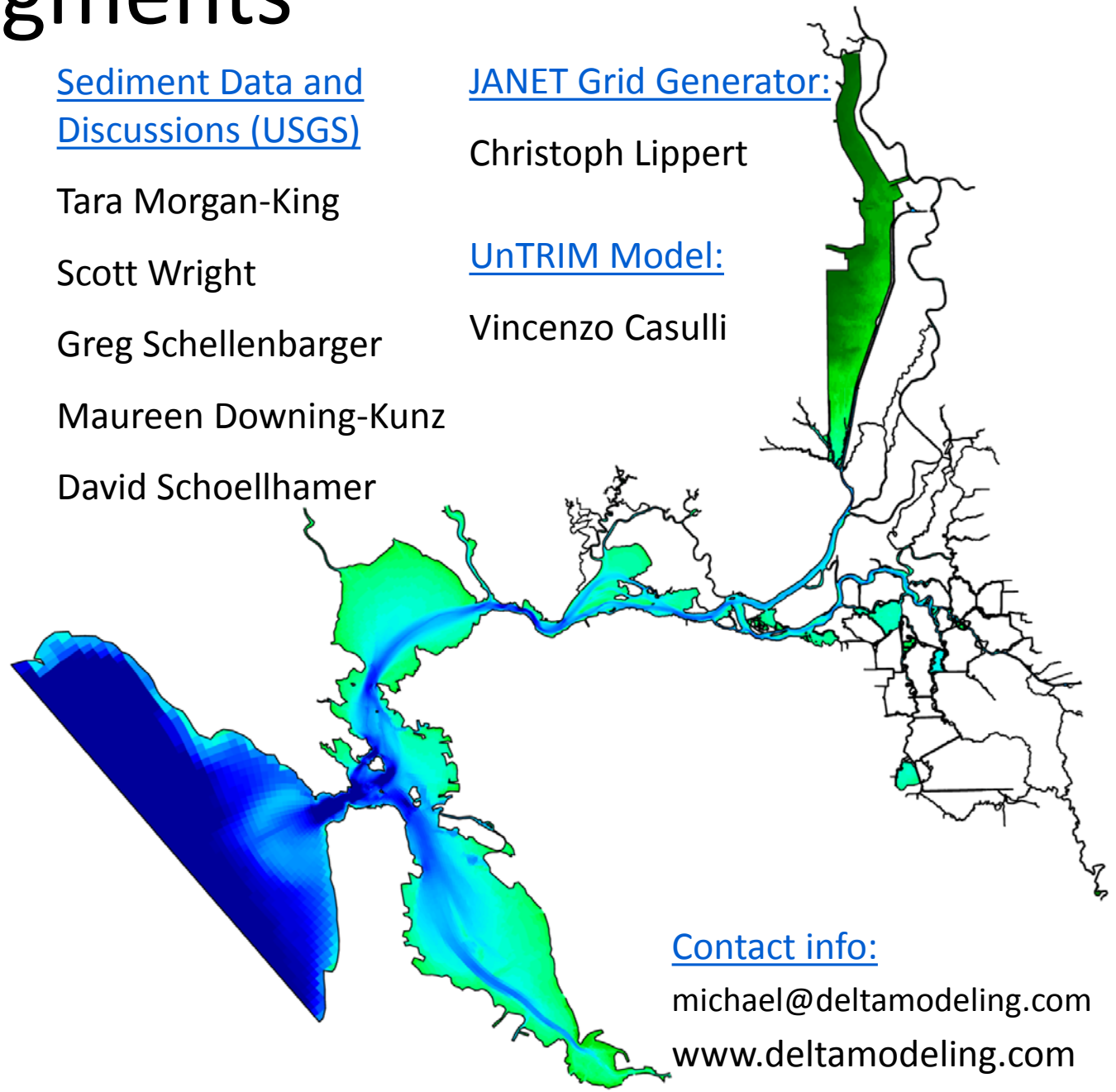
David Schoellhamer

JANET Grid Generator:

Christoph Lippert

UnTRIM Model:

Vincenzo Casulli



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DELTA MODELING ASSOCIATES

EXHIBIT 20

5. TAC EMISSIONS

5.1 INTRODUCTION

Under the Clean Air Act, toxic air contaminants (TACs) are airborne pollutants that may be expected to result in an increase in mortality or serious illness or which may pose a present or potential hazard to human health. TACs are also referred to as toxic air pollutants or hazardous air pollutants.

A wide range of sources, from industrial plants to households emits TACs. Because it is not practical to eliminate all TACs, these compounds are regulated through risk management programs. These programs are designed to eliminate, avoid, or minimize the risk of adverse health effects from exposures to TACs.

A substance becomes a regulated TAC after it is identified by the California Air Resources Board's (ARB) California Air Toxics Program or the U.S. Environmental Protection Agency's (EPA) National Air Toxics Assessments, assessed for its potential for human exposure, and evaluated for its health effects on humans. ARB has listed approximately 200 toxic substances, including those identified by EPA, which are included in the California Air Toxics Program's TAC List.

The California Health and Safety Code provides the District authority to control emissions from stationary sources[1,2] and to develop clean air strategies for other sources (mobile).[3]

5.1.1 HEALTH EFFECTS

TACs can cause long-term health effects such as cancer, birth defects, neurological damage, or genetic damage; or short-term acute affects such as eye watering, respiratory irritation (such as a cough), running nose, throat pain, and headaches. Regulating TACs is important not only because of the severity of their health effects, but also because the health effects can occur with exposure to even small amounts of TACs. TACs are not classified as criteria air pollutants (CAPs) and no ambient air quality standards have been established for them. The effects of TACs can be diverse and their health impacts tend to occur on a local level, rather than regional as is typical for ground level ozone; consequently uniform standards for these pollutants have not been established.

TACs can be separated into carcinogens and non-carcinogens based on the nature of the damage to the human body associated with exposure to the pollutant. For regulatory purposes, carcinogens are assumed to have no safe threshold below which health impacts would not occur and cancer risk is expressed as excess cancer cases per one million exposed individuals.

[1] California Health and Safety Code Section 41010
[2] California Health and Safety Code Section 40961
[3] California Health and Safety Code Section 40961

Non-carcinogens differ from carcinogens in that there is generally assumed to be a safe level of exposure below which no negative health impact is believed to occur. These levels are determined on a pollutant-by-pollutant basis. Acute and chronic exposure to non-carcinogens is expressed using a Hazard Index (HI), which is the ratio of expected exposure levels to health-acceptable exposure levels. ARB's web page, California Air Toxics Program, provides more detailed information about the history, multi-agency regulation, and health effects of TACs.

5.1.2 Concepts in Health Risk

The dose to which receptors are exposed to a TAC is the primary factor used to determine health risk. Dose is a function of the concentration of a substance or substances in the environment and the duration of exposure to the substances. Dose is positively correlated with the concentration of a toxic substance, which generally disperses with distance from the emission source under normal meteorological conditions. Dose is also positively correlated with time, meaning that a longer exposure period would result in a higher exposure level for an exposed individual. Thus, the risks estimated for a receptor are higher if a fixed exposure occurs over a longer period. The breathing rate of an exposed individual is also an important factor. For instance, children have higher intake rates on a per kilogram body weight basis and thus receive a higher dose of airborne pollutants.

5.1.3 Trends in Background TAC Levels

The California Air Resources Board (ARB) tracks the trends of various TAC emissions and their pollution levels in California's air. Currently, particulate matter in diesel exhaust (diesel PM) dominates other air toxics in California's air, and the estimated risk from breathing it is greater than the risk from all other airborne TACs combined.

In September 2000, ARB adopted the Diesel Risk Reduction Plan (DRR Plan), which recommends many control measures to reduce the risks associated with diesel PM The DRR Plan has been successful in cleaning up existing engines through engine retrofit emission control devices; the adoption of stringent standards for new diesel engines; lowered sulfur content of diesel fuel; and implementation of advanced technology emission control devices on diesel engines. ARB estimates that emissions of diesel PM in 2035 will be less than half those in 2010, even with increasing VMT.[4] In addition to the DRR Plan, many of the Air Toxic Control Measures that have been promulgated by ARB specifically address diesel PM emissions from a range of sources, including portable engines, cargo handling equipment used at ports, transport refrigeration units, and idling by commercial vehicles and school buses. A study from 2015 linked California regulations to dramatic declines in cancer risk from exposure to air toxics.

[4] http://www.arb.ca.gov/research/diesel/diesel-health.htm

It is important to note these TAC reductions in the context of well-planned mixed-use urban areas. In response to nonattainment conditions with respect to criteria air pollutants (CAP), specifically ozone, land uses within California are being developed with an increased emphasis on planning principles that reduce vehicle miles traveled (VMT) along with energy and water consumption (e.g., smart growth, transit-oriented design). With the passage of greenhouse gas (GHG) legislation and resulting emissions reduction goals, the implementation of such principles will play an increasingly important role with regards to land use planning as California will need to more efficiently (e.g., less VMT per household) accommodate population and job growth. Though this type of planning proves to effectively reduce regional CAP emissions and GHGs, inherent to the design, receptors are placed in closer proximity to localized sources of pollution (e.g., freeways, rail). Thus, the future TAC reductions discussed above will play an important role in addressing this matter.

5.2 ANALYSIS EXPECTATIONS

The District recommends that CEQA documents analyze potential impacts resulting from exposure of sensitive receptors to high doses of TACs and associated health risk for the circumstances/situations described below. Lead Agencies shall make a concerted effort to obtain detailed project-specific information in order to accurately disclose all potential TAC-related impacts. However, the District recognizes that the level of detail in which this information is available may vary at the time the impact analysis is performed.

These analyses shall include the following:

Construction TACs:

- A discussion of type of construction activities that would occur and the TAC emission sources associated with those activities. This may include the number and types of equipment anticipated to be used during construction. Detailed guidance about construction-generated TACs is provided in section 5.3.1, Construction Activity;
- A significance determination about construction-generated TAC emissions, without mitigation; and
- A discussion of feasible mitigation necessary to reduce construction-generated TACs and whether the reduction is sufficient to reduce impacts to a less-than-significant level.

Operational TACs:

- A discussion of whether the project would locate any permitted or non-permitted sources of TACs in close proximity to existing or future planned receptors;

- If the land use jurisdiction determines that a qualitative analysis of TAC impacts is not sufficient, a quantitative health risk assessment (HRA) that discloses health risk levels at affected receptors may be necessary. The HRA shall be conducted in consultation with the District and in accordance with acceptable guidance such as that provided by the Office of Environmental Health Hazard Assessment and the California Air Pollution Control Officers Association[5];

- A significance determination about exposure to TACs from project operations without mitigation; and

- A discussion of feasible mitigation necessary to reduce TAC exposure resulting from project operations and whether the reduction would be sufficient to reduce the impact to a less-than-significant level.

More detailed guidance for analyzing TAC impacts is provided below.

5.3 METHODOLOGIES

Methodologies for assessing impacts resulting from diesel PM and airborne asbestos emissions generated by short-term construction activity are discussed below, followed by methodologies for assessing operational TAC emissions.

5.3.1 Construction Activity

Construction activity can result in emissions of particulate matter from diesel exhaust (diesel PM), airborne asbestos resulting from the demolition of asbestos-containing materials, and, in some areas of Sacramento County, earth disturbance activity can result in the release of naturally occurring asbestos (NOA) to the air. These TACs are addressed separately below.

DIESEL PM EXHAUST

The use of off-road heavy-duty diesel equipment for site grading and excavation, paving, and other construction activities results in the generation of diesel PM emissions, which was identified as a TAC by ARB in 1998.

The District has not established a quantitative threshold of significance for construction-related TAC emissions. Therefore, the District recommends that lead agencies address this issue on a case-by-case basis, taking into consideration the specific construction-related characteristics of each project and its proximity to off-site receptors.

The impact discussion shall disclose the following about the construction activity associated with each project.

- Types of off-site receptors and their proximity to construction activity;

[5] CAPCOA's HRA and Land Use guidance is undergoing major revisions as of September 2018

- Duration of construction period;
- Quantity and types of diesel-powered equipment;
- Number of hours equipment would be operated each day;
- Location of equipment staging area;
- Predominant wind direction; and
- Amount of on-site diesel-generated PM exhaust if mass emission levels from construction activity are estimated.

The District recognizes that detailed information about a project's construction activities may not be known at the time of writing the impact analysis. In this case, the District recommends the use of conservative estimates for the parameters including the number and type of construction equipment used, the hours of operation, and the distance from equipment to the nearest off-site receptors.

Demolition or Renovation of Regulated Asbestos Containing Materials

Demolition or renovation of existing buildings and structures are subject to District Rule 902 (Asbestos). District Rule 902 is intended to limit asbestos emissions from demolition or renovation of structures and the associated disturbance of regulated asbestos containing material (RACM) generated or handled during these activities. The rule addresses the national emissions standards for asbestos along with some additional requirements. The rule requires lead agencies, building owners, and their contractors to notify the District of any regulated renovation or demolition activity. This notification includes specific requirements for surveying, removal, location, work methods, and disposal of RACM. Projects that comply with Rule 902 ensure that RACM will be disposed of appropriately and safely, minimizing the release of airborne asbestos emissions. Therefore, demolition activity would not result in a significant impact to air quality.

Because District Rule 902 is in place, no further analysis about the demolition of RACM is needed in a CEQA document. However, the District does recommend that CEQA documents acknowledge and discuss District Rule 902 to support the public's understanding of this issue.

Naturally Occurring Asbestos

Naturally occurring asbestos (NOA) was identified as a TAC in 1986 by ARB. NOA is located in many parts of California and is commonly associated with ultramafic rocks, according the California Department of Geology's special publication titled *Guidelines for Geologic Investigations of Naturally Occurring Asbestos in California*. Asbestos is the common name for a group of naturally occurring fibrous silicate minerals that can separate into thin but strong and durable fibers. Ultramafic rocks form in high-temperature environments well below the surface of

the earth. By the time they are exposed at the surface by geologic uplift and erosion, ultramafic rocks may be partially to completely altered into a type of metamorphic rock called serpentinite. Sometimes the metamorphic conditions are right for the formation of chrysotile asbestos or tremolite-actinolite asbestos in the bodies of these rocks or along their boundaries, according to a report published in 2000 by the California Geological Survey (formerly the California Division of Mines and Geology) titled *A General Location Guide for Ultramafic Rocks in California—Areas More Likely to Contain Naturally Occurring Asbestos*.

For individuals living in areas of NOA, there are many potential pathways for airborne exposure. Exposures to soil dust containing asbestos can occur under a variety of scenarios, including children playing in the dirt, dust raised from unpaved roads and driveways covered with crushed serpentine, grading and earth disturbance associated with construction activity, quarrying, gardening, and other human activities. For homes built on asbestos outcroppings, asbestos can be tracked into the home and can also enter as fibers suspended in the air. Once such fibers are indoors, they can be entrained into the air by normal household activities, such as vacuuming (as many respirable fibers will simply pass through vacuum cleaner bags).

People exposed to low levels of asbestos may be at elevated risk (e.g., above background rates) of lung cancer and mesothelioma. The risk is proportional to the cumulative inhaled dose (quantity of fibers), and also increases with time since first exposure. Although there are a number of factors that influence the disease-causing potency of any given asbestos (such as fiber length and width, fiber type, and fiber chemistry), all forms are carcinogens.

At the request of SMAQMD, the California Geological Survey (formerly the California Division of Mines and Geology) prepared a report called the *Relative Likelihood for the Presence of Naturally Occurring Asbestos in Eastern Sacramento County, California*. The map in this report displays "areas moderately likely to contain NOA." Although geologic conditions are more likely for asbestos formation in particular areas identified by the map, the presence thereof is not certain.

Using the detailed map at the end of this report, a lead agency shall discuss whether a proposed project would be located in "areas moderately likely to contain NOA." If a project would not involve earth-disturbing construction activity in one of these areas or would not locate receptors in one of these areas then it can be assumed that the project would not have the potential to expose people to airborne asbestos particles. If a project would be located in an area moderately likely to contain NOA, then the impact shall be considered potentially significant.

5.3.2 Siting New Operational TAC Sources

Siting Permitted TAC Sources

The siting of new stationary sources of TACs is subject to the rules under District Regulation 2, Permits. Each new stationary source is evaluated to determine

whether it has the potential to emit TACs. The District assesses the impact from TACs based on its guidance document, *Supplemental Risk Assessment Guidelines for New and Modified Sources*, as well as guidance documents from the Office of Environmental Health Hazard Assessment (OEHHA), ARB and the California Air Pollution Control Officers Association. The District requires emission controls, similar to Best Available Control Technology (BACT), called Toxic Best Available Control Technology (T-BACT) for certain sources.

In addition to T-BACT requirements, permits for equipment that may emit TACs may also contain conditions required by the National Emission Standards for Hazardous Air Pollutants (NESHAPs) and Air Toxic Control Measures (ATCMs) promulgated by the EPA and ARB, respectively. In short, a new stationary source of TACs would not receive the authority to construct or permit to operate if it would result in:

- A cancer risk greater than 10.0 in one million at any off-site receptor; and/or
- An off-site ground-level concentration of non-carcinogenic TACs generated from the project that would result in a Hazard Index greater than 1.0 (unless approved by OEHHA).

These permitting requirements are identical to the District's thresholds of significance for TACs generated by stationary sources. Therefore, lead agencies can determine that a new stationary source of TACs that attains the authority to construct and permit to operate from the District would not exceed the District's applicable TAC thresholds of significance.

Siting Land Uses that Include Non-Permitted TAC Sources

Some land use development projects, such as a truck distribution center or a commercial venue, could result in a high volume of TAC-generating activity in a relatively small or defined area. For instance, a discount superstore may receive approximately 5 deliveries each day from semi-tractor trailers at its loading dock. The potential impact of TAC emissions from a project of this type and size could be assessed qualitatively based on the level of truck activity, the proximity to nearby off-site receptors, and the predominant wind direction. However, a truck distribution center that has multiple loading docks, generates a high number of trips by diesel trucks, and/or includes diesel-powered "yard trucks" that only operate on the site would likely require a full HRA to disclose the potential health impacts. These types of HRAs should be performed according to the guidance provided by the California Air Pollution Control Officers Association.

5.3.3 Siting New Sensitive Receptors

The California Supreme Court decision in the case of *California Building Industry Association v. Bay Area Air Quality Management District (2015) 62 Cal. 4th 369* clarified that lead agencies are not required by CEQA to analyze the impact of the existing environmental conditions on a project's future users or residents unless

the project will exacerbate the existing environmental hazards or conditions.[6] This limits the CEQA analysis of existing TAC source impacts on a proposed project's new receptors. It is important to note that CEQA does require analysis of existing environmental conditions in specific situations, such as airports and schools. Consult the State CEQA Statutes and Guidelines for more information.

While not a CEQA impact, siting new receptors where they will be exposed to an existing TAC source is an important public health issue that should be analyzed, health risks disclosed, and measures implemented to reduce risks through the lead agency's planning process.

For projects that would site receptors in close proximity to existing permitting and non-permitted sources of TACs, the District provides *Recommendations for Siting New Projects Near Existing Sources that Emit Odors and Toxic Air Contaminants* to assist lead agencies outside of CEQA review.

For projects that would site receptors in close proximity to major roadways and railways, lead agencies shall use the District's *Mobile Sources Air Toxics Protocol (Protocol)*. The Protocol includes an online risk mapping tool disclosing cancer risk and PM2.5 concentrations at a user-selected location, an accompanying guidance document, a methodology document, and exposure reduction measures, including the District's *Landscaping Guidance for Improving Air Quality Near Roadways*.

5.4 MITIGATION

Mitigation strategies for reducing diesel PM exhaust emitted by off-road construction equipment, on-road engines, and measures for controlling NOA during construction are discussed separately below.

Measures that reduce health risk exposure from TACs generated by new permitted stationary sources are determined through the District's permitting process in compliance with federal, state and District regulations. Measures to reduce health risk exposure from TACs generated by new non-permitted sources will be determined on a project by project basis by the lead agency in consultation with the District.

5.4.1 DIESEL PM EXHAUST FROM CONSTRUCTION EQUIPMENT

Implementation of the District's Basic Construction Emission Control Practices would result in the reduction of diesel PM exhaust emissions in addition to criteria pollutant emissions, particularly the measures to minimize engine idling time and maintain construction equipment in proper working condition and according to manufacturer's specifications. The Enhanced Exhaust Control Practices for off-road construction equipment, which requires NOx emissions be reduced to 85 pounds/day will entice the use of higher tier engines with lower particulate exhaust emissions. The District's basic and enhanced mitigation measures are

[6] *California Building Industry Association v. Bay Area Air Quality Management District* (2015) 62 Cal. 4th 369

discussed in further detail in Chapter 3, Construction-Generated Criteria Air Pollutant and Precursor Emissions.

In addition, the District provides the following non-comprehensive list of measures to reduce exposure of sensitive receptors to diesel PM exhaust emissions associated with construction activity.

- Install diesel particulate filters or implement other ARB-verified diesel emission control strategies on construction equipment;
- Use Tier 4 off-road engines;
- Use equipment during times when receptors are not present (e.g., when school is not in session or during non-school hours; or when office buildings are unoccupied);
- Establish staging areas for the construction equipment that are as distant as possible from off-site receptors;
- Establish an electricity supply to the construction site and use electric powered equipment instead of diesel-powered equipment or generators, where feasible;
- Use haul trucks with on-road engines instead of off-road engines even for on-site hauling;
- Equip nearby buildings with appropriate filtration systems at all mechanical air intake points to the building to reduce the levels of diesel PM that enter the buildings; and/or
- Temporarily relocate receptors during construction activity.

Lead agencies shall consider the applicability and feasibility of each measure on a project by project basis. The District also encourages lead agencies to develop additional measures.

5.4.2 Diesel PM Exhaust from On-Road Equipment

In some instances diesel PM can be controlled at the source by implementing emission control technologies. ARB's Diesel Certification Program maintains a list of ARB-verified diesel emission control strategies for reducing diesel PM from on-road and off-road engines (e.g., diesel particulate filters). Lead agencies may implement mitigation that requires the use of these strategies. For example, a lead agency may require that ARB-verified diesel emission control strategies be implemented by the operator of a proposed truck yard that would be located near existing or future planned receptors.

5.4.3 Control Measures for Naturally Occurring Asbestos

The District recommends the following mitigation measure for projects that would be located in "areas moderately likely to contain NOA" identified by the California Geological Survey's report, titled *Relative Likelihood for the Presence of Naturally Occurring Asbestos in Eastern Sacramento County, California*.

- A site investigation shall be performed to determine whether and where NOA is present in the soil and rock on the project site and/or areas that would be disturbed by the project. The site investigation shall include the collection of soil and rock samples (3 per acre) by a California Registered geologist. If the site investigation determines that NOA is not present on the project site then the project applicant shall submit a Geologic Exemption as allowed under Title 17, Section 93105, Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining (Asbestos ATCM). If the site investigation determines that NOA is present on the project site, then the project applicant shall submit an Asbestos Dust Mitigation Plan including but not limited to control measures required by the Asbestos ATCM for approval by the District. The project applicant shall submit the plan to the District for review and approval before beginning any ground disturbance activity. District approval of the plan must be received before ground disturbance occurs in any "areas moderately likely to contain NOA," as determined by the map in California Geological Survey's report titled *Relative Likelihood for the Presence of Naturally Occurring Asbestos in Eastern Sacramento County, California*. Upon approval of the Asbestos Dust Mitigation Plan by the District, the applicant shall ensure that construction contractors implement the terms of the plan throughout the construction period. This measure shall be fully funded by the project applicant.

Implementation of the above mitigation measure would reduce impacts associated with generation of fugitive dust that potentially contains NOA. If the site investigation determines that NOA is present on the project site, then implementation of a District-approved dust mitigation plan would reduce impacts related to construction in serpentinite soils. Implementation of these measures would reduce the potentially significant impact associated with exposure to NOA during construction to a less-than-significant level.

If NOA is located on the surface of the project site then mitigation may be necessary to reduce the risk of generating airborne asbestos from some operational activities such as recreational activities on baseball diamonds and dirt running tracks or residents overturning soil for gardening purposes. In order to reduce exposure to airborne asbestos emissions in these types of situations, lead agencies shall consider mitigation that requires all surface soil containing NOA to be replaced with clean soil or capping these surfaces with another material (e.g., cinder or rubber).

EXHIBIT 21

8.2. GREENHOUSE GASES

The District does not have an adopted *Threshold of Significance* for construction-related GHG emissions. However, the Lead Agency should quantify and disclose GHG emissions that would occur during construction, and make a determination on the significance of these construction-generated GHG emission impacts in relation to meeting AB 32 GHG reduction goals. BAAQMD recommends using URBEMIS for proposed land use development projects and RoadMod for proposed projects that are linear in nature. Sources of construction-related GHGs only include exhaust, for which the same detailed guidance as described for criteria air pollutants and precursors should be followed.

The Lead Agency is encouraged to incorporate best management practices to reduce GHG emissions during construction, as applicable. Best management practices may include, but are not limited to: using alternative fueled (e.g., biodiesel, electric) construction vehicles/equipment of at least 15 percent of the fleet; using local building materials of at least 10 percent; and recycling or reusing at least 50 percent of construction waste or demolition materials.

8.3. TOXIC AIR CONTAMINANTS

BAAQMD recommends that the same community risk and hazard *Threshold of Significance* for project operations be applied to construction. However, BAAQMD suggests associated impacts should be addressed on a case-by-case basis, taking into consideration the specific construction-related characteristics of each project and proximity to off-site receptors, as applicable. The Air District recommends that for construction projects that are less than one year duration, Lead Agencies should annualize impacts over the scope of actual days that peak impacts are to occur, rather than the full year.

BAAQMD has developed guidance for estimating risk and hazards impacts entitled *Recommended Methods for Screening and Modeling Local Risks and Hazards* (May 2010) which also includes recommendations for mitigation of significant risk and hazards impacts. The Air District has also developed a Construction Risk Calculator model that provides distances from a construction site, based on user-provided project date, where the risk impacts are estimated to be less than significant; sensitive receptors located within these distances would be considered to have potentially significant risk and hazards impacts from construction. The Construction Risk Calculator can be downloaded from the Air District web site at: http://www.baaqmd.gov/Divisions/Planning-and-Research/CEQA-GUIDELINES.aspx.

8.3.1. Diesel Particulate Matter

Construction-related activities could result in the generation of TACs, specifically diesel PM, from on-road haul trucks and off-road equipment exhaust emissions. Due to the variable nature of construction activity, the generation of TAC emissions in most cases would be temporary, especially considering the short amount of time such equipment is typically within an influential distance that would result in the exposure of sensitive receptors to substantial concentrations. Concentrations of mobile-source diesel PM emissions are typically reduced by 70 percent at a distance of approximately 500 feet (ARB 2005). In addition, current models and methodologies for conducting health risk assessments are associated with longer-term exposure periods of 9, 40, and 70 years, which do not correlate well with the temporary and highly variable nature of construction activities. This results in difficulties with producing accurate estimates of health risk. Additionally, the implementation of the *Basic Construction Mitigation Measures* (table 8-2), which is recommended for all proposed projects, would also reduce diesel PM exhaust emissions.

However, these variability issues associated with construction do not necessarily minimize the significance of possible impacts.

The analysis shall disclose the following about construction-related activities:

1. Types of off-site receptors and their proximity to construction activity within approximately 1,000 feet;
2. Duration of construction period;
3. Quantity and types of diesel-powered equipment;
4. Number of hours equipment would be operated each day;
5. Location(s) of equipment use, distance to nearest off-site sensitive receptors, and orientation with respect to the predominant wind direction;
6. Location of equipment staging area; and
7. Amount of on-site diesel-generated $PM_{2.5}$ exhaust (assuming that all on-site diesel $PM_{2.5}$ exhaust is diesel PM) if mass emission levels from construction activity are estimated.

In cases where construction-generated emissions of diesel PM are anticipated to occur in close proximity to sensitive receptors for extended periods of time, lead agencies are encouraged to consult with BAAQMD.

8.3.2. Demolition and Renovation of Asbestos-Containing Materials

Demolition of existing buildings and structures would be subject to BAAQMD Regulation 11, Rule 2 (Asbestos Demolition, Renovation, and Manufacturing). BAAQMD Regulation 11, Rule 2 is intended to limit asbestos emissions from demolition or renovation of structures and the associated disturbance of asbestos-containing waste material generated or handled during these activities. The rule addresses the national emissions standards for asbestos along with some additional requirements. The rule requires the Lead Agency and its contractors to notify BAAQMD of any regulated renovation or demolition activity. This notification includes a description of structures and methods utilized to determine whether asbestos-containing materials are potentially present. All asbestos-containing material found on the site must be removed prior to demolition or renovation activity in accordance with BAAQMD Regulation 11, Rule 2, including specific requirements for surveying, notification, removal, and disposal of material containing asbestos. Therefore, projects that comply with Regulation 11, Rule 2 would ensure that asbestos-containing materials would be disposed of appropriately and safely. By complying with BAAQMD Regulation 11, Rule 2, thereby minimizing the release of airborne asbestos emissions, demolition activity would not result in a significant impact to air quality.

Because BAAQMD Regulation 11, Rule 2 is in place, no further analysis about the demolition of asbestos-containing materials is needed in a CEQA document. BAAQMD does recommend that CEQA documents acknowledge and discuss BAAQMD Regulation 11, Rule 2 to support the public's understanding of this issue.

8.3.3. Naturally Occurring Asbestos

Naturally occurring asbestos (NOA) was identified as a TAC in 1986 by ARB. NOA is located in many parts of California and is commonly associated with ultramafic rocks, according to the California Department of Geology's special publication titled Guidelines for Geologic Investigations of Naturally Occurring Asbestos in California. Asbestos is the common name for a group of naturally occurring fibrous silicate minerals that can separate into thin but strong and durable fibers. Ultramafic rocks form in high-temperature environments well below the surface of the earth. By the time they are exposed at the surface by geologic uplift and erosion, ultramafic rocks may be partially to completely altered into a type of metamorphic rock called serpentinite.

EXHIBIT 22

Chapter 7

"Black, Black, Black Is the Color of My True Love's ..." Exhaust

Diesel exhaust

Major impacts: Lung cancer, heart and lung disease, mental impacts, asthma and more

Introduction

California's Proposition 65 (the Safe Drinking Water and Toxic Enforcement Act of 1986) mandates an inventory listing toxic materials and public warnings of their presence. The list is long, but one substance alone, diesel exhaust, accounts for 70 percent of the airborne toxic effects of all toxic air contaminants (TAC) combined. The primary problem is heavy polycyclic aeronautic hydrocarbons (PAHs) caused by incomplete combustion of heavy petroleum fuels. But diesel exhaust warrants many other concerns, too. In a recent study, prenatal exposure to PAHs was correlated with physical changes in children's brain structure along with mental problems, slower reasoning, hyperactivity, and more.

The reason why diesel exhaust is so polluting and toxic is inherent in diesel combustion. The walls of the engine's cylinders must be kept relatively cool, but the combustion in the center is very hot. This allows partial combustion of the heavy fuel and the generation of polycyclic aromatic hydrocarbons (PAHs), the most problematic carcinogenic compounds in the atmosphere. And while diesel exhaust is ubiquitous, There are areas of special concern in certain locales. Many of these are downwind of rail yard and truck multimodal facilities. For example, the plume of materials from the BNSF Railway facility in San Bernardino, California, was estimated at about 2,500 excess cancer deaths per lifetime. Note that since the lifetime risk of cancer is on the order of one quarter of all deaths (250,000 afflicted among each million in population), the excess amounts to only about a 1 percent increase even in this especially impacted area with just a few thousand people.

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One key reason for this relatively low risk today is the 91 percent reduction in diesel emissions from trucks during the past 30 years, from 1,100 milligrams of emissions per kilometer traveled (mg/km) in 1972, to about 100 mg/km in 2002, as Figure 7-1 shows. Further progress is occurring, resulting in development and production of very clean-burning diesel engines. This is well advanced in long-haul trucks, but almost totally lacking in three-axle diesel vehicles (including school buses, dump trucks and delivery vans) and, regretfully, most trains. Cars pose special problems in trying to maintain diesel soot reduction techniques, assuming they are not part of some scam (viz. Volkswagen)

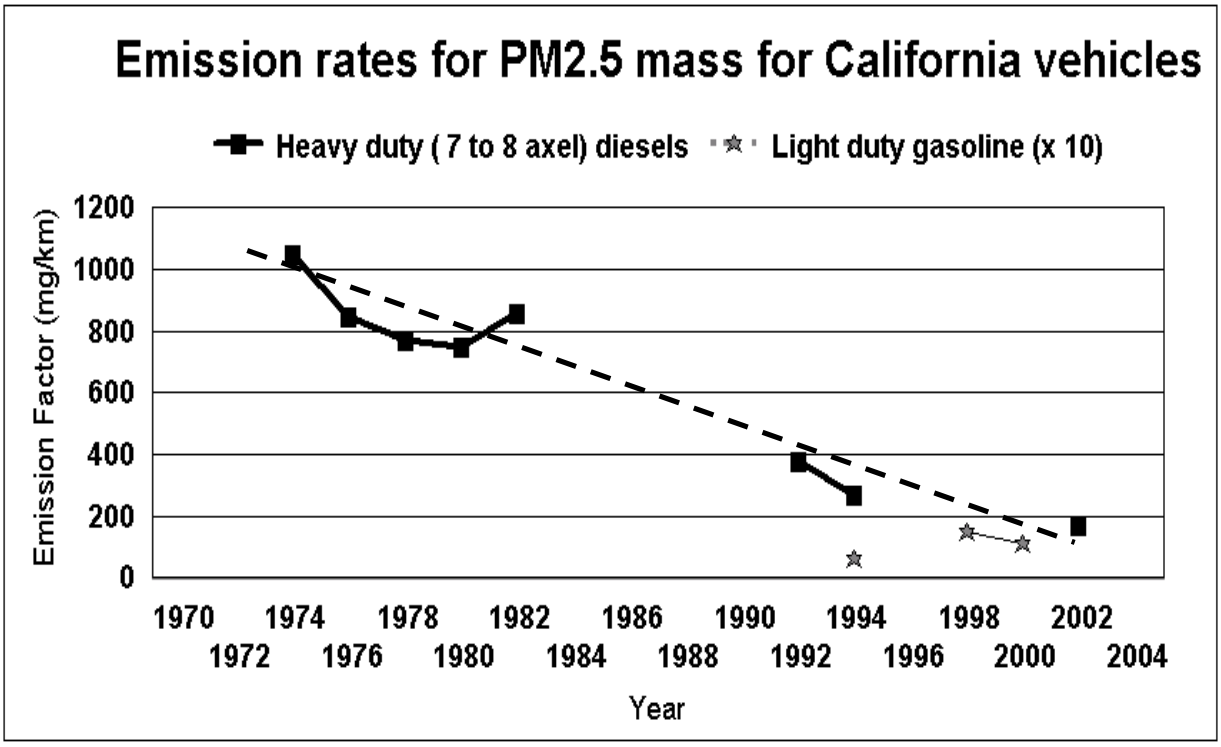

Figure 7-1. $PM_{2.5}$ emission factors for heavy- and light-duty trucks, 1972–2002. Cars produced about one-tenth the emission volume that trucks do.

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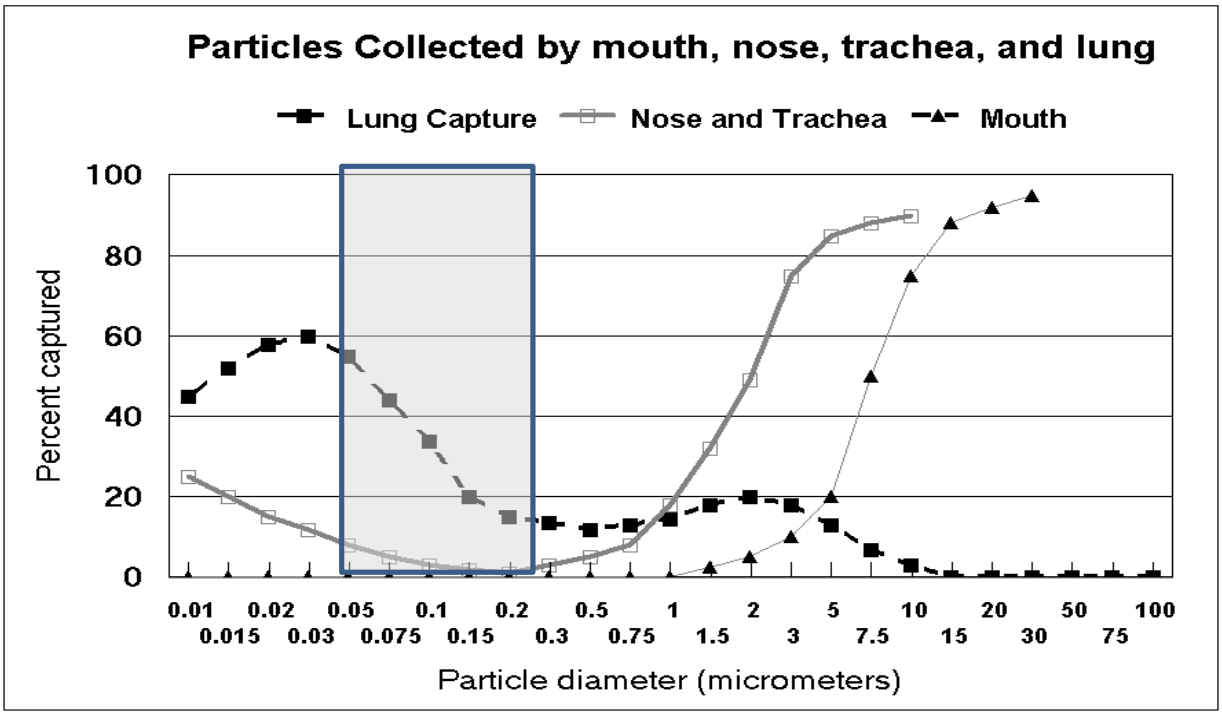

Figure 7-2. The gray shaded area shows the size range and lung deposition for diesel exhaust.

And on top of this, there is Volkswagen. I was amazed in 2009 that it ever made the ARB's smog emission limits. Well, a "defeat device" that sensed when the car was being tested turned on emission controls. Once testing was done, the device turned off the pollution control system, after which time the car emitted 10 to 40 times more nitrous oxide than allowed.

Even greater problems appear in Europe, where about half of all cars have diesel engines. That may be why Paris and other European cities still have such dirty air, despite claims of widespread use of "clean diesel." In addition, the manufacturers' mileage claims are inflated by about 40 percent, using tricks while they do their own tests.

How can I protect myself?

Essentially all diesel exhaust comes from one of seven sources:

1. Heavy duty (typically eight-axle) diesel-powered trucks on freeways and major highways
2. Lighter duty (often three-axle) diesels on secondary streets, such as delivery and dump trucks, school buses, and the like

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3. Railroad diesel engines, especially downwind of a rail yard

4. Off-road and construction diesel-powered equipment

5. Diesel-fueled water pumps for agriculture

6. Peaking diesel-powered electric backup generators used to respond to short term power needs

7. Diesel-powered cars

Do your homework. Explore the websites of transportation agencies and other reliable sources for data on heavy truck use.

For each of the diesel sources given above, different types of protection are needed:

- For sources1 and 2 (diesel on vehicular roadways), follow the "How can I protect myself" guidelines in Chapter 8 for ultra-fine particles and in Chapter 9 for highways.
- For diesel source 3, become aware of railroad activities, and especially rail yards, because some of the worst levels of toxic air contaminants occur downwind of rail-truck facilities. Check the Chapter 7 (Diesel exhaust) section about the Roseville, California, rail yard. That segment shows that diesel exhaust in rail yards is more toxic than that emitted by trucks on roadways.
- For diesel sources 4 and 5, don't sweat it, as they are not close to you for extended periods.
- For source 6, learn where such generators are in relation to wind direction, and ascertain how often they run. Usually such facilities, if in cities, have particle controls on them.
- For source 7, read on to learn more about Volkswagen cheating.

More about Volkswagen's diesel cheating

Cheating on "clean diesels"? I am shocked! Shocked! But I was really shocked when told in 2009 that the Volkswagen diesel had passed the ARB's stringent dynamometer emission tests. Make no bones about it – diesel combustion is essentially filthy, and only by extensive and expensive efforts can its problems be overcome. I had no clue that a corporate fix was on.

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There had been several earlier examples of shenanigans with “defeat devices” by homegrown and foreign auto companies, but this one from Volkswagen was a lulu, with pollution up to 40 times greater than the maximum allowable standard. The heart of the matter is that California’s vaunted vehicle testing and validation programs have an “Achilles heel”: what is seen in laboratory dynamometer tests is not what appears on the highway. Volkswagen knew that, and if not for a fluke West Virginia based on-road test that revealed the discrepancy, could have continued cheating for years to come.

This is not the first time lab results and real-world results differed. I was working on lead pollution from highways in 1973. We had models from the U.S. EPA, but California wanted to validate these by on-road testing. My work found that the elevated freeways that were supposed to be the cleanest by the EPA model were the dirtiest, dumping 400 percent more lead than the California standard into downwind houses. My data helped Jerry Brown version 1.0 (in his first term as California’s governor) win a sweeping victory against both industry and the EPA, which opposed establishment of separate California standards. The stunning reductions in California air pollution encouraged most of the world to follow California, with the exception of Europe and its diesel fixation based on mileage claims. But automotive manufacturing companies hire the contractors to do the testing. What could possibly go wrong in this scenario? It probably explains why on-road mileage of diesels in Europe is about 40 percent worse than advertised.

By the mid 1980’s, it had become clear that something was wrong in the Los Angeles basin. Ozone precursor gasses and ozone itself were not decreasing in the way the laboratory measurements and air quality models predicted. The answer came from a series of tests made in a freeway tunnel in Van Nuys, in the San Fernando Valley region of Los Angeles. Tunnels are nice to use because the volume of air and the number and types of cars and trucks were both accurately known. Thud the tunnel studies were able to compare the predicted auto emissions from ARB dynamometer laboratory tests to real-world conditions. The tunnel tests revealed carbon monoxide (CO) and hydrocarbon (HC) emission values 300 percent and 400 percent higher, respectively, than expected on the basis of dynamometer tests. The on-road tests identified a sad result – most California cars were clean, but a small number of “gross emitters” were discharging two-thirds of all highway pollution. These cars include modified vehicles with

bypassed catalytic converters, old throw-away cars, unregistered cars, cars with fake smog check clearances, and the like.

In order to rectify the problem of "gross emitters," the California Inspection and Maintenance Review Committee (IMRC), a state board on which I served for years, repeatedly recommended on-road testing to identify "gross emitters." The technique is actually simple, using an infrared beam aimed across a freeway on-ramp to measure pollutants. If this test had been modified to also detect nitric oxide (NO), that would have immediately identified the diesel cheaters, and the pollution would have been stopped years ago. Regretfully, the IMRC was shut down in 2011.

And even post-Volkswagen, laboratory dynamometer tests cannot protect us in real-world conditions. "Wear" aerosols – from the roadbed, resuspended freeway dust, brake drums, and other sources resulting from abrasion, cannot be realistically measured in the lab. But health data on children living near freeways in Los Angeles, and our data on heart disease in the Central Valley, show that roadways are still causing health problems. Medical studies points to "wear" aerosols and ultra-fine metals from brakes as potentially toxic agents. This very important problem of very fine and ultra-fine metals from brakes will be covered in the next chapter.

California needs to initiate truly realistic on-road testing not only to catch "gross emitters" and to detect cheating by "defeat devices," but also to measure "wear aerosols" by size and composition. These tests should include realistic freeway actions such as braking and accelerating, as I and my team are doing in an ongoing U.S. EPA study in Detroit. Only with such data can we propose legislation that can rectify these problems and protect the health of Californians.

The special case of diesel trains and rail yards

The Union Pacific rail yard in Roseville, 15 miles northeast of Sacramento, California, is one of the largest in the western United States, and has a major repair and testing missions. As normal operating procedure, diesel engines are often left idling for extended periods of time. California Air Resources Board analysis in 2004 indicated about 900 excess cancer deaths per lifetime downwind of the rail yard. Note that the BNSF intermodal rail yard in San Bernardino had a predicted cancer death rate of about 2,500 per lifetime, much worse than Roseville.

We participated in tests of rail yard impacts both for diesel and other pollutants emitted from the repair activities. One of the goals was to make a direct measurement of diesel components, and especially the heavy PAHs like benzo[a]pyrene, a potent carcinogen in diesel smoke, for comparison with the ARB model. We also wished to evaluate other potential particulate pollutants emitted by comparing downwind sites to upwind or control sites. Figure 7-3 illustrates a comparison between a downwind site (Denio's Roseville Auction) and an upwind site for sulfur, associated with the sulfur in diesel fuel. Many other metallic aerosols followed the same pattern.

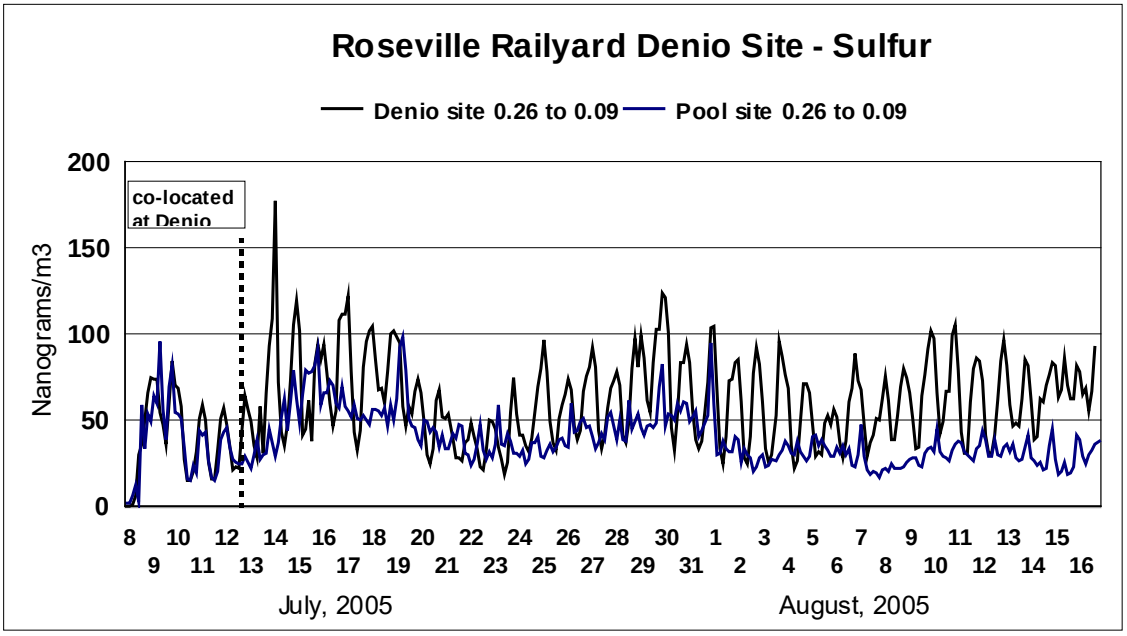

Figure 7-3. Comparison of very fine sulfur, Denio site vs. an upwind site.

For the comparison of cancer death rates, we measured speciated organics as a function of particle size. Figure 7-4 is one such plot, showing that these PAHs deposit deep in the lung.

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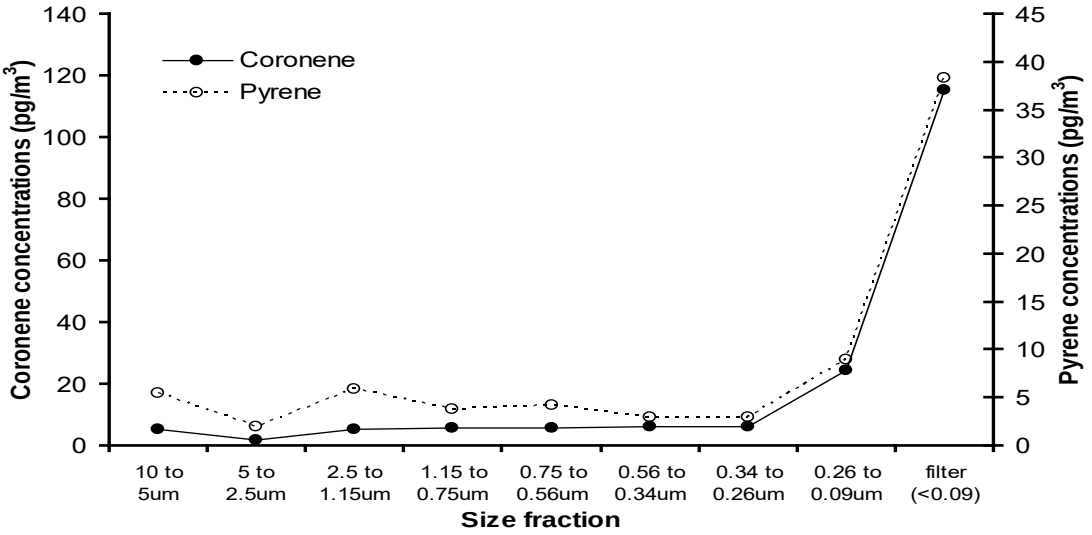
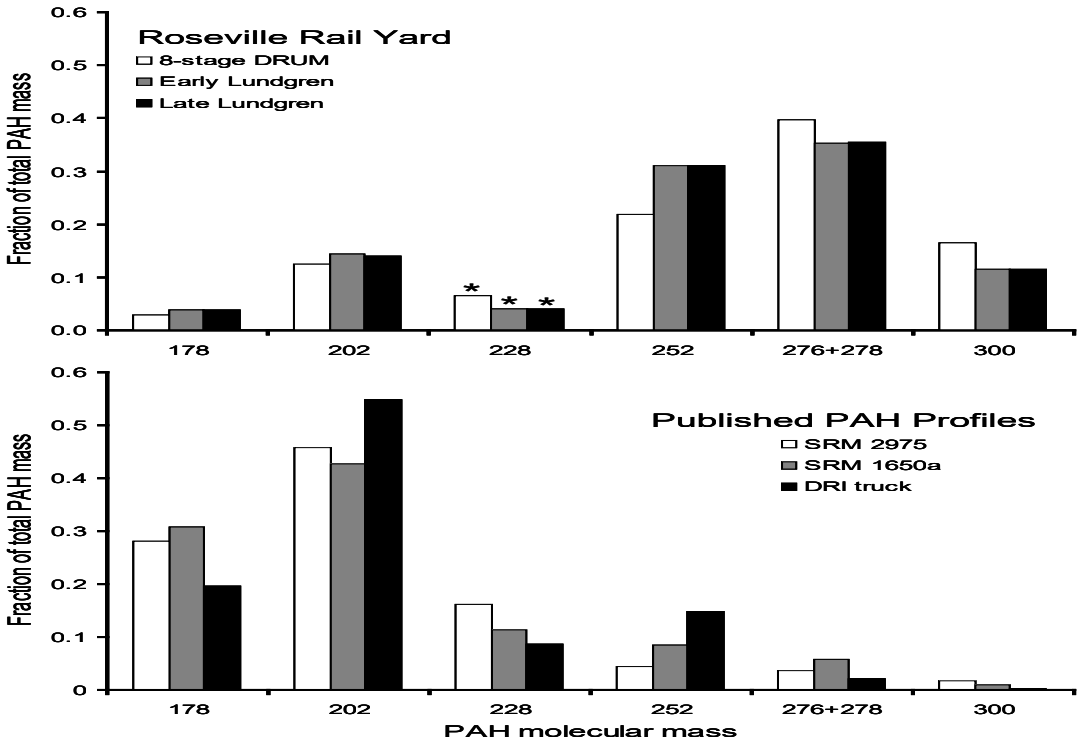


1551

1552 Figure 7-4. Roseville rail yard coronene and pyrene concentrations (pg/m^3) delineating
1553 the different size fractions of the eight-stage DRUM sampler (Davis Rotating-drum
1554 Universal size-cut Monitoring impactor) and the after-filter.



1555

1556 Figure 7-5. Comparison of Roseville rail yard and truck diesel PAH profiles.

Rail yards have a variety of diesel sources – some of which are unique to them, such as idling diesels and stationary diesels under test, as in the Roseville rail yard. As an additional complication, the BNSF rail yard in San Bernardino is an intermodal facility that is subject to heavy truck traffic from the Port of Los Angeles and Long Beach. Both diesel testing and port-to-rail transit traffic are likely to generate enhanced cancer rates downwind.

References

- Cahill, Thomas A., Thomas M. Cahill, David E. Barnes, Nicholas J. Spada, and Roger Miller. 2011. "Inorganic and Organic Aerosols Downwind of California's Roseville Railyard." *Aerosol Science and Technology* 45: 1049–1059. doi:10.1080/02786826.2011.580796.
- Cahill, Thomas A. (P.I), Thomas M. Cahill, David E. Barnes, Nicholas J. Spada, Steven S. Cliff, Kevin D. Perry, and Erin Fujii. November 1, 2007. "Final Report to the Health Effects Task Force (HETF), Breathe California of Sacramento-Emigrant Trails: Mass, Organic, And Elemental Aerosols by Size, Time, and Composition at the Union Pacific Rail Road's Roseville Railyard."
- Gertler, Alan, Mahmoud Abu-Allaban, William Coulombe, John A. Gillies, William R. Pierson, C. Fred Rogers, John C. Sagebiel, Leland Tarnay, and Thomas A. Cahill. 2002. "Measurements of Mobile Source Particulate Emissions in a Highway Tunnel." *International Journal of Vehicle Design 2001*, 27:86–93. doi:10.1504/IJVD.2001.001954.
- Zielinska, B. et al**.** 2004. "Final Report of the Diesel Studies." Desert Research Institute.

Chapter 8

"It Was an Itsy Bitsy Teenie Weenie Yellow ..." Ultra-fine Metal

Copper and other ultra-fine transition metals

Major impacts: Cardiopulmonary conditions, especially ischemic heart disease and permanent loss of lung function in children

[*For the antiquity-challenged, the 1960 song that inspired the title of this chapter was about a young girl suffering a mild case of hypothermia due to a questionable swimwear choice.]*

Introduction

I probably take more pride than I should or deserve for highlights in my career – the first, the only, the biggest. But I am embarrassed about one record. I am told that I hold the record at the Trauma Intensive Care Unit of the University of California, Davis, Medical Center for the most ribs broken in a single fall from a ladder – seven – by a patient who survived. Knowing that now, I really should not have been climbing a long ladder onto the roof of Arden Middle School in the rain with my colleague, Betty Turner (combined ages circa 140 years) on that December day in 2002.

We were responding to a request by the principal to add Arden Middle School to a network of air sampling stations we were setting up. The network was designed to evaluate the effects of freeways on Sacramento, as part of our research with the Health Effects Task Force of what is now Breathe California of Sacramento-Emigrant Trails (at that time an affiliate of the American Lung Association). The study focused on the health-compromising implications of aerosols from two heavily traveled north-south freeways, Interstate 5 and California Highway 99. The six-site network stretched 50 miles, from the western side of the Sacramento Valley west of Davis to the foothills of the Sierra Nevada east of Sacramento. The request from the principal of Arden Middle School was based on her concerns about the school's proximity to the intersection of two main arterials. The school grounds are 50 feet downwind of the signal-controlled

intersection of multi-lane Watt Avenue at Arden Way, and those streets were and are heavily used and often congested. Arterial streets were never part of our plan to evaluate air quality adjacent to freeways, but I had one extra air sampler, just brought back from the Aerosol Characterization Experiment-Asia (ACE-Asia) study (see Chapter 10, The Mad Hatter Had a Point) and, lacking any available staff at that moment, the geezer squad swung into action.

Once again, I am struck about how lucky I have been in my career. I was not at all interested in Arden Middle School because it was not part of our plan, but it turned out to be the key to unlocking one of the major detrimental health effects affecting the nation. When we finally completed our analysis of the results in spring 2003, we discovered that Arden Middle School – downwind of 65,000 vehicles per day, 1.5 percent of which are heavy trucks traveling on Watt Avenue – was subject to about the same amount of pollution as locations measured downwind of Interstate 5 carrying 265,000 vehicles per day, 12 percent of which are heavy trucks.

These results were a wake-up call that we had better look more closely at Arden Middle School, triggering intensive studies in 2006 and 2007. Table 8-1 illustrates the results of these and other comparative studies.

Sampling site	**Sampling dates**	**Mass data, very fine particles**	**Mass theory, very fine plus ultra-fine**	**Comment**
Size modes		0.26 to 0.09 μm	0.30 to 0.0 μm	
Sacramento, Interstate 5	Winter 2002	4.1 $\mu g/m^3$		265,000 vehicles/day
Fresno, 1st Street	Winter 2001	4.2 $\mu g/m^3$		
Arden Middle School, Watt Avenue	Winter 2006	4.0 $\mu g/m^3$	6.4 ± 0.8 $\mu g/m^3$	65,000 vehicles/day

Table 8-1. Measurements at Arden Middle School, in suburban Sacramento, and comparative data and theory. The theory value is based on three sources, averaged.

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These results could be explained only by the anomalous fact that for the first time in decades we were measuring aerosols at a study at a stop light, with braking and acceleration. We all noticed the plumes of black smoke when the diesels accelerated as the light turned green.

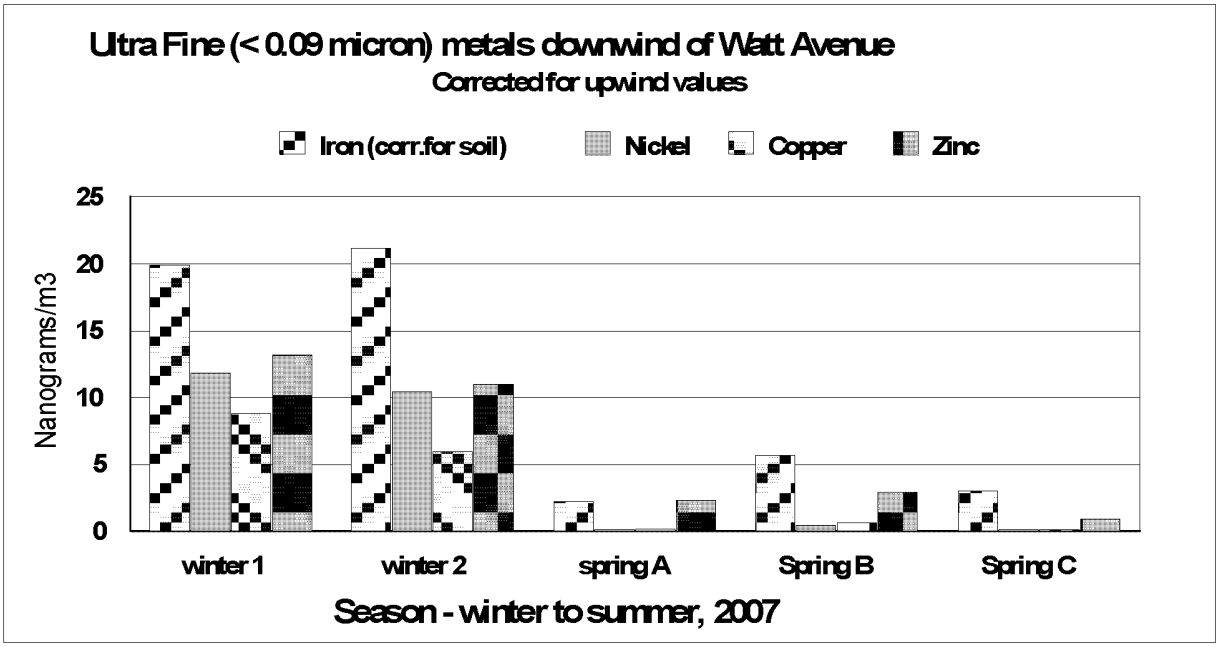

Figure 8-1. Ultra fine metals at Arden Middle School 50 feet downwind of Watt Avenue

Three other long-term research efforts now came to bear. The Health Effects Task Force (HETF) already had spent several years looking at the enhanced heart attack death rate in the southern San Joaquin Valley, which we showed was associated with enhanced ischemic heart disease (HETF, 1997). A separate key study in Los Angeles showed large losses of lung capacity in children growing up near freeways. And UC Davis environmental health teams identified a relationship between freeway proximity and incidence of autism, with metals a likely cause.

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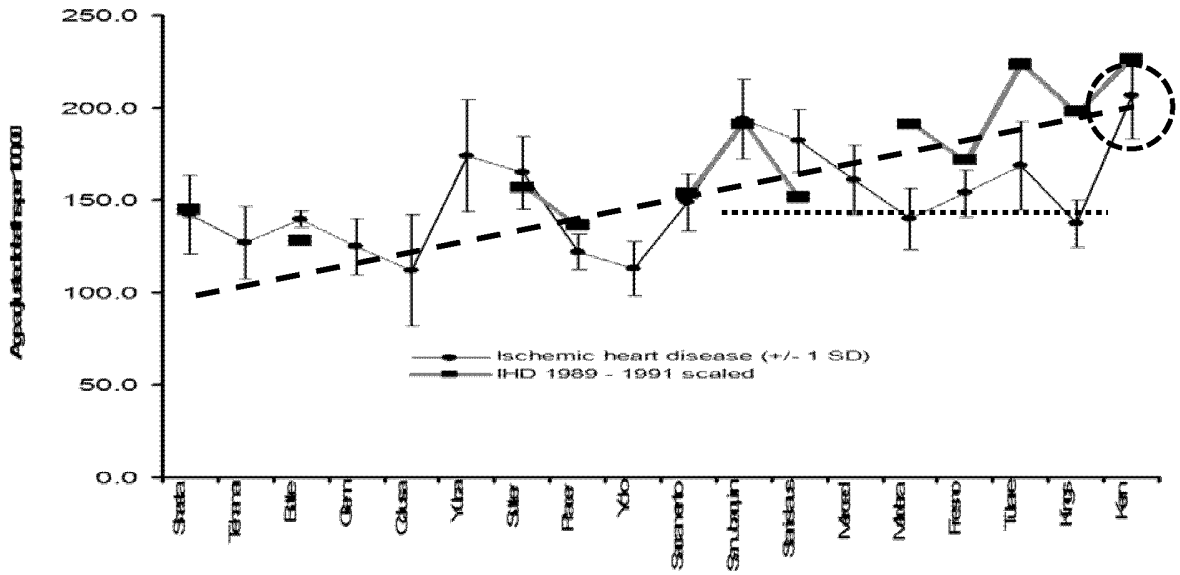

Figure 8-2. Death rates from heart attacks by location in the California Central Valley. The lower dotted line traces the reduced rate of ischemic heart disease that resulted from a 1990 cleanup of ultra-fine metals from oil extraction operations. Note that the cleanup did not reduce heart attack incidence in Bakersfield (dotted circle), which is upwind of most of the oil fields.

A search of the scientific literature confirmed what we already suspected: these metals are known constituents of brake pads and drums, plus some zinc from zinc thiophosphate, a stabilizing additive in motor oil that we had seen before in ultra-fine modes (Zielinska et al., 2004).

All these data led to the hypothesis that the enhanced heart attacks in the southern San Joaquin Valley might be caused by ultra-fine particles of brake drums and pads from cars and trucks trapped at cities that experience intense winter inversions, as Bakersfield does. With assistance from a local non-governmental organization, we did a study in January 2009 simultaneously measuring coarse, fine, very fine and ultra-fine particles at five sites from Redding (at the northern end of California's Central Valley) to Bakersfield (440 miles distant, at the southern end of the valley). This study also benefitted from much better data on deaths rates, including data that showed one specific source of mortality was ischemic health disease (IHD),

the largest single cause of death in the San Joaquin Valley. It also used data from extensive EPA studies on metals in rats, and our data from Watt Avenue tying these metals to braking. Thus, in summary, the resulted in peer reviewed papers in a special US EPA journal proving that very fine and ultra-fine insoluble metallic particles were the cause of thousands of fatal heart attacks.

When added to the earlier work on loss of lung function in children growing up near (less than 1 mile) Los Angeles freeways and the data on enhanced autism rates for pregnancies near freeways, the seriousness of the very fine and ultra-fine metals becomes urgent.

And now we know what you can do protect yourselves.

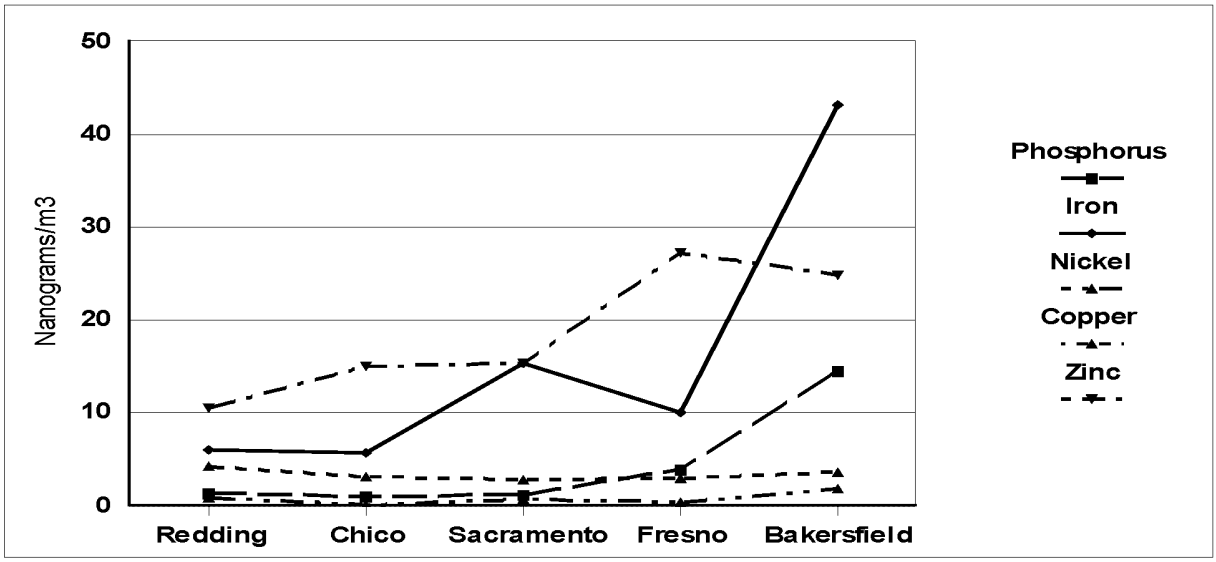

Figure 8-3. Very fine and ultra-fine metals that correlate with ischemic heart disease (IHD) mortality. IHD is usually the largest single reason for heart attack mortality in the California Central Valley.

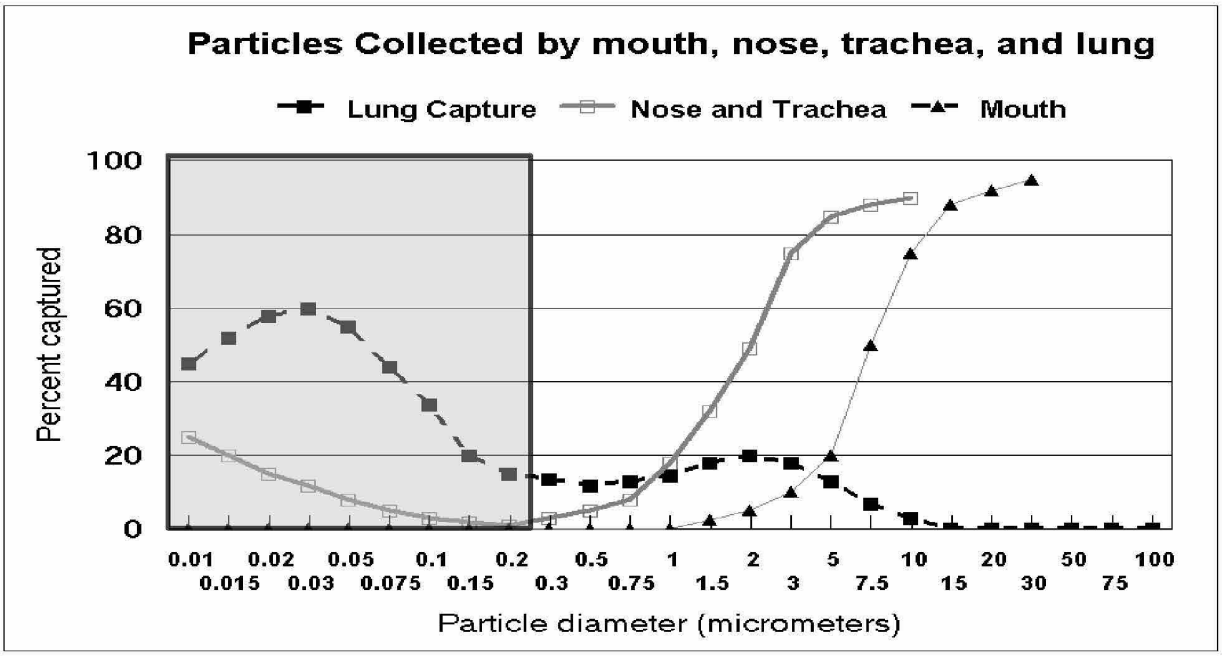

Figure 8-4. The gray shaded area shows the size range and lung deposition for very fine particles with diameters between 0.25 micrometers and 0.1 micrometers, and ultra-fine particles with diameters less than 0.1 micrometers. These are normally written in a short version, for very fine ($0.25 > Dp > 0.1$ μm) and for ultra-fine particles, ($D_p < 0.1$ μm).

How can I protect myself?

Know the sources:

- Avoid the outdoor areas where such particles exist, especially downwind of roadways where heavy braking routinely occurs (Chapter 9, Outdoor Air Quality)
- Learn of other industrial sources of ultra-fine metals, especially car shredding operations, and ultra-filter the air in your house (Chapter 10, Indoor Air Quality)

Nitty-gritty details

Comparison of diesel exhaust to ischemic heart disease death rates

The California Proposition 65 (law on toxics) limit for notification: 10 deaths per million people per 70-year lifetime, or approximately a **0.001% increase in the total death rate**

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Diesel exhaust is the most ominous of the old Prop 65 toxic air contaminants (TACs), resulting in about 70 percent of all cancer cases attributable to TACs combined. Using the fact that about 20 percent of all deaths are from either cancer or heart attacks, we can estimate the enhanced death rate, deaths per million people per 70-year lifetime:

- Downwind of Union Pacific rail repair yard, Roseville, California: approximately 800 deaths per million people per 70-year lifetime: **about a 0.5 percent increase in the cancer death rate**
- **VW diesel cheating** (if continued at the present level – estimate by the *Sacramento Bee*): approximately 900 deaths per million people per 70-year lifetime: **about a 0.5 percent increase in the cancer death rate**
- Downwind of the worst California rail-truck facility, in San Bernardino approximately 2,500 deaths per million people per 70-year lifetime: (ARB report, San Bernardino BNSF): about a **1.3 percent increase in the cancer death rate.** This rate equates to < (fewer than) 1,000 people in the city of San Bernardino

Now compare that to the impact of very fine and ultra-fine metals from brakes:

- Bakersfield, in the city center: **approximately 25 percent increase in the heart attack deaths (**this rate affects about 350,000 people in the city of Bakersfield)

Thus the death rate in Bakersfield, enhanced by approximately 25% in the death rate of the single largest source of mortality in a city of 350,000 people, can be compared to the enhanced death rate at the worst California site impacted by diesel, about 1.3% in a population of no more than a few thousand people. So while vast efforts are being made to control diesel, and with considerable success, very fine and ultra-fine metals, proven killers, slide by under the radar. As I said in Chapter 4, "…the Worst of Acts".

Note added in proof:

We have just published a paper on Detroit that includes the final statement of the abstract: "……*This result supports earlier publications showing the ability of very fine and ultra-fine particles to transport to sites well removed from the freeway sources. The concentrations of very fine and ultra-fine metals from brake wear and zinc in motor oil observed*

in Detroit have the potential of being a significant component in statistically established $PM_{2.5}$ mortality rates."

Transition metals in coarse, fine, very fine and ultra-fine particles from an interstate highway transect near Detroit, Thomas A. Cahill, David E. Barnes, Jonathan A Lawton, Roger Miller, Nicholas Spada, Robert D. Willis and Sue Kimbrough (the last 2 EPA OAPQS North Carolina), Atmospheric Environment (9/2016)

Detroit is a lot bigger than Bakersfield. The word is getting out.

References

- Cahill, Thomas A., David E. Barnes, Nicholas J. Spada. 2014. **"Seasonal Variability of Ultra-Fine Metals Downwind of a Heavily Traveled Secondary Road**." *Atmospheric Environment* 94: 173–179.
- Cahill, Thomas A. David E. Barnes, Nicholas J. Spada, Jonathan A. Lawton and Thomas M. Cahill**.** 2011. **"Very Fine and Ultra-fine Metals and Ischemic Heart Disease in the California Central Valley 1: 2003–2007**." *Aerosol Science and Technology* 45: 1125–1134. doi:10.1080/02786826.2011.582194
- Cahill, Thomas A., David E. Barnes, Earl Withycombe, and Mitchell Watnik**.** 2011. **"Very Fine and Ultra-fine Metals and Ischemic Heart Disease in the California Central Valley 2: 1974–1991."** *Aerosol Science and Technology* 45:1135–1142. doi:10.1080/02786826.2011.582196.
- Cahill, Thomas A., Thomas M. Cahill, David E. Barnes, Nicholas J. Spada and Roger Miller. 2011. **"Inorganic and Organic Aerosols Downwind of California's Roseville Railyard**." *Aerosol Science and Technology* 45: 1049–1059. doi:10.1080/02786826.2011.580796.
- •Cahill, Thomas A., Debrina Dutcher, Chris Clark, Jeanette Martin, Theresa McCarthy, and David Lipnick. June 1998. **"Comparison of Cardiac and Stroke Mortality to Carbon Monoxide, Ozone, and Particulate Air Pollutant Concentrations in the Sacramento region: Final Report to the American Lung Association of Sacramento – Emigrant Trails**."

- Cahill, Thomas M. 2010. **"Size-resolved Organic Speciation of Wintertime Aerosols in California's Central Valley**." *Environmental Science and Technology* 44: 2315–2321. doi: 10.1021/es902936v.
- Cahill, Thomas M., and Thomas A. Cahill. 2013. "**Seasonal Variability of Particle-associated Organic Compounds Near a Heavily Traveled Secondary Road**." *Aerosol Science and Technology.* doi: 10.1080/02786826.2013.857757

Thomas A. Cahill, David E. Barnes, Jonathan A Lawton, Roger Miller, Nicholas Spada, Robert D. Willis and Sue Kimbrough, **Transition metals in coarse, fine, very fine and ultra-fine particles from an interstate highway transect near Detroit,** in press, Atmospheric Environment (2016)

Gauderman, W. J., McConnell, R., Gilliland, F., London, S., Thomas, D., Avol, E., Vora, H., Berhane, K., Rappaport, E. B., Lurmann, F., Margolis, H. G. and Peters, J. (2000). **Association between air pollution and lung function growth in southern California children.** *Am. J. Respir. Crit. Care Med.* 162:1383-1390.

Volk, H. E., Hertz-Picciotto, I., Delwiche, L., Lurmann, F., and McConnell, R., Residential **Proximity to Freeways and the CHARGE Study**, Environmental Health Perspectives, **119,** # 6 , pg 872 – 877 (2011)

Shut down Tom – attempt No. 3

Ultra-fine particles and the massive governmental screw-up at the World Trade Center

- **George Bush, president, 2003 – World Trade Center air was not safe to breathe!**

None of us can forget when we first became aware of the WTC disaster on September 11, 2001. But my concerns were raised higher when three days later, I saw TV coverage showing blue fumes coming up from the collapsed piles after a rainstorm on September 13. Blue smoke is bad smoke, especially in industrial fires, because it indicates very fine particles that go deep into the lung and even the bloodstream and heart. I felt both helpless and worried for the workers and firemen working in such conditions.

About two weeks later, I received a phone call from Bob Leifer, Department of Energy physicist with a laboratory on Varick Street in New York. His laboratory was at the southern limit of sites that still had electrical power. We had collaborated on the Mount St. Helens work, and I respected his expertise. He asked if I could send one of my Davis Rotating-drum Universal size-cut Monitoring impactor(DRUM) samplers to him. I had invented the current DRUM sampler in 1985, and it has been the work horse of my research for decades. It was designed to address problems with EPA required sampling protocol, which required 24 hr average filters analyzed only for mass. The standard protocol also calls for operating this unit only one day in 6. (see Chapter 4) The DRUM gives data in 8 size modes, not one size mode, every 3 hr, not every 24 hr, and is routinely analyzed for mass, 42 elements, soot, and occasionally organic matter.

Well, one had just come back from Beijing and ACE-Asia, (Chapter 19), so a cleaned it up, reloaded foils, and just made the FedEx pickup at 4 p.m. that Friday.

Robert got the sampler up and running by October 2, and ran it flawlessly until we shut down in mid-December. At that time, we analyzed the samples at the Advanced Light Source, Lawrence Berkeley National Laboratory, and at Lawrence Livermore National Lab. By Christmas we had the results, which showed that, despite what the EPA and White House press releases asserted, the air was most assuredly not "safe to breathe," and that people could expect massive detrimental health effects. These health problems included both the "WTC cough" (from coarse particles) and loss of lung function and eventual ischemic heart disease (from ultra-fine particles) as a result of breathing emissions from the fuming collapsed material piles, on which hundreds worked with minimal protection. There were high levels of strange elements, some toxic, in very fine size modes, predictably harmful to health.

As soon as I had results in early January, I called EPA Region II, and was told that it was none of my business. The EPA contact person asked just two questions: "Who asked you to do it? Who paid for it?" They had zero interest in our findings. Then I asked the University of California's Washington lobbyist to present our material to the committee headed by then-Senator Hillary Clinton on this topic. The committee was scheduled to conduct hearings later that month, and UC contacted her staff and mentioned our work. The Senate staff said that our work not needed, as they already had their experts lined up, including a senior professor from New York University. When the hearing was finally held, the NYU professor testified that his

data showed that the aerosols experienced in New York City were regional in nature from upwind sources, and not the WTC smolder pile. I was aghast.

Finally, I called my friends at EPA research in North Carolina, and their first question was "What did you find?" It turns out they at they were not even allowed to go to New York City to help because it was "a regulatory matter." Some of them went anyway. So, frustrated at every turn, we made our results public in a news conference in Davis. Our work was added to work other work done in September but only now made public. It showed the dust was as basic chemically as Drano, and hence very irritating and damaging to mucous membranes, information that had been given to the EPA in September but never released. We got enough ink to get invited to come to a House of Representatives hearing in New York City at the end of February, with the U.S. EPA Ombudsman in attendance. I was hesitant to go, but Sylvia Wright of the UC Davis News Service office said we must go. So Sylvia, my wife Ginny, and I headed off to New York.

The hearing was bizarre. I was grilled for about an hour, under oath, by the Ombudsman's lawyer, replete with leading and compound questions and trickery. They were trying to get at what EPA Administrator Christie Whitman knew about the dangers of the WTC smoke and when she knew it. The hearing also focused on asbestos, of which we saw very little. Ginny was beside herself because I did not have my lawyer to deflect unfair questions. A large audience there wanted EPA blood. I was very careful to avoid saying any more than I knew.

I subsequently met with Dr. Stephen M. Levin, who was treating WTC workers, and a reporter for the *New York Daily News* who, unlike the *New York Times,* was covering the story well. Levin was director of the World Trade Center Worker and Volunteer Medical Screening Program. I then got a call from ABC News, which did an interview with me at the WTC site that ran on the national news. Even though six months had passed since the collapse of the towers, a bitter burned insulation-like smell permeated the air, and the pile was still hot. Sylvia took some photos at the interview that I have shamelessly used everywhere. Now people knew who we were, and that, unlike the EPA, we were worried about current and future health impacts. The "air is safe to breathe" comment was in Whitman's September press release, which had declared air at the WTC site and vicinity as "…safe to breathe," but it was not. We began getting some strong negative pushback in response to our work.

As a result of my visibility I got into contact with Cate Jenkins. Cate, a senior EPA chemist, had become a whistleblower who accused the EPA of underestimating the toxicity of the fumes in the World Trade Center vicinity. She was under some sort of protection, and people sent her the most amazing information, which she then copied to us all. We added our results to her network, and received all sorts of documents. Some of these were reports that would suddenly appear on the EPA website, only to be removed the next day. Some sort of fix was in play!

The next action was something new to me. A good friend at U.S. EPA phoned me and leaked that the EPA was funding a grant at a famous old New York university to challenge my data. He apologized to me, and I allayed his concerns.

In such situations my only resource was the peer-reviewed literature, which we prepared and submitted. I have never seen that other group's report (which was never released), but my data is published in the peer-reviewed literature. One reviewer was so set against our publishing the data (see Figure 8-5) that the editor had to remove him from the referee list, since everybody else was effusive in praise of our work. Not only was it important, with the help of the Livermore lab, but it also was in many ways the most complete aerosol event analysis ever done, with seven different analytical methods, some done for the first time (Cahill et al., 2004).

I met with and challenged a senior NYU professor on in this testimony before Hillary Clinton. It turns out that he had made measurements, but at the surface and in the wrong direction from winds, so despite being closer than we were, he did not see the plume. He did not have the capability we had with the DRUM and its three-hour time resolution, vital for seeing plumes from the collapse pile.

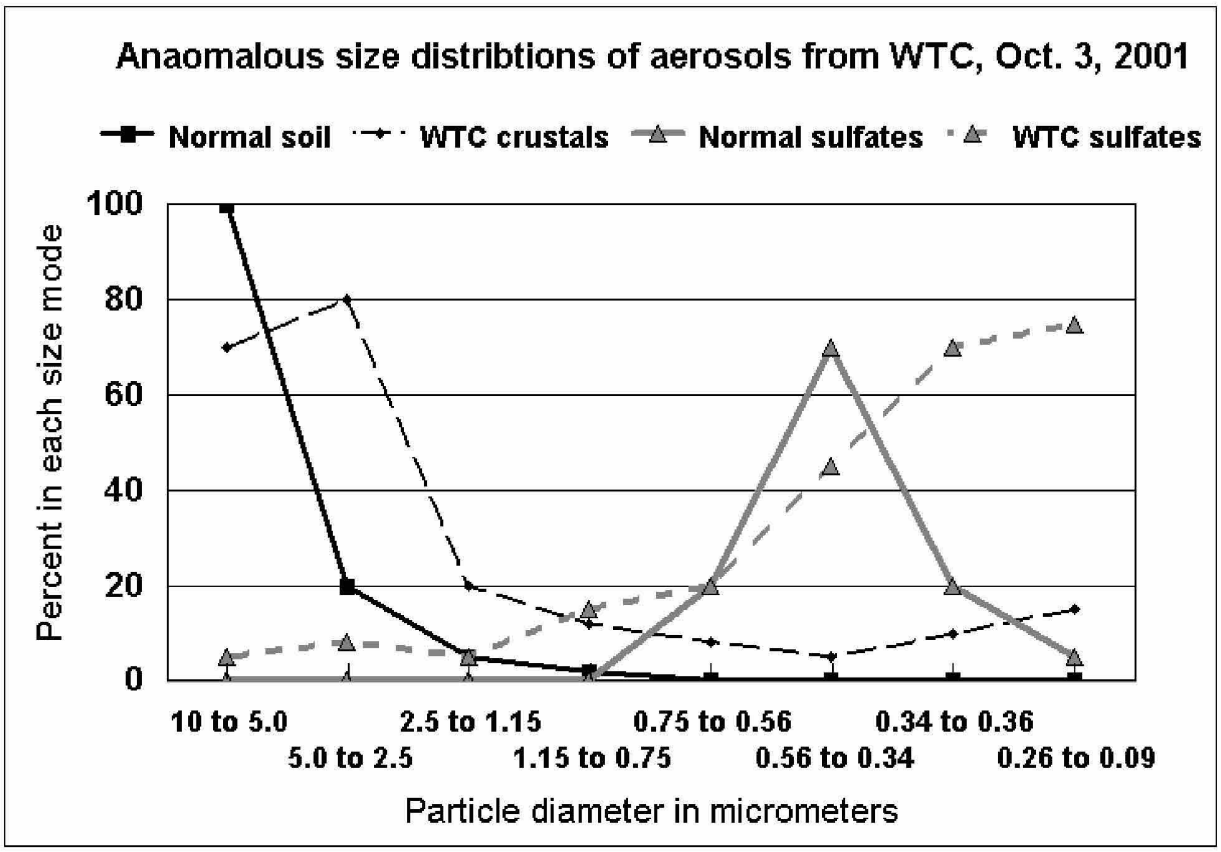

Figure 8-5. Anomalous size distribution of World Trade Center aerosols. The unusual aerosols from 2.5 μm to 0.75 μm were as caustic as Drano, burning throat and bronchial membranes.

Things began to unravel for the Bush Administration just before the September, 2003 meeting of the American Chemical Society in New York. The year before, at a national American Association for Aerosol Research meeting in North Carolina, I was taken aside by two investigators from the Office of EPA Inspector General Nikki Tinsley. She was about to issue an extensive report showing how the press releases of Christie Whitman, including cautions on health impacts, had been truncated by the White House before release. This was especially true for an EPA release in September that "… air was safe to breathe and the water safe to drink." But the next phrase was deleted by the White House. My paraphrase: "However, our measurements raise concerns for working on the (collapse) pile and people coming back to work closer than Water Street." This White House emasculation of Christie Whitman's statement was widely

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reported, and probably helps explain the White House sensitivity to what came next, with me as the target, since my work was cited more than 10 times in her report.

She had compared the press releases that EPA Administrator Christy Whitman wrote with statements that the White House finally released, and found key phrases of concern had been deleted and other false comfort inserted. Tinsley released her report in August 2003, just a month before a major American Chemical Society (ACS) meeting in New York City that included a major session on WTC results. The ACS decided to hold its own news conference, and selected me and one other colleague to present our work, first on the dust cloud that spread immediately upon the collapse of the buildings, then my work on the plume from burning debris that continued to smolder throughout the days and weeks following the collapse. This announcement generated extensive news coverage.

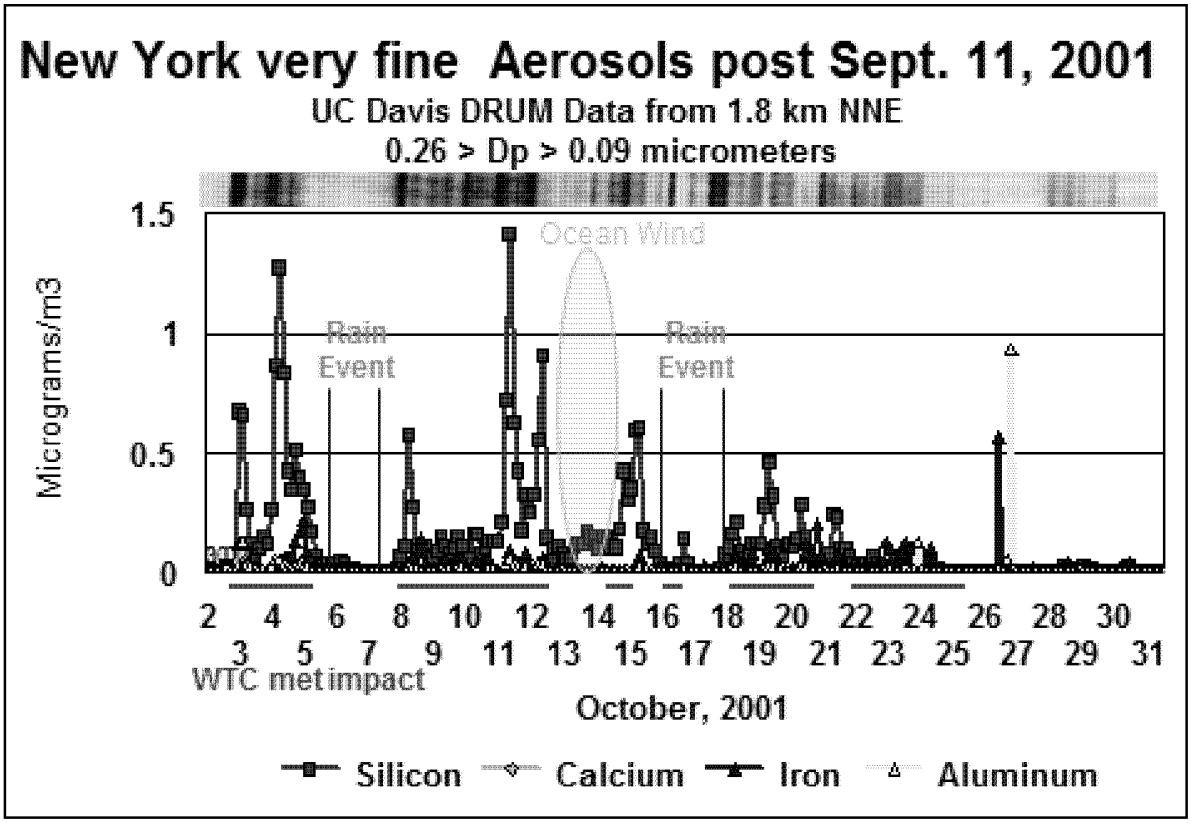

Figure 8-6. Assessment of very fine dust at the World Trade Center site.

With Sylvia's help we prepared a news release:

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Trade Center debris pile was a chemical factory, says new study

The fuming World Trade Center debris pile was a chemical factory that exhaled toxins in a particularly dangerous form that could penetrate deep into the lungs of rescue workers and local residents, says a new study by UC Davis air-quality experts.

The new work helps explain the unusual pollutants and extraordinarily high concentrations found by an earlier UC Davis study, the first to identify very fine metallic aerosols in unprecedented amounts from Ground Zero. It will be essential to understanding the growing record of health problems.

The conditions would have been "brutal" for people working at Ground Zero without respirators and slightly less so for those working or living in adjacent buildings, said the study's lead author, Thomas Cahill, a UC Davis professor emeritus of physics and atmospheric science and research professor in engineering.

"Now that we have a model of how the debris pile worked, it gives us a much better idea of what the people working on and near the pile were actually breathing," Cahill said. "Our first report was based on particles that we collected one mile away. This report gives a reasonable estimate of what type of pollutants were actually present at Ground Zero.

"The debris pile acted like a chemical factory. It cooked together the components of the buildings and their contents, including enormous numbers of computers, and gave off gases of toxic metals, acids and organics for at least six weeks."

Two days later, two of my secret sources independently informed me that a copy of my press release from my ACS presentation had arrived on George Bush's desk, with a yellow sticky note saying, "Look what UC is doing to us." Both of my sources agreed that "Bush had a cow" and told the Secretary of Energy to respond appropriately.

So the next Monday, after I had returned to Davis, I was called to a meeting with the vice chancellor of research and the dean of engineering, the organization that administered most of my grants. I was truly expecting praise, but instead got a scolding. The director of the Lawrence Livermore National Laboratory (LLNL), which at that time operated under the management of the University of California, had:

a) terminated all of the grants of my research group (LLNL previously had given us $16K for work at the World Trade Center);

b) cut my access to my colleagues at Livermore (permanently lost);

c) My New York colleagues who worked for DOE was suddenly retired, and

d) the building we had used was barred from further studies.

When I got back, Livermore asked UC Davis administrators to order me to pen an apology because I had not first sent my press release for review at Livermore and for using data that Livermore had not approved for release.

I was stunned, but responded first by showing the vice chancellor the peer-reviewed and published article in the journal *Aerosol Science and Technology* (*AS&T*) giving Livermore credit for the data and grant, and second by pointing out that because the data was public, we and Livermore personnel could report and apply the data as we wished. I did at least write an explanation, but I was pissed and lost all respect for him. Two weeks later, I received through a roundabout route a note from the director of the Livermore lab indicating that "he really liked the work."

In addition,

a) The EPA had contracted with a famous old New York university to refute my data, (note: their report was never released. My data is in the peer reviewed literature),

Happily, none of the White House pressure reached the National Science Foundation, which was funding both the large Aerosol Characterization Experiment-Asia (ACE Asia) program and the new program to measure aerosols on the Greenland ice cap (see Chapter 20, Global climate change).

My data drew criticism because it was so unlike anything anyone had ever seen before, especially anomalous levels of vanadium, silicon and other materials in very fine size modes that would lead deep into the lung. I gained some insight from my old buddy, Professor Ian Kennedy of the UC Davis Department of Engineering, an expert in ultra-fine metals. He told me that this was similar to situations seen in the late 1980s hospital incinerator probes in which metals that

should not be seen at the temperature of combustion were present, and tied to chlorine in the waste.

A search of scientific literature led me to exactly what I needed. I made a model, and every toxic element I expected to see, based on the chlorine, was there, in the right ratios, and every element my model said should not be there was absent. The article I wrote, one of my best, (Cahill et al, 2005), laid that question about the products of high-temperature combustion to rest.

Lawyers representing first responders contacted me, and I agreed to help them establish a fund to cover the detrimental health effects I had predicted. As the health effects began to show up, we gained traction. It took a while, and cost me three days of time for discovery of all my files at UC Davis by the opposition lawyers, but we won a massive settlement in favor of the first responders.

When *New York Daily News* investigative reporter Juan Gonzalez published his 2004 book "Fallout: The Environmental Consequences of the World Trade Center Collapse", he cited me as one of three "environmental heroes," along with Cate Jenkins – my EPA "leak" source protected by her whistleblower status. I was just lucky to have the ability to respond quickly and effectively following discovery of the air quality data. Any of my colleagues and all U.S. EPA scientists would have done the same given the opportunity. In fact, many EPA scientists snuck up to New York from North Carolina and also made measurements despite the ban.

In response to a massive lobbying effort by the first responders and John Stewart, in December 2015, Congress indefinitely extended the fund for which we had fought. This is terribly important because the rate of heart attacks from ischemic heart disease will soon begin to rise among WTC first responders and demolition workers. While indefinite extension of the fund is great news, attaining that authorization should not have been so hard. After all, if the City of New York, the federal OSHA safety people, and the U.S. EPA had done their jobs and followed laws and regulations, these thousands of people would not be sick today.

At the conclusion of the 10-day rescue phase to find and rescue trapped people, when survivors were no longer being found, the rescue workers should have been ordered to back away. At that point, the fire department should have deployed personnel wearing full-face canister respirators, and the operation should have shifted to concentration on extinguishing the fires before attempting cleanup. I cringed when I saw firemen with useless paper masks raking

debris in search of firemen's badges. California firefighters returned from the WTC site suffering from pneumonia because the caustic fine dust had burned their sensitive nose and throat membranes.

The story does not end here. As the health effects I had predicted started to appear, Eric Gillin, a reporter for *Esquire* magazine, became nervous. He had been standing close to the WTC south tower when it collapsed, and saved the backpack he had been carrying at the time. He had sealed the dust-covered backpack in a plastic bag, which he had been keeping in a closet for five years. He asked if I could I learn something from analyzing the particles on the bag. Recall that we had no aerosol data from the monster collapse clouds.

So I agreed to help, and designed an instrument to gently vacuum dust off fabrics at about the same wind velocity at which they had been deposited. Gillin came out to Davis, camera crew in tow, and we did the work. The bag's contents included a book, some papers, a transit schedule, and the debris-caked shirt he had been wearing that day as he had been enveloped in the furiously virulent cloud of dark grit that cloaked lower Manhattan.

When we called Gillin after completing our analysis of the results, he was really nervous, but then we told him most of the collapse dust that had coated him and his bag was harmless gypsum from the drywall used in the center walls of the WTC. His relief was palpable.

Gillin's resultant article, titled "The Bag," was published in the April 2007 issue of *Esquire*. It begins on page 133, immediately following a photo of Hilary Swank's feet. I recommend you read the article yourself – it is an accurate representation and well written. Upon my request, *Esquire* published an accompanying sidebar article on the smolder fumes, showing how toxic they were. Good work on all sides.

Amazingly, the story still does not end there. About a month after publication of the *Esquire* article, I received a furious and insulting phone call from someone asking who had paid me off to cover up the WTC conspiracy. Without realizing it, my data showed that there was no trace of thermite (or thermate) in the south tower collapse, driving a garlic-coated stake through the center of their ridiculous hypothesis. I still received nasty emails with similar accusations about twice a month. But I also get praise from my physics colleagues at meetings for sticking my neck out when the EPA-White house cover-up of the dangers the dust posed to workers was in full play.

References

The best summary:

Gonzales, Juan, **Fallout**, The New Press, New York (2002)

The best read:

Gillin, Eric **The Bag**, Esquire magazine, April 2007

And then for the masochists….

Cahill, Thomas A., Steven S. Cliff, Kevin D. Perry, Michael Jimenez-Cruz, Graham Bench, Patrick Grant, Dawn Ueda, James F. Shackelford, Michael Dunlap, Michael Meier, Peter B. Kelly, Sarah Riddle, Jodye Selco, and Robert Leifer**.** 2004. **"Analysis of Aerosols From the World Trade Center Collapse Site, New York, October 2 to October 30, 2001**." *Aerosol Science and Technology* 38: 165–183. doi: 10.1080/02786820490250836.

- Cahill, T.A., S.S. Cliff, J.F. Shackelford, M.L. Meier, M.R. Dunlap, K.D. Perry, G.S. Bench, and R.Z. Leifer. 2005. "**Very Fine Aerosols from the World Trade Center Collapse Piles: Anaerobic Incineration?**" *American Chemical Society Symposium Series,* 919: 152–163. doi:10.1021/bk-2006-0919.ch009.

Tales from the Field: Our essential volunteers

This is a good time to celebrate the volunteer experts that again and again have set me on the right path. I have learned to stop and listen to those people living within the problem. In the last chapter, we talked about Arden Middle School right downwind from the Watt Avenue stop lights. The Principal asked us to measure because of her concerns and being fully aware of how a bad result could harm her school's reputation. . We did it as a favor to her, not expecting much. Well, she was right, I was wrong, and the Watt data at Arden Middle School helped unlock the mystery of the excess heart attacked deaths all over California. Later in Chapter 14, we will meet a rancher near Moneo Lake who was worried enough about the dust that he volunteered his ranch as a location for our (unauthorized) air sampler. I can think of cores of other examples, including right now a high school in China where students are collecting samples for us. Now we always go to the site, sit down with locals over coffee or a beer, and listen.

Section C

Mitigation – Yes, You Can Do Better

The threats outlined in the Chapters 7 and 8, diesel carcinogens and ultra-fine metals, impact the population as a whole most severely for people who live near heavily traveled roadways. In Chapter 9, we address how you can evaluate the degree to which you are at risk from local roadways, and Chapter 10 starts the discussion of how you can make your indoor are essentially free from these threats. Detailed instructions of how to build an inexpensive but highly effective indoor air filtration system are given step by step in Appendix B.

Chapter 9

Outdoor Air Quality – My Way or the Highway

Living with heavily trafficked roadways

Introduction

My students and I had done very detailed study of pollution from Los Angeles freeways, data that caused Ronald Reagan's Air Resources Board to try to shut me down. (Chapter 11) But with the election of Jerry Brown 1.0 as California's governor in 1976, pretty much everybody thought that our troubles were over. Abundant data showed that only with the catalytic converter on cars could Los Angeles lower its appalling ozone impacts, which also required the removal of lead from gasoline. I also helped remove the sulfur from gasoline. California was the only state that could set standards more stringent than those of the U.S. EPA because California had initiated pollution control measures 20 years before the federal Clean Air Act was written. The stunning success that these anti-pollution measures caused many of us to assume that our problems were over, and we left for other tasks.

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http://www.tandfonline.com/loi/uast20

Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 1: 2003-2007

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Available online: 04 Jul 2011

To cite this article: Thomas A. Cahill, David E. Barnes, Nicholas J. Spada, Jonathan A. Lawton & Thomas M. Cahill (2011): Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 1: 2003-2007, Aerosol Science and Technology, 45:9, 1123-1134

To link to this article: http://dx.doi.org/10.1080/02786826.2011.582194

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Aerosol Science and Technology, 45:1123–1134, 2011
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ISSN: 0278-6826 print / 1521-7388 online
DOI: 10.1080/02786826.2011.582194

Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 1: 2003–2007

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The enhancement of mortality associated with cardiovascular and specifically ischemic heart disease (IHD) has been observed in the southern California Central Valley since at least 1990, and it continues to be a major source of mortality. While there is a strong statistical association of IHD with wintertime $PM_{2.5}$ mass, the causal agents are uncertain. Medical studies identify some potential causal agents, such as very fine and ultrafine metals, but they have not been fully characterized in most Central Valley regions. To provide improved information on specific and potentially causal agents, a five site aerosol sampling transect was conducted from Redding to Bakersfield during a 17-day period of strong stagnation, January 5–22, 2009. Mass and elemental components were measured every 3 h in eight particle size modes, ranging from 10 to 0.09 μm, while the ultrafine particles (<0.09 μm) were collected on Teflon filters. Ancillary studies were performed including direct upwind–downwind profiles across a heavily traveled secondary street near a stoplight. Very fine and ultrafine iron, nickel, copper, and zinc were identified as vehicular, with the most probable sources being brake drums and pads and the lubrication oil additive zinc thiophosphate. High correlations, many with $r^2 >$ 0.9, were found between these vehicular metals and IHD mortality, enhanced by the meteorology, terrain, and traffic patterns of the southern Central Valley. The braking systems of cars and trucks must now be considered along with direct exhaust emissions in estimating the health impacts from traffic.

Received 7 August 2010; accepted 27 November 2010.

The authors first wish to gratefully acknowledge the support of the Resources Legacy Fund of Sacramento, California, for encouragement and financial support for this study.

The staff of all of the Air Resources Board (ARB) sampling sites were key to successful execution of the project.

The authors also wish to gratefully acknowledge the financial support of the Sacramento Metropolitan Air Quality Management District under its CEO, Larry Greene.

The authors wish to acknowledge the input and oversight of the Health Effects Task Force (HETF) of Breathe California of Sacramento-Emigrant under Jananne Sharpless, Chair; Betty Turner, consultant to the HETF, and especially members Ralph Propper and Earl Withycombe. Helpful suggestions and review were provided by William Wilson, US Environmental Protection Agency (EPA).

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[Supplementary materials are available for this article. Go to the publisher's online edition of *Aerosol Science and Technology* to view the free supplementary files.]

INTRODUCTION

The task of determining the causal factors that lie behind the statistically sound association of mortality with aerosols continues to labor under severe difficulties. Reliance on Federal Reference Method (FRM) methodologies, even if enhanced by periodic compositional analysis, does not provide enough information to allow health research scientists to identify causal factors (Lippmann 2009). Intensive research studies, which can provide such data, are so expensive as to limit their scope in space and time and thus pose problems with statistical significance. An alternative is to identify regions with persistent and specific health impacts of suspected aerosol origins and then augment monitoring data and special studies to provide a suite of data from which causal factors may be identified. However, other factors such as meteorology, land use, and socioeconomic factors can often weaken the significance (Pope et al. 1995). The California Central Valley, however, is a region of such homogeneity that such efforts there might be fruitful.

The southern part of the California Central Valley, the San Joaquin Valley, is the largest contiguous area of the United Sates in serious violation of both ozone (summer) and $PM_{2.5}$ (winter) ambient air quality standards. While the summer ozone levels are relatively uniform over the Central Valley, the winter PM_{10} and $PM_{2.5}$ concentrations vary strongly, from low in the northern Sacramento Valley to high in the southern San Joaquin Valley. During individual winter stagnation episodes, the south to north

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(Bakersfield to Redding) mass ratio is up to a factor of 8 for PM_{10}, and a factor of 5 for $PM_{2.5}$.

In addition to improving monitoring data, a series of extensive research studies by and through the California Air Resources Board (ARB), such as California Regional Particulate Air Quality Study (CRPAQS 2001), Central Coast Ozone Study (CCOS), and Fresno Asthmatic Children's Environment Study (FACES), were initiated in 1999 through 2001 that greatly added to our knowledge of San Joaquin Valley aerosols. However, most field data were taken before the current understanding of aerosols and cardiovascular impacts was achieved (Devlin 2003, Lippmann 2009) and thus lack some critical measurements, especially ultrafine metals (Chow et al. 2006, 2007, 2008; Chen et al. 2007; Kleeman et al. 2009). One of the major results of these studies is an understanding that most of the $PM_{2.5}$ mass in the winter in the San Joaquin Valley is ammonium nitrate and wood smoke, neither of which are a known cardiovascular threat.

The mortality data in the entire Central Valley are relatively uniform for three of the four major causes of mortality, pulmonary disease, stroke, and cancer, but the 4th and most important, heart attacks from all causes, is higher by about 20% in the central and extreme southern California Central Valley [California Department of Health Services (CA DHS) 2010] and especially in Bakersfield. For one specific and major component of heart disease, ischemic heart disease (IHD), the incidence rises to about 35% (CA DHS 2010). In this research, we have measured some of the components of aerosols found by recent health studies most likely to be causal factors in this statistically strong association to cardiovascular disease, namely very fine and ultrafine metals, and size and compositionally-resolved organics (Cahill 2010), over the entire Central Valley, with the goal to enhance data from the earlier studies and provide additional material for future epidemiological analyses.

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EXPERIMENTAL METHODS

Study Region Geography and Climatology

The Central Valley of California (Figure 1) has remarkable uniformity in terrain and meteorology. It is one of the richest agricultural areas in the world, with two major metropolitan areas, the Sacramento–Stockton and Fresno, with smaller cities of a few 100,000 to small towns spread throughout the Valley. The Valley is a major transportation corridor for road and rail traffic but generally lacks strong industrial sources. There are active areas of oil extraction near and north of Bakersfield. The Central Valley offers an ideal situation to examine the effects of pollutants on health since many potential confounding factors, such as meteorology, land use patterns, socio-economic factors, and cigarette smoking, are very similar throughout the Valley (Cahill et al. 1998; note that the values in that report are slightly different in the present report since we have now available CORE Report #2 (1996), while the original report used CORE Report #1 (1994)).



FIG. 1. Map of the Central Valley of California. The northern part is referred to as the Sacramento Valley while the southern part is called the San Joaquin Valley. The areas within the dotted circumference vary in altitude from almost sea level in the Delta to a few hundred feet in elevation. The small arrows denote the typical winter wind patterns (Hayes et al. 1984). The cities marked were used in this study.

In summer, high temperatures in the Valley (mean daily high, July, 36°C ± 1°C) lower the surface pressure and draw massive inputs of marine air into the Valley from the San Francisco Bay, bringing with it oceanic aerosols and typical urban pollutants enhanced by the major petrochemical industrial sites at the Carquinez Strait, between Sacramento and San Francisco. These winds often funnel south down the entire San Joaquin Valley, south of the strait, but less often funnel north up the entire Sacramento Valley, north of the strait. Rainfall in the Valley is rare during the period from May through October (Hayes et al. 1984).

In winter, the Central Valley air basin tends to become stagnant due to its flat valley floor and circumferential mountains, except at the Straits (Figure 1). There is slow drainage of cold air from the Sierra Nevada Mountains each night to the Valley floor (mean daily low, January, 3°C ± 1°C). The air drains slowly, at the rate of about 50 km/day, from both the northern and southern ends of the valley towards the lowest point, the Sacramento–San Joaquin Delta, southwest of Sacramento and directly east of the Carquinez Strait. This pattern results in persistent stagnation episodes that are periodically interrupted by synoptic storms.

Typical Pollution Patterns

The annual pattern of $PM_{2.5}$ mass reflects the effects of the winter stagnation, with elevated levels from about November through February (Figure 2). All valley sites have similar annual

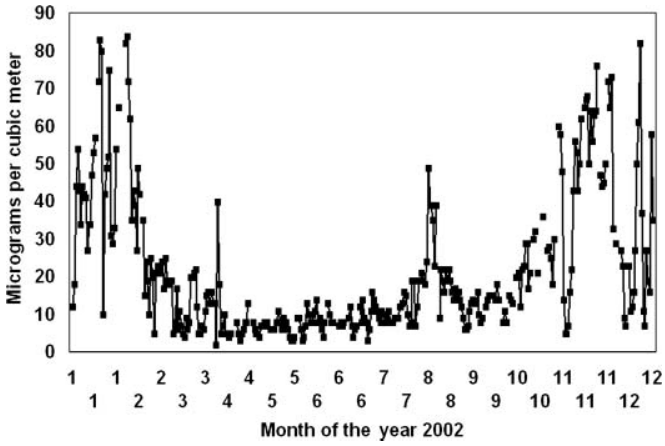

FIG. 2. Annual pattern of $PM_{2.5}$ mass as seen at Fresno.

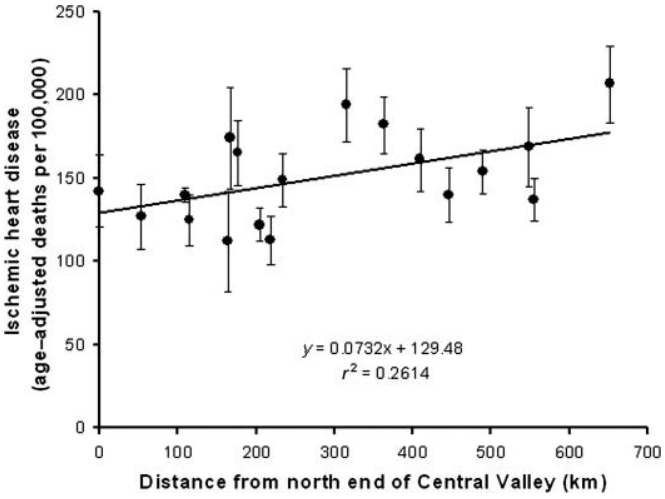

FIG. 3. IHD in the Central Valley of California, 2003–2007. Distances span from Redding in the north (0 km) through Chico (170 km), Sacramento (220 km), Fresno (400 km) to Bakersfield (680 km).

patterns, high in winter and low in summer. The $PM_{2.5}$ peak seen in August was from a forest fire in Oregon. While the southern reaches of the Central Valley have serious violations of federal and state mass standards (ADAM 2010), other parts of the valley that share agriculturally based land uses and meteorology do not exhibit serious violations of these standards. For PM_{10} mass, the ratio from Bakersfield in the south to Redding in the north can be as high as a factor of 9 in winter stagnation events, while for $PM_{2.5}$, the ratio can be as high as a factor of 5 (ADAM 2010). The pattern of winter air movement makes the high aerosol mass levels at Bakersfield difficult to explain, since the nighttime airflow into Bakersfield is from the mountains to the south, southeast, and east of the city. There is essentially no influence from the Los Angeles basin due to the blocking mountains. The air at Bakersfield then flows slowly north towards Fresno, which has generally lower $PM_{2.5}$ mass levels despite greater population and industry.

Epidemiological Data

Greatly improved data on mortality and morbidity became available circa 2001 from the California Department of Health Services (CA DHS 2010), which allow detailed analyses of death by hundreds of cause on an annual basis. These data show a persistent enhancement, 2003–2007, of IHD mortality of roughly 50% in the central region and at Bakersfield, at the extreme southern edge of the San Joaquin Valley, as compared with the northern valley (Figure 3).

Aerosol Sampling Methods

Aerosol samples were collected along a transect in the Central Valley to investigate the causal factors behind the increased mortality due to IHD in the Central Valley of California. Since routine air quality measurements were available in this region, we collected and analyzed aerosols not routinely measured by existing monitoring programs that were known or suspected to be causal factors in cardiovascular disease. Further, we selected a period of stagnation that maximizes winter particulate mass concentrations, avoiding the synoptic fronts and rain that periodically clean out the valley in winter. Using meteorological predictions, we simultaneously sampled continuously by size, time, and composition for 17 days starting on Jan 5, 2009, at five sites from the extreme north, Redding, to the extreme south, Bakersfield.

Rotating drum impactors (DELTA Group 8 DRUMs; Cahill et al. 1985; Raabe et al. 1988) were used at all sites to provide continuous samples capable of 3-h data in eight impaction size modes from 10 to 0.09 μm diameter plus an integrating Teflon after filter. The impaction samples were collected onto Apiezon-L greased Mylar stages (Wesolowski et al. 1977). Analyses were made for mass and elements from aluminum to molybdenum plus lead by synchrotron-induced x-ray fluorescence (Bench et al. 2002). The quality assurance validations, including a year-long inter-method comparison to ARB's FRM particular samplers, are summarized in the supplemental information. For the ARB side-by-side over the entire year, agreement for $PM_{2.5}$ mass was better than $\pm$10%, DRUM versus FRM, with the winter agreement much better than that, a few percent, probably because of higher winter mass values. Note that 49 individual mass values from a DRUM with 3-h time resolution and 6 sub-2.5-μm size cuts plus a $<$0.09 μm after-filter were required to match a single 24-h $PM_{2.5}$ mass value.

Aerosols destined for organic analyses were likewise collected with DRUM samplers at the same time and locations as the elemental samplers. However, the organic samples were analyzed averaging over the entire 17-day study, and the aerosols were collected onto fired aluminum substrates (Cahill 2010).

The study included three components, all conducted in winter conditions and using the same equipment, including integrating ultrafine Teflon filters: (1) an initial year-long study of the DRUM sampler side-by-side with the ARB's FRM at the

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Sacramento test site at 13th and T Street to establish equivalency of the sampling and analysis (Cahill and Barnes 2009), (2) a simultaneous transect across a heavily traveled secondary street to identify very fine and ultrafine aerosols from roadways, and (3) the main transect study in winter, 2009. Summaries of these studies are included in supplemental information.

For the transect study, samples were collected at five existing ARB and district monitoring sites covering the entire Central Valley (Figure 1):

Redding (roof of Health Department),
Chico (ARB Manzanita Avenue site),
Sacramento (ARB 13th and T Street site),
Fresno (ARB First Street site), and
Bakersfield (ARB California Street site).

Paired UC Davis DELTA Group 8 DRUM samplers were used at all sites except Sacramento, which had to use a PM 2.5 3 DRUM for lack of equipment. One 8 DRUM was used at each site for mass and elements (3-h time resolution), sampling onto lightly greased Mylar, and the other for organic matter (17-day average), sampling onto fired aluminum foils. All included identical Teflon ultrafine filters that integrated the entire 17-day period. The parameters measured at all sites include but are not limited to

1. time-averaged ultrafine particulate elemental composition, Al to Mo, plus lead, and mass, $0.09 > D_p > 0.0$ μm aerodynamic diameter,
2. time-dependent (3 h) mass and elements (see above) for the eight particle sizes 10.0–5.0, 2.5, 1.15, 0.75, 0.56, 0.34, 0.26–0.09 μm aerodynamic diameter,
3. time-averaged organic matter by size, 10.0–5.0, 2.5, 1.15, 0.75, 0.56, 0.34, 0.26–0.09 and <0.09 μm diameter, including polycyclic aromatic hydrocarbons (PAHs), sugars (including levoglucosan), fatty acids, and *n*-alkanes have been published (Cahill 2010).

RESULTS

Meteorology

After the sites were selected, deployment was delayed until weather predictions indicated at least a 10-day period of low winds and stagnation, conditions that produce the highest $PM_{2.5}$ mass. The prediction was accurate and the meteorology was favorable and allowed us to extend the study to a 17-day period characterized by high mass values and persistent hazes (Table 1).

Aerosol Mass Values

PM_{10} mass values were available at all sites on January 19, while all sites except Redding had daily $PM_{2.5}$ mass values collected by the ARB and local agencies (ADAM 2010). The $PM_{2.5}$ values were averaged over the entire 17-day study period

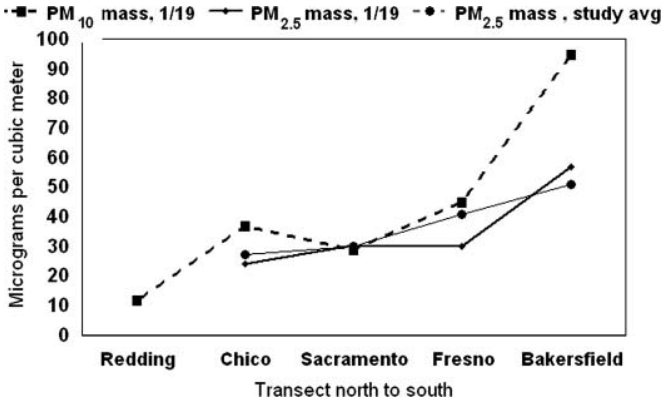

FIG. 4. $PM_{2.5}$ mass values were available every day, but only January 19th had PM_{10} mass at all valley sites. The high PM_{10} to $PM_{2.5}$ ratio on January 19 is unusual and unexplained.

and were typical of prior winter stagnation events (Table 2 and Figure 4). Looking in more detail, we can see that the north to south increase in average $PM_{2.5}$ mass is driven not as much by the increase in mass on a given day but the number of days that saw the high mass values.

Aerosol monitoring by state and local agencies with compositional data for $PM_{2.5}$ aerosols was only available at the Fresno site via the IMPROVE sampler (Malm et al. 1994). The evolution of the aerosol event is shown in Figure 6, showing that the study period would represent a winter day in violation of the $PM_{2.5}$ mass standard. The important role ammonium nitrate plays during these aerosol episodes is clearly indicated.

Size-Resolved Mass and Inorganic Aerosols

For the period from January 5 through 22, over 6400 measurements were made of mass and inorganic elements in nine size modes, measured every 3 h except for the integrating ultrafine filters. In addition, a simultaneous study (Cahill 2010) measured organic aerosols in four classes (alkanes, PAHs,

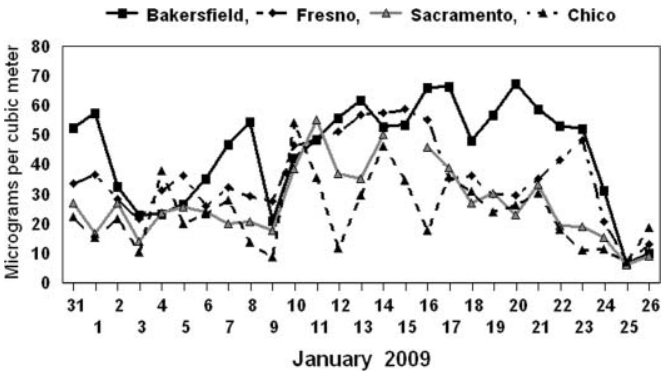

FIG. 5. $PM_{2.5}$ mass values before, during, and after the study period of January 5–22, 2009.

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TABLE 1
Summary of meteorological parameters during sample collection period of January 5–22, 2009. The values reported are the average over the entire aerosol sampling period except for rainfall, which includes the rain on the days of setup and take down, January 5 and 22

Parameter	Redding	Chico	Sacramento	Fresno	Bakersfield
Average temperature (°C)	11.3	9.6	9.0	9.4	10.6
Average high (°C)	19.3	15.5	16.1	15.4	16.5
Average low (°C)	3.0	3.7	1.7	3.2	4.4
Relative humidity (%)	56.4	71.6	73.4	71.8	66.4
Average wind speed (m/s)	1.92	1.27	0.47	0.62	1.17
Rain (cm)	1.2	2.2	2.5	1.2	0.1
Number of rain events	4	3	3	2	2
Number of fog events	0	2	11	2	2
Average visibility (km)	14.6	12.3	7.1	6.9	6.6

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sugars, and organic acids) in nine size modes at all sites. In this article, we focus on those particles that have the best support from the health literature as having the potential for causing or exacerbating IHD. Thus, we focus on only those insoluble particles in the very fine (0.26–0.09 μm) and ultrafine (<0.09 μm) modes that are able to penetrate deeply into the lung and pass into the cardiovascular system. However, before we focus on these particles, we need to examine the overall aerosol behavior important to eventually isolate the sources of these particles.

Using the well-studied Fresno site, we can see that the size distribution roughly matches expectations with a few differences (Figure 7). In Figure 7, three points stand out. First, the DRUM sampler with its coated substrates operated well, with negligible soil mass penetrating into the accumulation mode as shown by the calcium results. Second, there is a distinct deviation in the size profile of iron, which shows an enhancement in the 1.15–2.5 μm size mode not seen in other soil elements. Third, potassium becomes enhanced in the finest modes, clearly from non-soil sources. It is also much finer in size than typical wood smoke, which almost always peaks in the 0.34–0.75 μm mode.

Examining the non-soil iron anomaly (Figure 8), the size and 3-h time data show enhancement in the 2.5–1.15 μm mode each night not seen in other soil elements and not seen at any other valley site. The very fine iron often tracks the fine iron, but sharp deviations occur, indicating complex source behavior. Bakersfield lacks time information due to a system failure, and thus its behavior in time is unknown.

Further insight on zinc in Fresno can be obtained by examining zinc over most of a year (Cahill et al. 2003). The persistent presence of very fine zinc occurs throughout the entire year and becomes dominant in wintertime, closely associated with other vehicular aerosols. The zinc to very fine mass ratio was close to that seen in laboratory diesel tests (Zielinska et al. 2003).

Data on Very Fine and Ultrafine Aerosols

Very fine aerosols were collected on DRUM stage 8, 0.26 to 0.09 μm, and integrated over the 17-day study period to match the integrating ultrafine filters. Ultrafine aerosols were collected on the same 47-mm Teflon filters as the organic samples and averaged over the same 17-day period. The filters were analyzed by scans of S-XRF every 0.5 mm across the filter diameter. All filters were uniform except for Chico, which had contamination on one edge. This was easily avoided by modifying the averaging program. Two different averages were generated: one by summing the spectra, then analyzing and the other by averaging the typical eighteen individual elemental results.

In Table 3a, we show a summary time averaged DRUM very fine data and, in Table 3b, the integrated ultrafine filter data for the study period.

TABLE 2
Mass values for PM_{10} on January 19 and $PM_{2.5}$ averaged from January 5 though January 22, 2009. The value of ~9 for $PM_{2.5}$ is estimated assuming the same $PM_{10}/PM_{2.5}$ ratio as the other cities

Site	Redding	Chico	Sacramento	Fresno	Bakersfield
Size (μm)	PM_{10}	PM_{10}	PM_{10}	PM_{10}	PM_{10}
Mass (1/19) ($\mu g/m^3$)	12	37	29	46	95
Size (μm)	$PM_{2.5}$	$PM_{2.5}$	$PM_{2.5}$	$PM_{2.5}$	$PM_{2.5}$
Mass average ($\mu g/m^3$)	~9	27.3	30.2	40.9	51.0

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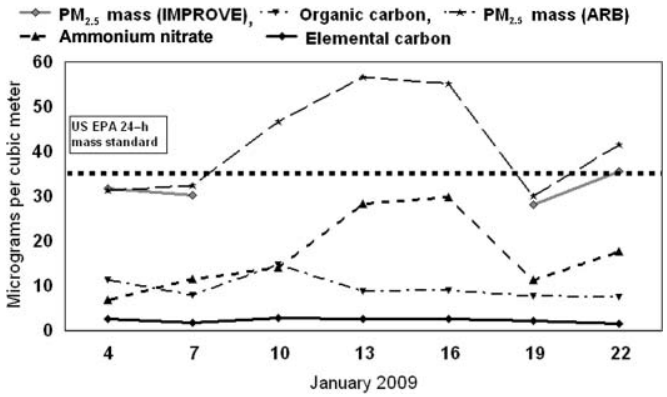

FIG. 6. IMPROVE and ARB $PM_{2.5}$ data at the Fresno site during the study. Note the dominance of ammonium nitrate in the mass maxima.

The values in bold represent vehicular sources identified in the next section of this article. The copper ultrafine values are suspect from contamination by copper containing filter holders. K_{non} is non-soil potassium, corrected by the Calcium content, and a standard IMPROVE tracer of wood smoke (Malm et al. 1994). MDL is minimum detectable limit. Uncertainties are nominally ±5%, and detailed quality assurance and uncertainties are in the supplemental information.

The correlations of sulfur (ammonium sulfate) and selenium are driven by the oil extraction and refining near Bakersfield (Figure 10). But there are strong associations between many metals and IHD in both the very fine and ultrafine modes. Although mass levels in the very fine and ultrafine modes are low, the concentration of metals was significant. Thus metals are a major contributor to particle numbers, many presumably in insoluble compounds. Examining spatial trends for very fine metals with known vehicular origins, we see at Bakersfield a clear north to south enhancement of many very fine metals that far exceeds the ×1.6 increase in $PM_{2.5}$ mass for the same period (Figure 9).

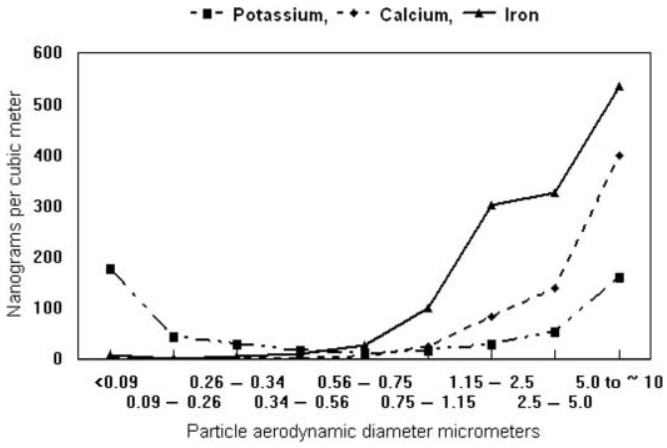

FIG. 7. Size distribution for Fresno aerosols.

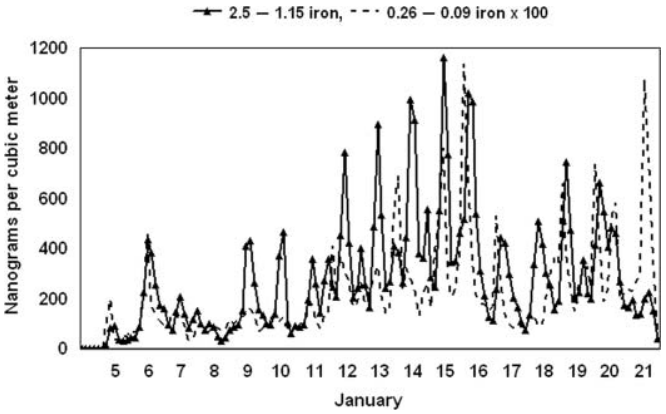

FIG. 8. Fine and very fine nonsoil iron at Fresno. Recall that the study began directly after a rainfall event and had almost no winds to stir up dust. Thus we propose that most of the iron is roadway and vehicle derived.

The upward trend of sulfur must be interpreted in accord with the meteorology, which moves air from Bakersfield towards the Delta. Typical elements associated with vehicles include nonsoil iron, phosphorus, zinc, nickel, and copper. From the ratio present in the zinc thiophosphate in lubricating oil, there are clearly additional zinc sources present at all sites except perhaps Bakersfield.

In summary, there are significant contributions of metals in the very fine and ultrafine mode, many of which rise to their highest levels at Bakersfield (Figures 11 and 12) and correlate strongly with the IHD mortality data.

DISCUSSION

Sources of the Metals

The generation of metals in the ultrafine mode requires high temperatures and/or pressures. Thus, many sources of metals from vehicles, such as zinc from tire wear, are not candidates for sources of ultrafine aerosols. Two potential sources are engines, and especially diesel engines because of the high temperatures and pressures involved, and the braking systems in vehicles.

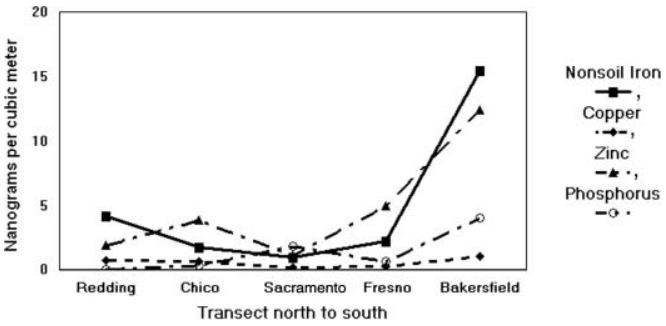

FIG. 9. Very fine transition metals with known vehicular sources, zinc and phosphorus from zinc thiophosphate in lubricating oil, iron, copper, and zinc potentially from braking systems.

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TABLE 3a
Aerosol mass data from the study and their correlation to IHD mortality. Uncertainties are nominally ±5%, and detailed quality assurance and uncertainties are in the supporting materials. Concentration (ng/m^3) of very fine (0.09 to 0.26 μm) aerosols

Site	Redding	Chico	Sacramento	Fresno	Bakersfield	Correlation r^2 to IHD
Ammonium sulfate	45	82	75	120	580	0.98
Chlorine	<0.4	2.5	1.8	0.7	2.6	0.22
Phosphorus	**<0.1**	**0.4**	**0.8**	**0.7**	**4.0**	**0.98**
Potassium (non-soil)	18.0	54.1	10.9	45	32.7	0.00
Vanadium	<0.1	0.03	0.04	0.2	<0.1	0.04
Chromium	<0.1	0.01	0.01	0.6	0.2	0.04
Iron (non-soil)	**2.2**	**1.8**	**1.0**	**2.3**	**15.5**	**0.95**
Nickel	**<0.03**	**0.03**	**0.07**	**0.05**	**0.16**	**0.95**
Copper	**0.7**	**0.6**	**0.16**	**0.27**	**1.1**	**0.47**
Zinc	**1.9**	**3.9**	**1.1**	**4.9**	**12.5**	**0.88**
Arsenic	0.15	0.2	0.07	0.54	1.07	0.87
Selenium	<0.1	<0.1	0.09	0.10	0.24	0.95
Bromine	0.5	0.7	1.3	1.1	4.2	0.98
Lead	0.1	0.4	0.4	0.55	2.0	0.97

While there is considerable information on the total particulate emissions from vehicles, the information on ultrafine metals from vehicular exhaust is limited (Kleeman et al. 2000; Zielinska et al. 2003, 2004). The Zielinska et al.'s (2003) study involved detailed analysis of diesel exhaust. As part of the study, we analyzed for 32 elements collected in 11 tests with a 14-stage nano-MOUDI (lowest stage 0.01 μm). Sulfur, phosphorus and the metals zinc, calcium, and, in one of the 11 tests, lead, all peaked generally in the 0.10–0.056 μm modes (Zielinska et al. 2003). In addition to elemental and organic carbon, the tracer elements were assigned to sources: sulfur was from the fuel (CA low sulfur), the zinc and phosphorus from the zinc thiophosphate stabilizer in the lubricating oil, and calcium from an antacid additive. No other transition metals were seen in statistically significant amounts.

A second potential source of very fine and ultrafine metals is the braking systems of cars and trucks, since high temperatures and/or pressures are involved in this process. The brake drums have evolved from the massive, heat-conductive structures and generally well cooled in the past and now are often made of "grey iron," roughly 90% iron with the admixture of a few percent carbon, plus copper, silicon, and other metals in

TABLE 3b
Concentration (ng/m^3) of ultrafine (<0.09 μm) aerosols

Site	Redding	Chico	Sacramento	Fresno	Bakersfield	Correlation r^2 to IHD
Ammonium sulfate	122	215	270	470	999	0.95
Chlorine	2.5	5.1	0.6	3.0	0.5	−0.38
Phosphorus	**1.3**	**0.6**	**4.0**	**3.3**	**10.5**	**0.96**
Potassium (non-soil)	40.7	138.1	76.9	176.1	70.9	−0.05
Vanadium	0.05	0.15	0.10	0.21	0.02	0.00
Chromium	0.13	0.04	0.75	0.28	0.32	0.03
Iron (non-soil)	**3.9**	**3.9**	**14.3**	**7.7**	**27.7**	**0.88**
Nickel	**0.9**	**0.1**	**0.6**	**0.3**	**1.6**	**0.70**
Copper	**na**	**na**	**na**	**na**	**na**	**na**
Zinc	**8.6**	**11.2**	**14.3**	**22.4**	**12.3**	**0.00**
Arsenic	0.41	0.64	1.1	2.6	1.5	0.12
Selenium	0.47	0.64	0.62	1.1	0.9	0.05
Bromine	11.2	12.4	13.7	25.3	18.9	0.16
Lead	1.7	2.2	2.5	3.6	2.6	0.06

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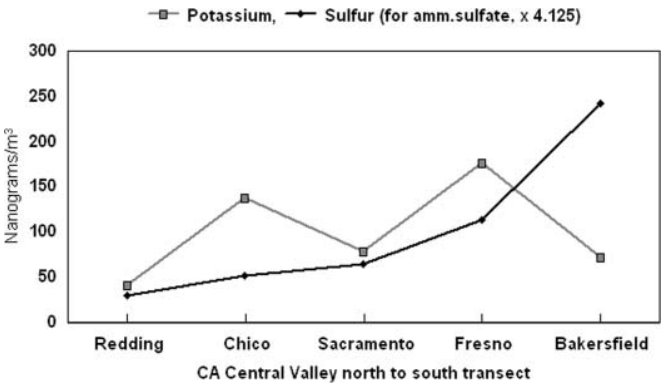

FIG. 10. Ultrafine potassium and sulfur.

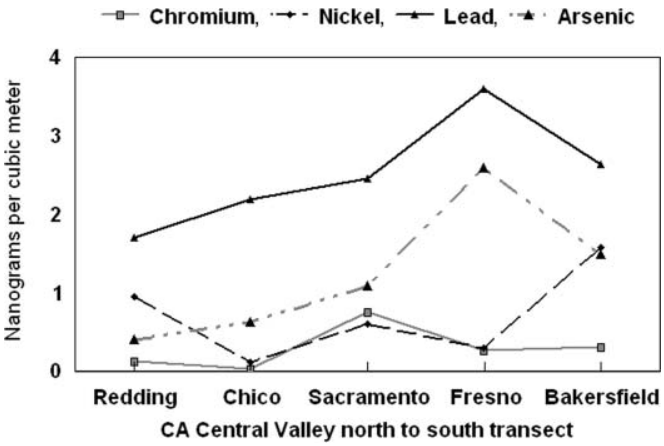

FIG. 12. Additional ultrafine elements.

smaller amounts, making them like brake pads an erodible surface. Brake pads are far more complex in composition and are traditionally designed to erode.

Limited information is available on a complete inventory of vehicular expendables. An early one was developed as a part of the extensive California freeway lead and particulate studies in the 1970s. In Cahill and Feeney (1973), the UC Davis vehicle fleet was studied for all forms of expendables, including fuel, oil, brake wear, exhaust train erosion, tires, etc., by directly measuring mass loss at replacement intervals. While many of the results are uncertain due to technological changes in the fuels and engines, measurements of brake drums and brake pads gave $\sim$5 and 108 gm, respectively, at a replacement cycle of 58,400 km, or $<$1 and 15 mg/km. However, these data were based on asbestos-containing brake pads and may not be reliable, which also impacts the US Environmental Protection Agency (EPA) PART5 model estimate of 20.6 mg/km, based on 1985 data. In terms of brake drums, changes in brake drums from iron to "grey iron" containing graphite could materially increase that source of particles from prior values. Even with the uncertainties, it is clear that brakes contribute a significant component of typical vehicle total emission rates. However, averages are misleading because braking is only used for limited times. Thus the emission rates at stoplights and especially extensive mountain

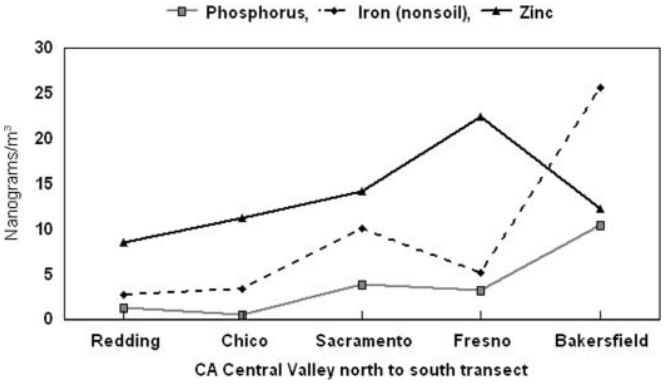

FIG. 11. Typical vehicular ultrafine metals.

down grades will be much higher than these values. It is worth noting that traditional dynamometer studies and roadside side studies near freeways are likely to miss brake wear as an emission source, thus these emissions may be largely unrecognized by the majority of vehicle emission and assessment studies.

Information on brake pad composition was reviewed by Kennedy et al. (2002) and Chan and Stachowiak (2004). The latter report, "A multitude of different brake pads have sprung onto the market in the post-asbestos brake pad revolution, each with their own unique composition," often proprietary. Brake pads comprise four subcomponents: (1) frictional additives, abrasives, and lubricants; (2) fillers; (3) a binder; and (4) reinforcing fibers for strength. The brake pads are described as metallic, semimetallic, with organic components, and organic. Asbestos to be used mainly as a reinforcing fiber in brake pads, and after its removal, a variety of materials have been used, including iron fibers. Some of them include potentially hazardous materials potassium titanate and sepiolite, a magnesium-silicon compound, both of which have potential health hazards. Organic aramaid fibers (e.g., Kelvar) and ceramics such as alumina and carbides are becoming more popular as prices decline. Fillers include a wide variety of organic (cashew hulls, old tires) and inorganic materials (barium sulfate is popular). The frictional components include graphite and metal sulfides including copper, antimony, tin, zirconium, and lead. Copper in particular has been identified as a problem in aquatic systems, and legislation to remove it from brake pads has been passed in the states of Washington and California.

While there is enormous variability in the data, as shown by the percentile distributions, the four main elements are iron, copper, zinc, and nickel (Table 4). In summary, there is a wide variety of very fine and ultrafine metals that may arise from brake drums and pads, but iron and copper are clearly two major components.

Information on ambient and near source very fine and ultrafine metals was derived from two additional studies in Sacramento. The first was a complete analysis of ultrafine ($<$0.09 μm)

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TABLE 4
Summary of concentrations of elements in New Zealand brake pads, from largest to smallest concentrations of transition metals plus heavier elements. The distributions are shown to emphasize with wide variability between manufacturers

Element (ppm)	10th percentile	Median	90th percentile
Iron	11,700	18,300	190,000
Copper	29	5000*	116,000
Zinc	127	1630	37,400
Nickel	44	342	652
Manganese	143	315	1088
Lead	6	50	949
Barium	558	3195	6144

*Preferred interim median for copper due to high variability. Barium (median = 3100 ppm) was not resolved in our data due to interferences.

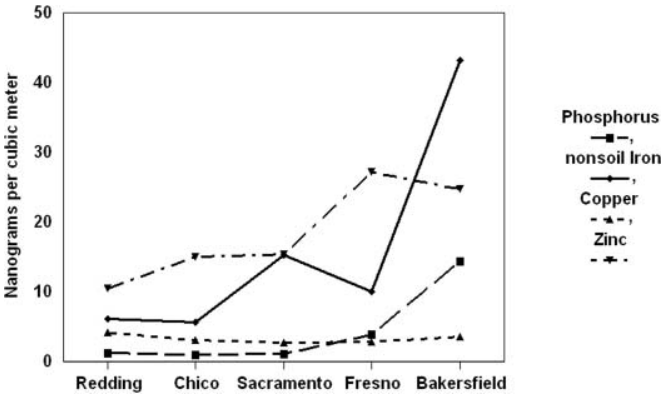

FIG. 13. Very fine plus ultrafine aerosols with known vehicular sources.

aerosols over a 2-week period, November–December, 2007, as part of an 8-month DRUM to FRM intercomparison with the California ARB in central Sacramento at the 13th and T Street ARB site (Cahill and Barnes 2009, supplementary materials), and the second was a 2007 study directly measuring aerosols across a heavily traveled (65,000 v/day, 1.5% diesels) secondary street in Sacramento, Watt Avenue (Cahill et al. 2007, supplementary materials).

One period in the Sacramento ARB intercomparison in November and December was chosen for mass closure through addition of surrogate organic measurements (Cahill et al. 1989; Malm et al. 1994). As anticipated, most of the ultrafine mass is organic (Table 5). Note also that the only nondetermined major species, nitrate, could not have been a major factor in Sacramento or the agreement would not have been as robust. Farther south in the San Joaquin Valley, nitrates are always a major factor. The presence of the fine transition metals in these quantities represents a very large number of particles. Note that the zinc value seen in Sacramento in 2007, 11.5 ng/m^3, is similar to the transect zinc value in 2009, 14 ng/m^3.

The second study was performed at Watt Avenue, the site of several studies on the impact of Watt Avenue on Arden Middle School (Cahill et al. 2007, supplementary materials). The Watt Avenue study utilized the same sampler as the ARB study, with two identical eight stage DRUM samplers with greased Mylar substrates and a 47-mm stretched Teflon after filter for the <0.09 μm ultrafine mode. The school sampler was 15 m downwind from the nearest traffic lane on the roof of the one story building and 50 m south of a stoplight on Arden Way that backed traffic up to and south of the Arden Middle School site. Thus considerable braking occurred directly upwind of the Arden Middle School sampler. The far upwind sampler was 500 m away in a residential neighborhood. Samples were collected continuously over 8 weeks in February and March, 2007. The results of these studies are shown in Table 5.

Through the direct upwind downwind measurements across Watt Avenue, the source of the metals seen in downtown Sacramento can also be shown to be largely derived from traffic sources despite the fact that the nearest freeway to the 13th and T Street site is over 1 km away.

Almost identical values of the same four elements are seen in Sacramento and especially in Bakersfield (Table 6 and Figure 13).

Since the ultrafine four elements, non-soil iron, nickel, copper, and zinc, and a few others, are traffic related, we can examine the mass levels in the Central Valley to see how the levels correspond to traffic. Since the wind flows downslope across Bakersfield from the south, where I-5 descends from the Grapevine and Hwy 58 descends from Tehachapi Pass, we used the sum of the cars plus 10 times the trucks, to roughly match to emission rates, and compared the ratio of traffic to $PM_{2.5}$ at the ends of the Valley and across the Chico and Fresno lateral transects for I-5 plus Hwy. 99. For the valley ends, the traffic ratio was 4.6 and the aerosol ratio 4.4, while for the central lateral transect, traffic was 2.1 and the aerosol was 1.4. Therefore the $PM_{2.5}$ mass values in the study were similar to the local traffic volumes, and the ultrafine metals at Bakersfield are from the two major highways south of Bakersfield climbing and descending the mountain passes.

Support for this hypothesis comes from historical data taken in Bakersfield in winter, 1974–1976 (Cahill and Flocchini 1974; Flocchini et al. 1976). The historical data show that particulate pollution from cars was high in Bakersfield in the 1970s data. Lead levels at Bakersfield, population circa 75,000 in 1975, in the average winter period were higher on average than in parts of the Los Angeles urban area. This is a clear indication that the local meteorology and geographical setting of Bakersfield results in it being highly impacted by vehicular sources, most likely vehicles on I-5 and Hwy 58 as they climb out of or descend into the valley.

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TABLE 5
Measured and reconstructed ultrafine mass and elemental components in two studies in Sacramento, 2007. Watt 0.5 km is 500 m upwind; Watt 15 m is downwind. Sac Center is the ARB 13th and T Street site. There are no elemental carbon data or nitrate data, so the reconstructed mass is incomplete

	Watt ave. upwind (~ 0.5 km)	Watt ave. downwind (15 m)	Sacramento center
Major components	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
Mass (gravimetric)	Na	Na	2.04
Mass (recon.)	Na	Na	2.15
Organics (H)	Na	na	1.72
Sulfur (ammonium sulfate)	0.09	0.18	0.34
Chlorine (NaCl)	0.00	0.00	0.04
Soil	0.04	0.08	0.048
K non-soil (wood smoke)	0.04	0.14	0.053
Metals	0.01	0.09	0.035
Minor components	ng/m^3	ng/m^3	ng/m^3
Phosphorus	1.1	1.0	2.4
Vanadium	0.06	0.18	0.15
Chromium	2.2	1.3	0.45
Iron (non-soil)	5.2	34.9	17.0
Nickel	0.3	16.3	3.5
Copper	0.1	9.8	8.3
Zinc	1.2	17.3	11.5
Arsenic	0.16	0.46	0.6
Selenium	0.10	0.13	0.3
Bromine	0.8	1.1	3.7
Lead	0.5	2.3	4

Examining the current IHD mortality data from Figure 3, we observed that if we remove a totally arbitrary average background IHD mortality rate of 120 from the total rate (about 2/3 of the valley average rate), and matching the Bakersfield result, the excess IHD mortality roughly scales with local truck traffic on the major freeways (CalTrans 2010) and the very fine–ultrafine iron (Figure 14).

The pattern reflects the pattern that the two major north–south freeways, I-5 and Hwy 99, come close to each other only at Sacramento–Stockton and Bakersfield. Note that car traffic has a very different pattern because of the large automobile traffic on local Sacramento highways. When ultrafine aerosols alone are correlated with IHD mortality for the entire Central Valley, the highest correlations are for phosphorus ($r^2 = 0.96$) and iron ($r^2 = 0.88$), both with known vehicular sources.

The association of IHD with toxic organic contaminants, specifically benzo[*a*]pyrene (B*a*P) and coronene (Cahill 2010),

TABLE 6
Very fine and ultrafine metals with known vehicular sources

Site	Redding	Chico	Sacramento	Fresno	Bakersfield
Class	Very fine + ultrafine	Very fine + ultrafine	Very fine + ultrafine	Very fine + ultrafine	Very fine + ultrafine
Size	0.26–0 μm	0.26–0 μm	0.26–0 μm	0.26–0 μm	0.26–0 μm
Species					
Phosphorus	1.3	1.0	1.2	4.0	14.5
Iron	6.1	5.7	15.3	10.0	43.2
Nickel	0.9	0.13	0.67	0.35	1.8
Copper	4.2	3.1	2.8	2.9	3.6
Zinc	10.5	15.1	15.4	27.3	24.8

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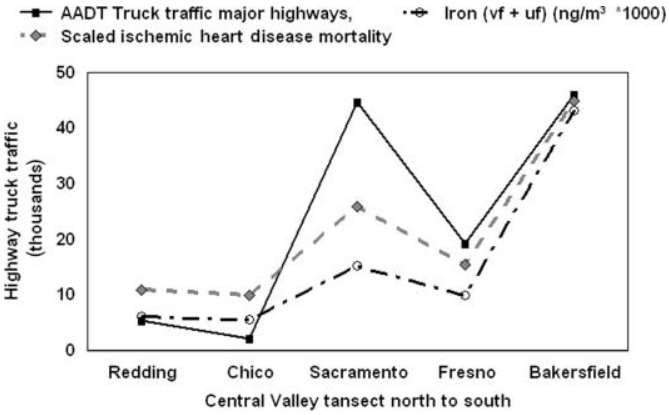

FIG. 14. Association between local average annual daily truck (AADT) traffic on major freeways, scaled ischemic heart disease, and very fine plus ultrafine iron.

was examined but the pattern did not produce a fit to the IHD increase (Figure 15). The relatively high values of B*a*P at Chico in winter, observed for years in prior CARB toxics data reported in the ADAM database (ARB ADAM 2010), was traced to the burning of primarily pine wood.

Coronene is normally associated with the exhaust of automobiles, while B*a*P has known vehicular sources (diesels and cars) as well as wood smoke (Fujita et al. 2007; Riddle et al. 2007; Kleeman et al. 2009; Cahill 2010). The non-soil, nonwood smoke potassium was also observed by Gertler et al. (2003) in the Tuscarora Tunnel studies from light duty vehicles, but not from diesels. Thus, there appears to be a spark emission source of potassium and coronene in the very fine/ultrafine. A south valley enhancement was also seen in petroleum derived alkanes (Cahill 2010), which were present in the largest amounts in Fresno, lesser amounts in Bakersfield, and negligible elsewhere. In summary, it does not appear that organic aerosols from wood smoke, diesels, and automobiles are a component in the IHD excess.

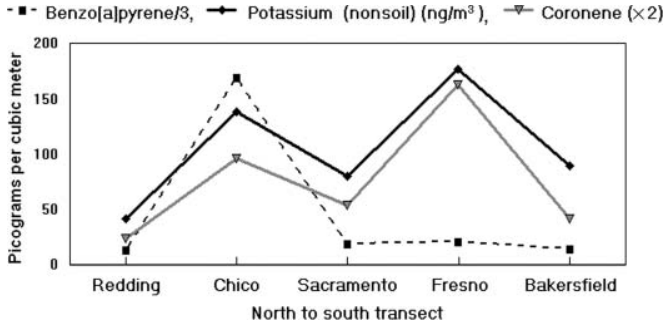

FIG. 15. Comparison of ultrafine B*a*P, potassium, and coronene.

CONCLUSIONS

Persistent enhancement of mortality associated with cardiovascular and specifically IHD has been observed in the southern San Joaquin Valley since 1990, yet while there is a strong statistical association with mass, most of the mass is known to be relatively innocuous to the cardiovascular system. Most of the mass is ammonium nitrate, which is soluble in lung fluid. This makes ammonium nitrate unlikely as a source of cardiovascular disease. In order to examine potential causal agents, a profile was made of mass, inorganic, and organic components of mass in nine size modes, including ultrafines $<0.09\ \mu$m, at five sites from Redding to Bakersfield during a 3-week period of strong stagnation, January 5–22, 2009. The strongest correaltions to IHD mortality were found in very fine (0.26–0.09 μm) to ultrafine metals, with most tied to vehicular sources. This result is supported by several independent lines of reasoning. First, there is an association with truck traffic and IHD throughout the Valley. Second, the four key transition elements, non-soil iron, nickel, copper, and zinc, are closely tied to vehicular sources through upwind–downwind measurements at Watt Avenue, a secondary artery in suburban Sacramento. Third, the same four elements are found at the downtown ARB 13th and T Street site. Fourth, there are known diesel sources of zinc and phosphorus, from zinc thiophosphate in lubricating oil, plus calcium as an antacid. No iron, nickel, or copper were seen in the diesel dynamometer tests, so these elements are not coming from engine wear. Conversely, brake pads include many elements, including iron, nickel, copper, and zinc. The Watt Avenue data were taken just south of a stoplight, so braking was occurring. Heavy braking also occurs on the I-5 "Grapevine" and Highway 58 downgrades, each more than a 1000 m descent, and both carry heavy truck traffic into Bakersfield, where the same elements are seen again correlating with increased rates of IHD.

Thus, in summary, we present here evidence that, while not conclusive, strongly supports the hypothesis that very fine and ultrafine transition metals are a causal factor in IHD in the Central Valley of California. Removal of zinc thiophosphate from lubricating oil could greatly reduce the zinc concentration, while changes in brake drums and pads could reduce the non-soil iron, copper, zinc, and nickel concentrations in ambient air. After a 15-year fight that surfaced with concerns about the San Francisco Bay, on October 5, 2010, Governor Arnold Schwarzenegger signed SB346, which requires brake pad manufacturers to reduce the use of copper to not more than 5% by 2021 and no more than 0.5% by 2025. The reasons were based on the toxicity of copper in water run-off from roads and follows similar action by Washington State.

Finally, it is clear that the lack of correlation between $PM_{2.5}$ (or $PM_{1.0}$) composition and very fine and ultrafine aerosol composition makes measurements of the composition of very fine and ultrafine particles critical for obtaining causal relations to health impacts, both for organic and inorganic species.

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REFERENCES

ADAM. (2010). *California Environmental Protection Agency—Air Resources Board*. Retrieved from http://www.arb.ca.gov/ADAM

Bench, G., Grant, P., Ueda, D., Cliff, S., Perry, K., and Cahill, T. A. (2002). The Use of STIM and PESA to Measure Profiles of Aerosol Mass and Hydrogen Content, Respectively, Across Mylar Rotating Drums Impactor Samples. *Aerosol Sci. Technol.*, 36:642–651.

California Department of Health Services. (2010). *Web Based Inquiry for Mortality Data*. Retrieved from http://www.applications.dhs.ca.gov/vsq/default.asp accessed 3 May, 2011.

CalTrans. (2010). *CA Transportation Authority, Average Daily Truck Traffic on the California Highway System*. Retrieved from http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/truck2008final.pdf

Cahill, T., Cliff, S. S., Jimenez-Cruz, M., and Perry, K. (2003). *Aerosols by Size, Time, and Composition in Support of the Fresno Asthmatic Children's Environment Study, 2001*. Final Report to the California Air Resources Board, Sacramento, CA.

Cahill, T., Dutcher, D., Clark, C., Martin, J., McCarthy, T., and Lipnick, D. (1998). *Comparison of Cardiac and Stroke Mortality to Carbon Monoxide, Ozone, and Particulate Air Pollutant Concentrations in the Sacramento Valley Region*. Report to the Health Effects Task Force, American Lung Association Sacramento Emigrant Trails, Sacramento, CA.

Cahill, T. A., and Barnes, D. E. (2009). *Comparison of Fine Mass, UC Davis DRUM versus FRM, at the Air Resources Board 13th and T Street Site*. Final Report to the California ARB, Sacramento, CA.

Cahill, T. A., Cahill, T. M., Spada, N. J., and Barnes, D. E. (2007). *Organic and Elemental Aerosols near Watt Avenue, Late Winter—Spring, 2007*. Final Report to the Sacramento Metropolitan Air Quality Management District, Sacramento, CA.

Cahill, T. A., Eldred, R. A., Motallebi, N., and Malm, W. C. (1989). Indirect Measurement of Hydrocarbon Aerosols Across the United States by Non-sulfate Hydrogen-Remaining Gravimetric Mass Correlations. *Aerosol Sci. Technol.*, 10:421–429.

Cahill, T. A., and Feeney, P. J. (1973). *Contribution of Freeway Traffic to Airborne Particulate Matter*. Final Report of the California Air Resources Board, Contract ARB-502, Sacramento, CA.

Cahill, T. A., and Flocchini, R. G. (1974). *Regional Monitoring of Smog Aerosols*. Annual Reports to the California Air Resources Board, Contract 2–006, 1974, 1975, 1976, 1977, Sacramento, CA.

Cahill, T. A., Goodart, C., Nelson, J. W., Eldred, R. A., Nasstrom, J. S., and Feeney, P. J. (1985). Design and Evaluation of the Drum Impactor, in *Proceedings of International Symposium on Particulate and Multi-phase Processes*, T. Ariman and T. Nejat Veziroglu, eds., Hemisphere Publishing Corporation, Washington, DC, Vol. 2, pp. 319–325.

Cahill, T. M. (2010). Size-Resolved Organic Speciation of Wintertime Aerosols in the California Central Valley. *Environ. Sci. Technol.*, 44:2315–2321.

Chan, D., and Stachowiak, G. W. (2004). Review of Automotive Brake Friction Materials. *Proc. Instn. Mech. Engrs.*, 218(9):953–966.

Chen, L. W. A., Watson, J. G., Chow, J. C., and Magliano, K. L. (2007). Quantifying PM2.5 Source Contributions for the San Joaquin Valley with Multivariate Receptor Models. *Environ. Sci. Technol.*, 41(8):2818–2826.

Chow, J. C., Chen, L. W. A., Watson, J. G., Lowenthal, D. H., Magliano, K. A., Turkiewicz, K., and Lehrman, D. E. (2006). PM2.5 Chemical Composition and Spatiotemporal Variability During the California Regional PM10/PM2.5 Air Quality Study (CRPAQS). *J. Geophys. Res.—Atmos.*, 111: D10.

Chow, J. C., Watson, J. G., Lowenthal, D. H., Chen, L. W. A., Zielinska, B., Mazzoleni, L. R., and Magliano, K. L. (2007). Evaluation of Organic Markers for Chemical Mass Balance Source Apportionment at the Fresno Supersite. *Atmos. Chem. Phys.*, 7(7):1741–1754.

Chow, J. C., Watson, J. G., Lowenthal, D. H., and Magliano, K. L. (2008). Size-Resolved Aerosol Chemical Concentrations at Rural and Urban Sites in Central California, USA. *Atmos. Res.*, 90(2–4):243–252.

Devlin, R. (2003). What We Know and What We Think We Know About Health Effects of Fine Particles; Is It Enough? American Association of Aerosol Research (AAAR), Annual Meeting, Charlotte, NC.

Flocchini, R. G., Cahill, T. A., Shadoan, D. J., Lange, S. J., Eldred, R. A., Feeney, P. J., Wolfe, G. W., Simeroth, D. C., and Suder, J. K. (1976). Monitoring California's Aerosols by Size and Elemental Composition. *Environ. Sci. Technol.*, 10:76–82.

Fujita, E. M., Zielinska, B., Campbell, D. E., Arnott, W. P., Sagebiel, J. C., Mazzoleni, L., Chow, J. C., Gabele, P. A., Crews, W., Snow, R., Clark, N. N., Wayne, W. S., and Lawson, D. R. (2007). Variations in Speciated Emissions from Spark-Ignition and Compression-Ignition Motor Vehicles in California's South Coast Air Basin. *J. Air Waste Manage.*, 57(6):705–720.

Gertler, A., Abu-Allaban, M., Coulombe, W., Gillies, J. A., Pierson, W. R., Rogers, C. F., Sagebiel, J. C., Tarnay, L., and Cahill, T. A. (2003). Measurements of Mobile Source Particulate Emissions in a Highway Tunnel. *Int. J. Vehicle Des.*, 27:86–93.

Hayes, T. P., Kinney, J. J. R., and Wheeler, N. J. M. (1984). California Surface Wind Climetology State of California Air Resources Board, Aerometric Data Division, Sacramento, California.

Kennedy, P., Gadd, J., and Moncrieff, I. (2002). *Emission Factors for Contaminants Released by Motor Vehicles in New Zealand*. Ministry of Transport, Auckland, New Zealand.

Kleeman, M. J., Riddle, S. G., Robert, M. A., Jakober, C. A., Fine, P. M., Hays, M. D., Schauer, J. J., and Hannigan, M. P. (2009). Source Apportionment of Fine (PM1.8) and Ultrafine (PM0.1) Airborne Particulate Matter During a Severe Winter Pollution Episode. *Environ. Sci. Technol.*, 43(2):272–279.

Kleeman, M. J., Schauer, J. J., and Cass, G. R. (2000). Size and Composition Distribution of Fine Particulate Matter Emitted from Motor Vehicles. *Environ. Sci. Technol.*, 34(7):1132–1142.

Lippmann, M. (2009). Semi-Continuous Speciation Analyses for Ambient Air Particulate Matter: An Urgent Need for Health Effects Studies. *J. Expo. Sci. Epidemiol.*, 19:235–247.

Malm, W. C., Sisler, J. F., Huffman, D., Eldred, R. A., and Cahill, T. A. (1994). Spatial and Seasonal Trends in Particle Concentration and Optical Extinction in the United States. *J. Geophys. Res.*, 99(D1):1347–1370.

Pope, C. A., III, Thun, M., Namboodiri, M. M., Dockery, D. W., Evans, J. S., Speizer, F. E., and Heath, C. W., Jr. (1995). Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U. S. Adults. *Am. J. Respir. Crit. Care Med.*, 151(3) (Part 1):669–674.

Raabe, O. G., Braaten, D. A., Axelbaum, R. L., Teague, S. V., and Cahill, T. A. (1988). Calibration Studies of the Drum Impactor. *J. Aerosol Sci.*, 19(2):183–195.

Riddle, S. G., Jakober, C. A., Robert, M. A., Cahill, T. M., Charles, M. J., and Kleeman, M. J. (2007). Large PAHs Detected in Fine Particulate Matter Emitted from Light-Duty Gasoline Vehicles. *Atmos. Environ.*, 41(38):8658–8668.

Wesolowski, J. J., John, W., Devor, W., Cahill, T. A., Feeney, P. J., Wolfe, G., and Flocchini, R. (1977). *Collection Surfaces of Cascade Impactors, in X-Ray Fluorescence Analysis of Environmental Samples*. T. Dzubay, ed., Ann Arbor Science Publishers, Ann Arbor, Michigan, pp. 121–130.

Zielinska, B., Goliff, W., McDaniel, M., Cahill, T., Kittelson, D., and Watts, W. (2003). *Chemical Analyses of Collected Diesel Particulate Matter Samples in the E-43 Project*. National Renewable Energy Laboratory, Golden, COLORADO.

Zielinska, B., Sagebiel, J., McDonald, J. D., Whitney, K., and Lawson, D. R. (2004). Emission Rates and Comparative Chemical Composition from Selected in-use Diesel and Gasoline Fueled Vehicles. *J. Air Waste Manage. Assoc.*, 54:1138–1150.

AR002304

EXHIBIT 24

Atmospheric Environment 136 (2016) 31–42

Contents lists available at ScienceDirect

Atmospheric Environment

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Artificial ultra-fine aerosol tracers for highway transect studies

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ARTICLE INFO

Article history:
Received 4 December 2015
Accepted 29 March 2016
Available online 7 April 2016

Keywords:
Aerosols
Roadway configurations
Downwind distribution vs configuration
Vegetation

ABSTRACT

The persistent evidence of health impacts of roadway aerosols requires extensive information for urban planning to avoid putting populations at risk, especially in-fill projects. The required information must cover both highway aerosol sources as well as transport into residential areas under a variety of roadway configurations, traffic conditions, downwind vegetation, and meteorology. Such studies are difficult and expensive to do, but were easier in the past when there was a robust fine aerosol tracer uniquely tied to traffic – lead. In this report we propose and test a modern alternative, highway safety flare aerosols. Roadway safety flares on vehicles in traffic can provide very fine and ultra-fine aerosols of unique composition that can be detected quantitatively far downwind of roadways due to a lack of upwind interferences. The collection method uses inexpensive portable aerosol collection hardware and x-ray analysis protocols. The time required for each transect is typically 1 h. Side by side tests showed precision at ± 4%. We have evaluated this technique both by aerosol removal in vegetation in a wind tunnel and by tracking aerosols downwind of freeways as a function of season, highway configuration and vegetation coverage. The results show that sound walls for at-grade freeways cause freeway pollution to extend much farther downwind than standard models predict. The elevated or fill section freeway on a berm projected essentially undiluted roadway aerosols at distances well beyond 325 m, deep into residential neighborhoods. Canopy vegetation with roughly 70% cover reduced very fine and ultra-fine aerosols by up to a factor of 2 at distances up to 200 m downwind.

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1. Introduction

Pollutants emitted from vehicles have a disproportionate impact on sensitive receptor populations, such as residences, schools, senior housing, and medical facilities, since roadways are so ubiquitous. This situation is exacerbated when efforts to reduce energy use favors infill development close to roadways. This makes the ability to accurately predict pollutant concentrations downwind of roadways critical in terms of both roadway design and urban and sub-urban planning.

Clearly, the primary effort must be to reduce toxic emission rates from vehicles on roadways. Enormous advances have been made in the past 40 years in reducing particulate pollutants from highway vehicles, including the elimination of lead from gasoline. California's pioneering effort in this regard was driven, however, primarily by the need to remover reactive hydrocarbons and oxides of nitrogen from exhaust to control ozone. The lead removal was a necessary requirement for the catalytic converter to operate. California also controlled sulfur in gasoline to avoid sulfuric acid emissions from the converter (Courtney et al., 1978). Emissions of diesel exhaust from trucks also dropped steadily in these decades. (Gertler et al., 2003; Propper et al., 2015). The stunning success of these actions resulted in less emphasis on highway impact studies in the next decade.

In the 1990s, epidemiological studies showed important health impacts near freeways, even after the elimination of lead. Specifically, there was a significant loss of lung function in children living within 1.6 km of Los Angeles freeways (Peters et al., 1999a,b; Gauderman et al., 2000). The problem was made more complex by an increased understanding of vehicular emissions, and especially the role of very fine ($0.25 > D_p > 0.1$ μm) and ultra-fine

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http://dx.doi.org/10.1016/j.atmosenv.2016.03.058
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(<0.1 μm) insoluble aerosols on cardio-vascular disease. Very fine and ultra-fine metals are known to penetrate into the deep lung and transport into the circulatory system (Lewis et al., 2005; Chen and Lippmann, 2009; Oberdorster et al., 2007; Lippmann, 2009; Ostro et al., 2010; EPA, 2015). Traffic is increasingly implicated (Brugge et al., 2007; Hagler et al., 2009; HEI, 2009; Lin and Peng, 2010; Karner et al., 2010; WHO, 2013), with copper and iron implicated in hydroxyl radical formation in lung fluid (Charrier et al., 2014; Charrier and Anastasio, 2015). Recent publications have identified very fine and ultra-fine transition metals, including iron and copper, as a major component of "wear" aerosols from brake debris (Cahill et al., 2014; Grigoratos and Martini, 2015). These very fine and ultra-fine "wear" aerosols are tied to a very sharp (~25%) increase in ischemic heart disease death rates in Bakersfield, CA (Cahill et al., 2011).

A recent European survey noted that mass derived from "wear" aerosols from brakes, roadway resuspensions, etc. was approaching and would soon pass exhaust aerosols near roadways, with uncertain health impacts (Denier Van der Gon et al., 2013). Their consensus statement concludes, "In light of the continuous increase of the relative contribution of non-exhaust emission to ambient PM, where it is becoming the dominant emission process for urban transport, it is more than timely to devote greater efforts to properly quantifying non-exhaust emissions and assessing health relevance."

A key factor in assessing health relevance of highway pollution is establishment of transport phenomena from roadways into receptor populations, largely by downwind transect studies. The primary method used to establish transects of downwind impacts of roadways is use of highway pollutants themselves. This was especially easy when one had very fine lead uniquely associated with automobiles, and especially the unique form PbBrCl, with few interfering species. The largest study of this kind was part of the California effort in 1972 to assess the impact of lead in Los Angeles (Cahill and Feeney, 1973). While at-grade freeways without obstructions were in excellent agreement with predictions from lead emission rates and line source downwind dispersion, dramatic order of magnitude differences were seen as a function of freeway configuration (Feeney et al., 1975). Specifically, elevated or fill section freeways on a berm had 10 times the lead at 160 m downwind than the at-grade freeways. At 100 m downwind, the 24 h lead level in a residential area was 10 $\mu g/m^3$, 4 times the admittedly inadequate California standard of the time and 67 times the current US EPA standard of 0.15 $\mu g/m^3$. This problem was resolved in California by removal of lead from gasoline, required so as to not poison the catalytic converter.

Now with a new appreciation of health impacts from roadways, both from diesel exhaust and very fine and ultra-fine metals, the need for transects again becomes urgent, both to aid urban planners who might inadvertently put downwind populations at risk and also to better understand the existing health impact data. However, the very success of prior efforts at tailpipe emissions has made measurement of such transects more difficult. The competition between the highway pollutant and the regional or upwind background limits natural tracers to freeway species that dominate the local environment. An additional criterion is that the pollutant must be a robust measure of the traffic flow to allow extension of the results to other sites. Finally, priority should be given to those pollutants that have the highest chance of deleterious impact, especially to health.

In response to the health concerns and lack of data, new studies of freeway impacts have been initiated in the past 15 years. Two studies especially relevant to the health data were done in Los Angeles, first for the automobile-dominated I-405 (Zhu et al., 2002a) and the second on the heavily truck traveled I-710 freeway (Zhu et al., 2002b). I-710 connects the ports of Los Angeles and Long Beach to the intermodal truck-rail facilities near San Bernardino, and thus has very heavy truck traffic. In 2002, that averaged an average traffic flow of around 216,000 v/day with roughly 25% trucks, more than ½ with 5 axels or more (CalTrans, 2015). Further, the Zhu et al. studies occurred in the typical marine inversion of the Los Angeles basin, similar to that in the 1972 lead studies and the Peters et al., 1999b children's health data. This team used natural tracers from highway emissions, black carbon (diesel dominated), particle numbers, and carbon monoxide, upwind and downwind of the freeways (Fig. 1). There is a good to excellent correlation between black carbon, particle number, and carbon monoxide, all of which have important upwind concentrations. The pattern from the I-710 freeway was also very similar to that seen in Zhu et al., 2002a for the I-405 freeway.

The Zhu et al. data can be compared to one of the earlier lead transects from freeways in Los Angeles, 1972. (Cahill and Feeney, 1973; Feeney et al., 1975). Eighty individual 2 h transects were made near Los Angeles freeways, each with size resolved aerosol samples (Lundgren, 1967). These were placed both upwind and downwind of freeways in a variety of freeway configurations, meteorological conditions, and times of day. Each of the roughly 2400 samples was analyzed for typically 35 elements sodium to lead by particle induced x-ray emission (PIXE). (Johansson et al., 1970; Cahill, 1980). While the focus was on lead, an extremely useful element was bromine, since lead was emitted as PbBrCl from the tailpipe due to the admixture of ethyl additives (Habibi, 1973). This allowed isolation of freeway lead from other industrial sources in the Los Angeles basin. These data include an at-grade freeway, and thus are relevant to the Zhu et al. data. In Fig. 1, the 1972 at-grade freeway lead data (Cahill and Feeney, 1973) are plotted with the Zhu et al., 2002b I-710 data, normalizing to the edge-of-freeway maximum. The accord between two very different data sets taken 30 years apart is comforting, and both sets of data are in reasonable agreement with the CA ARB Emfac2007 model of roadway impacts. (ARB, 2007).

Some important items to note about these transects. First, the health data in children (Peters et al., 1999a,b) extend much farther out from freeways, to 1.6 km, than the at-grade data and models support. Also, the downwind fall off shows no sign of particle removal by coagulation, which was common when both gasoline and diesel fuel contained high levels of sulfur. Finally, it shows that CO as a diffusion limited system can be used as a surrogate for ultra-fine particles in the absence of confounding particle removal factors like vegetation.

However, there are limitations to the applicability of these and most other transect studies. First, the studies such as Zhu et al., 2002a,b are difficult and expensive, requiring a large study team, site security, access to power for the collection instrumentation, and other considerations. These factors have limited the number of freeway transects in the literature. Economics also can limit the collected species. Very fine and ultra-fine transition metal "wear" aerosols are rarely measured. It is also notable that there are important concentrations of these species upwind of the freeway, indicating an urban ultra-fine particle background that must be measured and subtracted from the freeway data.

The alternative proposed and tested in this study is to emit an artificial ultra-fine aerosol tracer that has little or no background concentrations from a vehicle on the highway. This makes detection easy and inexpensive, and if the pollutant is ultra-fine, allows studies of mitigation by removal onto vegetation.

2. Experimental methods

In increasing complexity of roadway transects in the era of ultra-

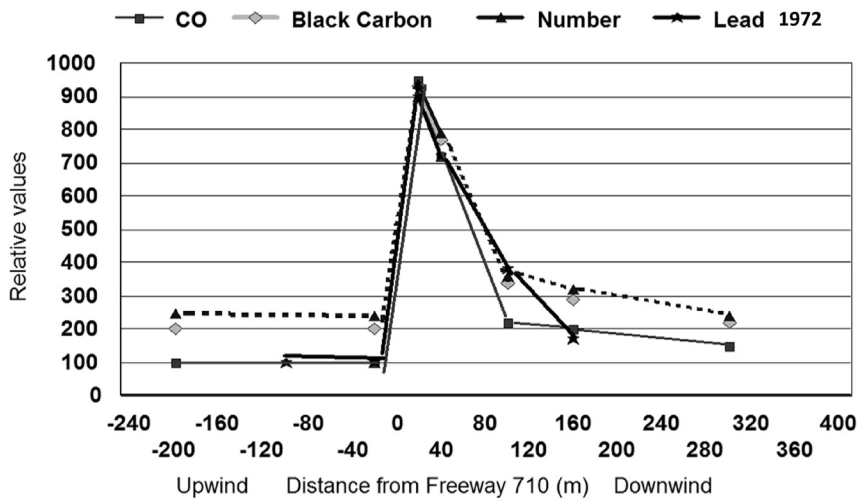

Fig. 1. Highway transect of Zhu et al., 2002b with added data from Cahill and Feeney, 1973 for lead.

fine "wear" aerosols and the need for effective mitigation can be addressed by using a very fine to ultra-fine aerosol tracer emitted by test vehicles on the highway. These requirements were met by standard highway safety flares as a potential source of the aerosols. Flares generally consist of a mixture of strontium and potassium nitrates, potassium perchlorate, finely powdered magnesium, aluminum and sulfur in a charcoal and a sawdust matrix. We used Orion™ Model #3152 15 min Emergency Flares. The flare weighs 0.17 kg and burns for 15 ± 1 min. The major aerosol component heavier than sodium is potassium, but strontium is the second most abundant aerosol at 70% of potassium. Others components are chlorine, 50% of potassium, followed by sulfur, 35%, silicon 20%, magnesium 12%, phosphorus 3%, and smaller tracers (Fujii et al., 2008). Many of these elements are easily measured by x-ray fluorescence techniques, and in their ensemble, are nothing like background aerosols in size and composition. The strontium provides the characteristic red color. The size and composition of the flares was tested in the UC Davis Engineering 60 m wind tunnel using a DELTA Group 8 DRUM impactor with 8 size modes (Raabe et al., 1988).

The velocities chosen are high enough so removal onto vegetation by very fine and ultra-fine particles is minimal. Almost all aerosol mass was smaller than 0.5 μm aerodynamic diameter. Strontium was chosen as the key tracer element since there is very little strontium in soil (375 ppm) and relatively little soil below 2.5 μm. A typical size distribution of diesel mass is shown for comparison. (Zielinska et al., 2003).

In order to evaluate whether flare aerosols were suitable for studies of mitigation by vegetation, removal studies were done on the 20 m wind tunnel of the College of Engineering, UC Davis. (Roney and White, 2006). A 2 m by 1 m section of the tunnel was loosely packed by several types of vegetation (redwood, deodar, and live oak) at about 10 times what would occur in nature. Flare aerosols were run through the vegetation at various wind speeds, and aerosol mass and composition were measured before and after the vegetation. Both mass and S-XRF data were used to quantify particle capture. The tunnel was run at wind velocities of 0.5, 1.0, 2.0, 3.0, and 4.0 m/s for each type of vegetation. Finally, the vegetation was weighed and the leaf area estimated by an LSAI 2000 plant surface area analyzer (Smolander and Stenberg, 1996).

Fig. 7 shows the result, with low wind speeds being highly effective in removing these aerosols as it allows diffusion to leaf and needle surfaces. (Fujii et al., 2008). These data also explain why the data at 2, 3, and 4 m/sec in Fig. 2 are almost identical.

3. Evaluation in field studies

For the freeway evaluations, the preferred method of aerosol tracer emission was a set of 4 flares, 15 min each, sequentially ignited in a steel housing open to the air but invisible to neighboring vehicles in the back of an open pick-up truck imbedded in traffic. The aim was to provide a line source so that the farthest downwind sampler would have the same source access as the nearest sampler, taking into account the lateral variability of the wind. If freeway access on ramps made the line source much larger than required, the number of flares was increased to provide the roughly same source strength.

The initial field evaluation was made in Detroit as part of the ongoing US EPA NEXUS study. (NEXUS, 2013; Vette et al., 2013; Baldauf et al., 2013; McGee et al., 2015). Lessons were learned showing the importance of paired off ramps that were close enough so that the test truck does not spend an inordinate amount of time away from the designed upwind line source. Since DRUM samplers (Raabe et al., 1988), were already in use, they were used to measure the very fine strontium.

For the Sacramento tests, (Cahill et al., 2013), we selected sites downwind of Interstate 5 south of the Highway 50 (W-X) freeway. The current study covered but a small subset of the potential conditions encountered near freeways. None of the freeway sections had heavy braking during the transects. In one site where no convenient freeway on ramp was available, a rolling cart with the flares was walked back and forth for an hour along a bikeway just upwind of the freeway.

3.1. Aerosol collection

Since the size distribution was very fine to ultra-fine, simple battery powered $PM_{2.5}$ Stacked Filter Units, SFUs (Cahill et al., 1977), were used to collect the samples. An inlet was set at roughly 10 μm, and the pre filter collected particles a between 10 and 2.5 μm. The 25 mm stretched Teflon after filter collected all particles <2.5 μm, validated by comparisons to standard dichotomous samplers (Cahill et al., 1990). Sampling flow was 10 l/min and sampling durations were 1 h to match the freeway emissions, yielding an areal density of 3.2 cm^2/m^3. While we had these SFU samplers available, a better choice would have been a 1.0 μm cut point cyclone at a

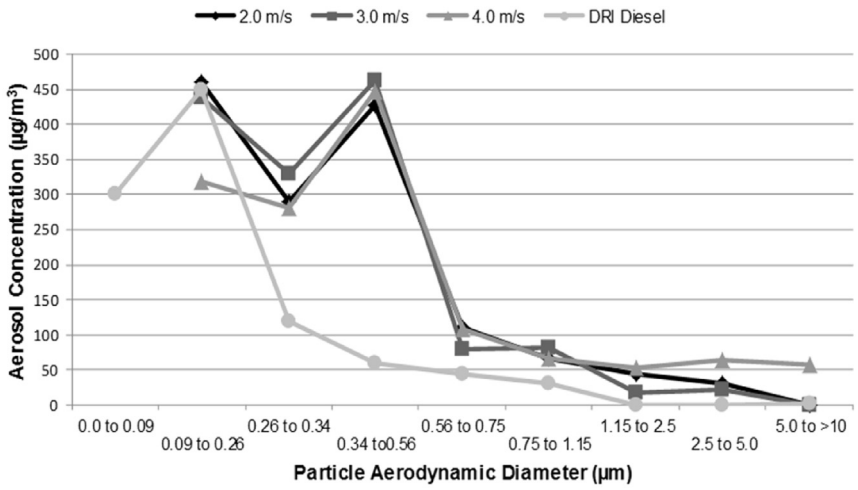

Fig. 2. Size distribution of aerosols as a function of wind velocity after passing through 2 m of loosely packed redwood branches.

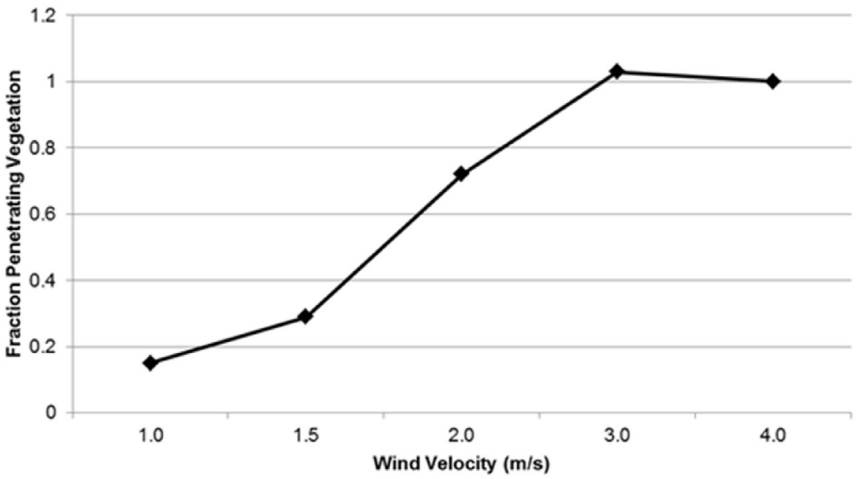

Fig. 3. Removal of flare aerosol mass by 2 m of redwood branches.

higher flow rate, which would have reduced the strontium from fine soil be an additional factor of 3 and allowed for less sensitive analytical methods.

3.2. Aerosol analysis

The analyses were performed at the Advanced Light Source, Lawrence Berkeley National Laboratory, on the UC Davis modified polarized x-ray milli-probe on Beam Line 10.3.1. Minimum detectable limit was around 2 ng/cm^2 and S-XRF protocols have been repeatedly validated, most recently in Science Magazine (Jenniskens et al., 2012). Each filter was scanned edge to edge with a 0.5 mm × 2 mm beam spot to check for depositional anomalies and establish blank values. The residual strontium was subtracted to give net flare strontium values, which were typically on the order of 20–35 ng/cm^2 for a single highway flare and a 1 h run duration.

3.3. Quality assurance

Two independent methods were used to establish the accuracy and precision of the aerosol collection and analysis. The total precision was confirmed through the use of paired SFU samplers at a downwind site, normally the 60 m site. The five side by side tests, with separate inverters and pumps, yielded a mean precision of ±4% in the ambient aerosol strontium. Since there was no detectable enhancement of sulfur at the immediately downwind site, accuracy and precision were also confirmed by the values for regional sulfur (ammonium sulfate) aerosols, showing a precision of ±9% over all SFU samplers during the entire study.

4. Meteorology

The meteorology conditions during the studies are shown for summer and fall, 2011, and winter, 2012 (see Table 1).

The summer meteorology was dominated by the strong southwest and west winds each afternoon, while fall and winter winds were more variable and generally more from the northwest.

5. Results

5.1. At-grade freeway configurations

The initial tests were done with at-grade freeways since there was so much earlier data and experience and theory are in good agreement. Data from the present studies and earlier at-grade studies relevant to the project are shown below in Table 2.

Table 1
Weather during the transects,. The shaded areas are the dates used for each site.

	T avg	Rh avg	Precip	v avg	v max	Dir	Visibility	Site
August 2011								
17	76	55	0	4	30	sww	10	
18	77	53	0	5	16	sw	10	35th Ave.
19	70	62	0	9	15	sw	10	
22	74	59	0	8	25	sw	10	
23	77	55	0	2	10	west	10	10th Ave, 13th Ave.
24	80	45	0	4	20	sw	10	
Nov 2011								
12	56	76	0.01	4	12	nnw	5	fog, rain
13	57	71	0	3	14	nnw	9	10th Ave, 13th Ave.
14	57	75	0	4	12	wsw	9	
Jan 2012								
15	46	68	0	7	25	ssw	10	
16	40	50	0	3	17	nw	10	10th Ave, 35th Ave.
17	38	58	0	1	6	sse	10	

The two northern locations were chosen with streets that allowed downwind transport of freeway aerosols on the prevailing winds. The northern site, 10th Avenue, was downwind of an at-grade freeway, with a modest screen of trees at the freeway, a 1.5 m berm and a 4 m sound wall, and a clear downwind fetch without canopy vegetation.

This site was paired with site to the south at 13th Avenue, which was also an at-grade freeway, had a similar modest tree barrier and 4 m sound wall, but transported aerosols into a 70% cover tree canopy. The aim was to evaluate the role of canopy vegetation in reducing ultra-fine aerosols, building on similar work in North Carolina (Baldauf et al., 2013). Both sites are shown below in Fig. 8. Since the near upwind site had too much freeway influence, a background site was set up across the Sacramento River for the November tests (see Fig. 4).

The tests were run in summer, fall, and winter, but the winter tests did not extend into the persistent and strong surfaced based inversions that result in the highest regional $PM_{2.5}$ mass every winter (Cahill et al., 2014).

The results for the 10th Avenue tests are shown below in Fig. 5.

Turning to the other member of this pair, the 13th Avenue profile, much the same downwind pattern is seen, but with lower concentrations. The very fine and ultra-fine concentrations in summer, when the ~70% tree canopy was intact, are only about 50% of what were seen at 10th Avenue at 60 m, 82%, at 120 m, and 50% at 210 m. This is consistent with vegetation impact of the Baldauf et al., 2013 work (see Fig. 6).

However, the gross mismatches of the downwind transect data as compared to the at-grade data and modeling needs resolution. Even in winter, there are far more aerosols present at 210 m downwind than the models and data from at-grade freeways predict. Clearly, this shows that freeways with sound walls have far more downwind impact than existing models like Emfac2007 predict.

Resolution of this problem is aided by the extensive freeways transect data done in 1972 when lead was a conserved very fine freeway tracer. There was one set of tests for an at-grade freeway, but in addition two sets for elevated or fill section freeways on solid berms (Fig. 7), and three sets for depressed freeways below grade (Fig. 13). To establish a quantitative connection between on road emissions and downwind values, a “sliding box model” was used as a well-tested way to measure roadway emissions when one has access to both upwind and downwind information on pollutants, a flat terrain, and a lateral wind across the roadway (Cahill and Feeney, 1973). The dimensions of the box are set by the roadway width, including lateral turbulence, and the top of the mixed zone, set by truck vehicle height and velocity. The latter is the greatest uncertainty, but extensive data on the height of the mixed zone were taken in Los Angles in 1973 and the value, 3.5 m, was used in several studies. The length of the box is arbitrary, and we used 1.6 km. The box so defined represents a volume into which pollutants are uniformly mixed by vehicular turbulence. The lateral

Table 2
Summary of relevant transect studies for at-grade freeway configurations. Vegetation barriers were ~30% opaque at 10th and 13th Ave. A low 1.5 m berm was present at 10th Avenue. Data from other relevant studies are also included. The current studies using artificial flare aerosols are highlighted in bold type.

Freeway configuration	Vegetation	Vegetation	Season			Tracer used	Transect site
	Barrier + sound wall	Downwind canopy	Summer	Fall	Winter		2013
At-grade*	**Yes**	**No**	**Yes**	**Yes**	**Yes**	**Flare aerosols**	**10th Ave**
At-grade	**Yes**	**Yes**	**Yes**	**Yes**		**Flare aerosols**	**13th Ave**
	Barrier + sound wall	Downwind canopy	Summer	Fall	Winter		1972
At-grade	No	No	Yes			Lead	I-405
							2002
At-grade	**No**	**No**	**Yes**	**Yes**		Roadway aerosols	Zhu et al. I-710
							2007
At-grade, braking	No	No	Spring		Yes	Roadway aerosols	Watt Ave
							2010
At-grade	**No**	**No**		**Yes**		Flare and Roadway aerosols	NEXUS I-96



Fig. 4. Location of the 10th and 13th Avenue transects downwind of I-5 in Sacramento.

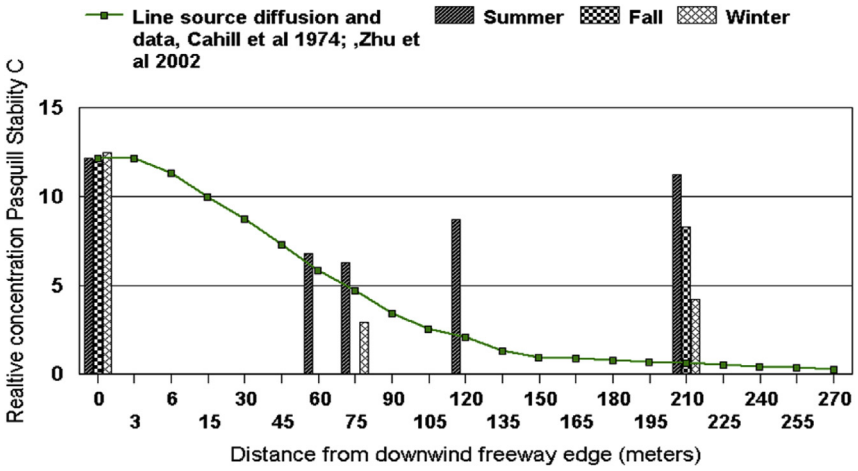

Fig. 5. Transport of very fine and ultra-fine flare tracer aerosols downwind of I-5 on 10th Avenue as a function of season. The plot also includes the line source diffusion modeling results that matched the lead (Cahill and Feeney, 1973) and fine aerosol and CO results (Zhu et al., 2002b) at at-grade freeways.

wind causes the virtual box to slide across the freeway while vehicles are emitting into the box. A new box takes its place upwind in a smooth transition and the process repeats.

Since accurate traffic data and meteorology were available and emissions of automotive lead were precisely known from the literature, (Habibi, 1973), the sliding box model gave a roadway edge prediction at the at-grade freeway section of 4.0 ± 0.4 μg/m^3 for 5000 vehicles/hr, winds > 5 km/h. The data at the at-grade site based on highway emission data (Habibi, 1972) were in excellent agreement with the model, 4.0 ± 0.6 μg/m^3 without any need for scaling. The results are shown in Table 3.

The sliding box model was also successfully applied in General Motors test facility studies of sulfur from catalytic converters. (Courtney et al., 1978).

The 1972 results from the fill section established that freeway pollution was transported downwind into residential areas far more than at-grade models and data predict, with important health impacts. The results were so at odds with the at-grade data that we returned to sample again, and at farther differences downwind, confirming and extending the earlier work.

Data were modeled using and elevated line source diffusion model with various stability classes (Cahill and Feeney, 1973, Fig. 62). Based upon qualitative observations of the meteorology, Pasquill stability class C (slightly unstable) was used as the preferred class, but model runs were done from Class A (unstable) to Class F (very stable). Modest reductions in concentration were made for particle settling based on a 1.0 μm size since our measurements showed 80% of all lead was below 5.0 μm aerodynamic diameter.

Fig. 8 shows the results for the selected Class C, Class B (more unstable) and Class D (neutral stability). The more stable classes E and F (not shown) propagated the freeway aerosols even farther

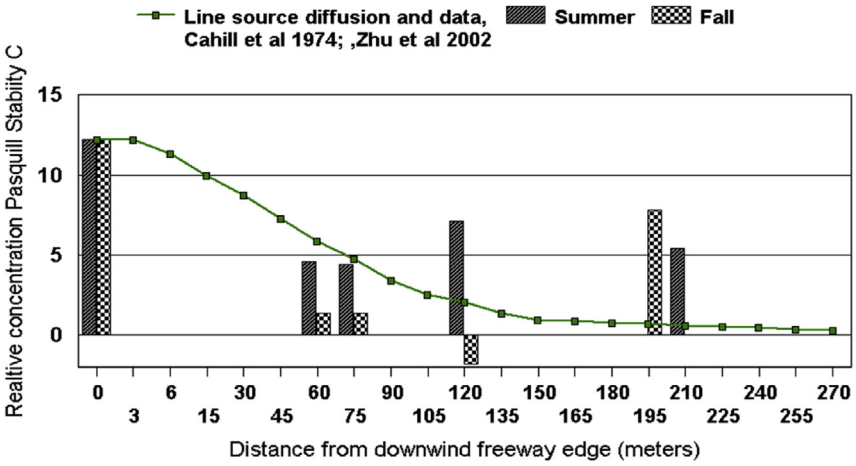

Fig. 6. Results for the 13th Avenue transects.

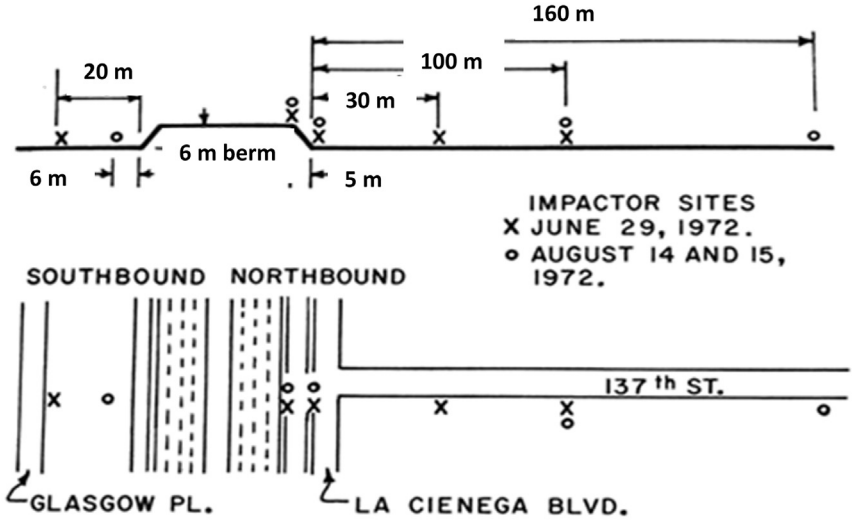

Fig. 7. Fill section on the San Diego Freeway (current I-405).

Table 3
Lead levels in μg/m^3 normalized to 5000 v/h, for wind velocities >5 km/h. Prior nomenclature was I-405 (San Diego), I-10 (Santa Monica), and I-110 (Harbor) freeways.* Data were taken on a pedestrian bridge over the middle of the freeway (Fig. 13).

	Freeway sites	On freeway	Right of way fence	Downwind # 1	Downwind # 2
Freeway configuration	Distance to median	30 m	40 m	100 m	160 m
At-grade theory		4.0 ± 0.4 μg/m^3	3.1 μg/m^3	1.4 μg/m^3	0.41 μg/m^3
At-grade data	I – 405	4.0 ± 0.6 μg/m^3	3.4 ± 0.6 μg/m^3	1.4 ± 0.2 μg/m^3	0.35 ± 0.06 μg/m^3
Fill sections data	I – 405 at 137th St. (2)	4.8 ± 1.2 μg/m^3	2.3 ± 0.6 μg/m^3	3.1 ± 0.8 μg/m^3	3.5 ± 0.9 μg/m^3
Cut sections data	I–10 at 4th, (2) I-110 at 146th	4.7 ± 0.6* μg/m^3	1.3 ± 0.2 μg/m^3	0.3 ± 0.06 μg/m^3	

from the freeway with only modest dilution. The data from Table 3 include average of all runs with wind velocities >5 km/h and upwind directions normal to the freeway, to ±45°. The semi-quantitative agreement with theory and experiment supported the observational data and confirmed that fill section freeways have major impact far downwind. At the 100 m site downwind of the fill section freeway in a residential neighborhood, the measured 24 h lead level for particles below 5 μm was 10 μg/m^3 ± 2.5 μg/m^3. The current US EPA standard is 0.15 μg/m^3, quarterly average.

Note than as wind velocities drop to an average 1.6 km/h, the model predicts the edge of freeway value at 25 μg/m^3 of lead/5000 v/hr, close to the observed 30 μg/m^3 of lead/5000 v/hr observed in these conditions at two sites.

The fill section lead data seen in 1972 are added to the 10th Avenue data in Fig. 9.

The good agreement between the 1972 fill section data with the 2013 data shows that the combination of the sound wall and/or the weak (~30%) vegetation screen has turned the at-grade section into an equivalent fill section freeway, with serious implications downwind.

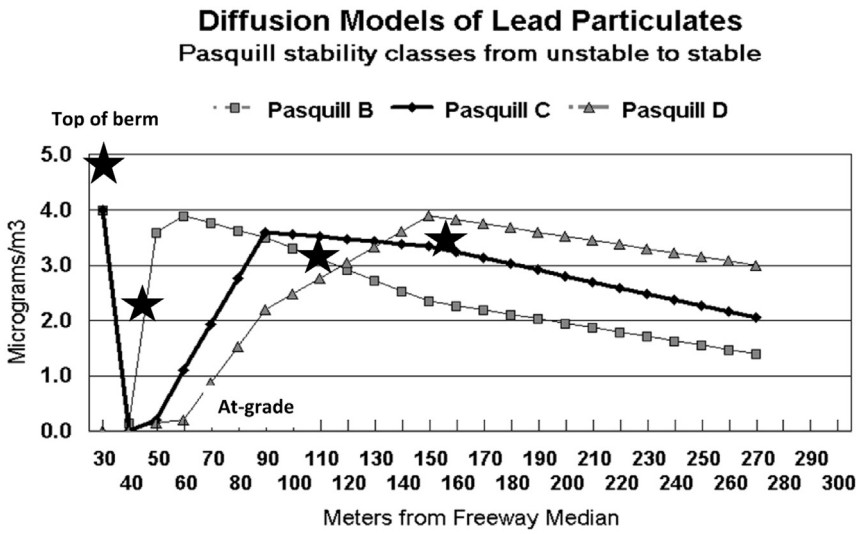

Fig. 8. Line source diffusion modeling of 1972 fill section lead data. Distances are from the freeway median, and data from Table 3 shown by stars.

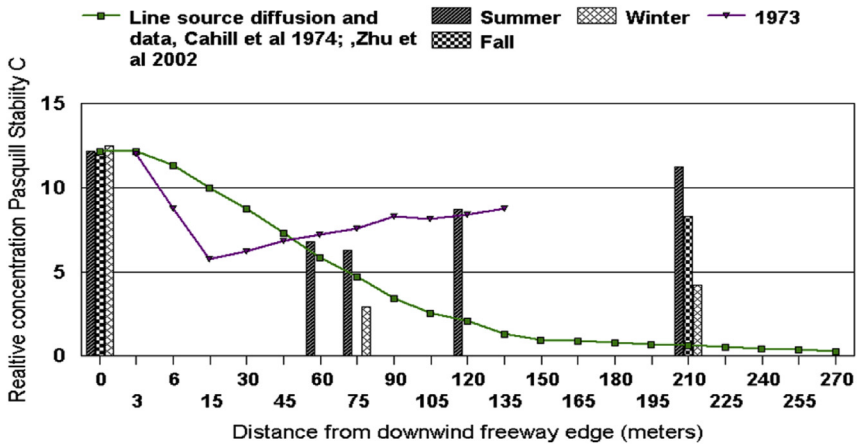

Fig. 9. Transport of flare tracer aerosols downwind of I-5 on 10th Avenue as a function of season, with a fit the lead seen at the fill section freeway site in 1973.

6. Results

6.1. Raised or fill section freeways

The final site used for these evaluations was 35th Avenue downwind of I-5 south of Sacramento. This was a complex site, with a large and opaque screen of redwood trees at the edge of a freeway on a 15 m berm above 35th Avenue (Fig. 11). This site was chosen partly to repeat the measurements done in the 1972 Los Angeles lead study on raised freeways. There was almost no tree canopy downwind. Convenient freeway off ramps allowed an efficient use of the pickup source truck in freely flowing traffic.

Below we include both the current I − 5 transects and others non-at-grade roadways relevant to the study (see Table 4 and Fig. 12).

The results for the fill section freeway in the Los Angeles lead study are also shown, as well as at at-grade freeway profiles. While the results confirm and extend the Los Angeles fill section results, the implications are unfortunate. The fill section freeway with a strong redwood screen results in reductions in roadway aerosols out to about 200 m, but beyond that point, roadway pollutants are pushed deeply into downwind residential neighborhoods far from the freeway with little dilution. There is the possibility that the redwood screen may have actually enhanced the downwind transport, acting like a massive sound wall. At the wind velocities seen during this study, diffusion onto vegetation would not be a factor, unlike during the winter inversion conditions.

At 160 m downwind, the at-grade theory, at-grade data, and Emfac2007 all predict pollution levels circa 10% of the near freeways values. However, the fill section gives 87%, of the near freeway values, and the levels were still rising farther downwind.

The profile has been recently better explained by improved models (Baldauf et al., 2013) that showing a gyre behind the berm over which the freeway air passes with little dilution (Fig. 13).

The result of these early experiments showed that impact studies of roadways must include all highway configurations, greatly increasing the number of transects required. This result was neglected in the assumption that by removing lead from gasoline would also remove freeway health impacts. That assumption is no longer tenable, and the need for many more transects drives our attempt to develop better methods are needed to achieve this goal.

One meteorological condition that was not encountered in these tests was the typical winter inversions common in the California Central valley. Models show that in this case on roadway pollutants reach their maximum values, and it is in these conditions with low wind velocities that diffusion of ultra-fine pollutants onto

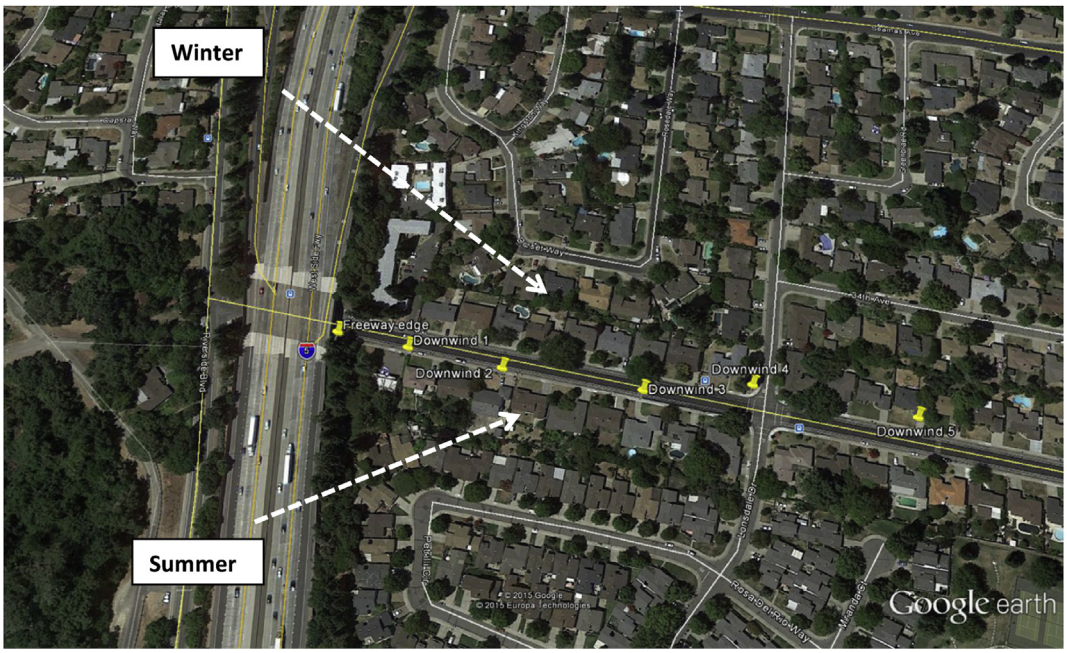

Fig. 10. Location of the 35th Avenue transect downwind of I-5 in Sacramento. The wind in the summer test was from the southwest, while the winter winds were from the northwest (marked).



Fig. 11. Redwood barrier east (and west, not shown) of Interstate 5 at 35th Avenue.

vegetation becomes most efficient (Fig. 3).

7. Results

7.1. Depressed or cut section freeways

While we had no cut section freeways in the current study, we include such data from the 1972 tests for completeness sake (Fig. 14, I-10). It, too, illustrates the dramatic order of magnitude of impacts of freeway configuration seen in Table 3. The cut section freeway was 5 times cleaner than the at-grade freeway at 100 m. As in the case of the fill section freeway, the results so differed from our expectations and that of other agencies (US EPA, 1972) that we returned to the Santa Monica freeway cut section we used before and made additional measurements.

Specifically, we placed a fast rotating 5 stage Lundgren impactor (Lundgren, 1967) directly next to the south traffic lane and placed a sampler at the middle of the pedestrian overcrossing. The pattern of optical absorption at the freeway showed a regular pattern of 7–11 min duration in which the optical absorption (soot) showed cleaner air being drawn down in to the freeway. When these data were combined with the low values at both freeway ROW fences and the elevated values directly above the freeway median, we proposed that the waste heat of the vehicles, partially trapped in this cut section, were warming the air. Using traffic and gasoline mileage, we predicted 1.0° C/minute in the sliding box mixed zone. Thus, in 7–11 min, the on freeway air had become warm enough to rise, drawing clean air in from the edges and thus sparing houses direct adjacent to the freeway. A similar effect was seen in the Watt Avenue transects Spring data (Cahill et al., 2014), and supported by

Table 4
Summary of relevant transect studies for fill and depressed freeways. The vegetation barriers was ~100% at 35th Avenue (Fig. 10).* A vegetation barrier was also present at I-10.1

Freeway configuration	Vegetation	Vegetation	Season			Tracer used	Transect site
	Barrier + sound wall	Downwind canopy	Summer	Fall	Winter		2013
Raised 12 m	**Yes**	**No**	**Yes**		**Yes**	**Flare aerosols**	**35th Ave**
	Barrier + sound wall	Downwind canopy	Summer	Fall	Winter		1973
Raised 10 m	No	No	Yes			Lead	I – 405 (2)
Depressed	No*	No	Yes			Lead	I – 10 (2) I – 110

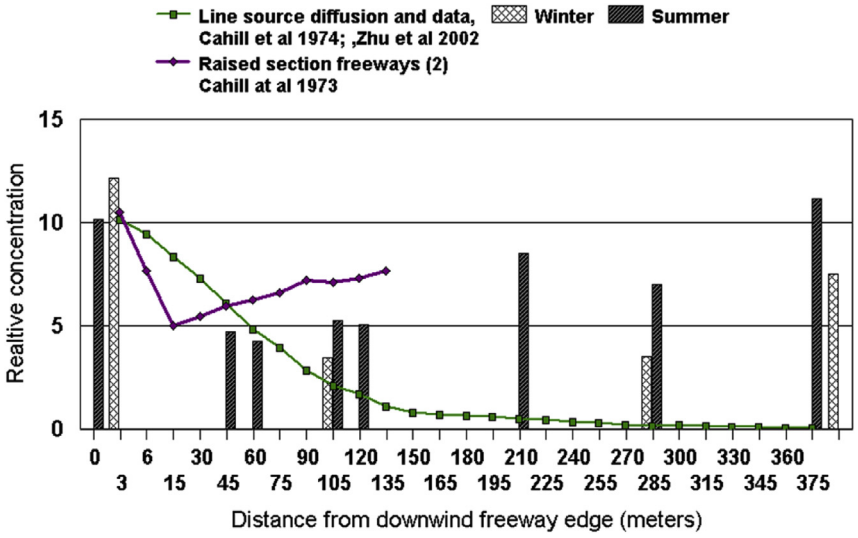

Fig. 12. Results of the 35th Avenue fill section freeway, summer and winter.

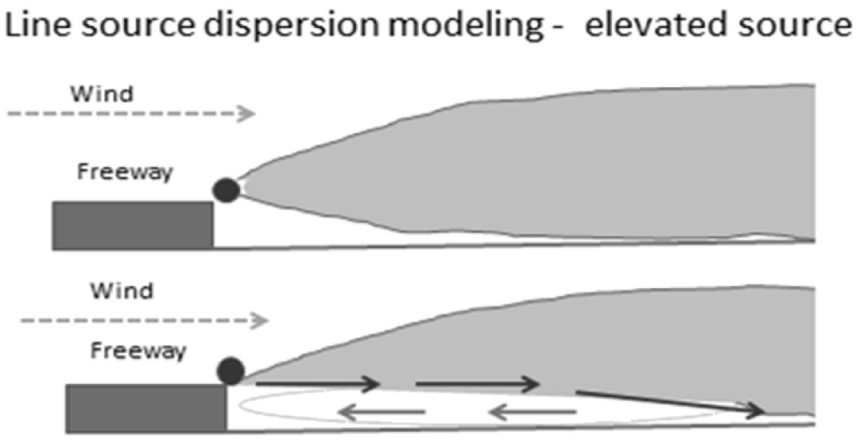

Fig. 13. Models of downwind dispersion from raised or fill section roadways. Top, the model used in Cahill and Feeney, 1973, the bottom the Baldauf et al., 2013 model.

measured temperature profiles on and across the heavily traveled roadway.

There was also a strong screen of trees at the lip of the depression, which may also have helped screen local residences from freeway impacts. We must note that the LA measurements were made in the typical summer marine inversion common in Los

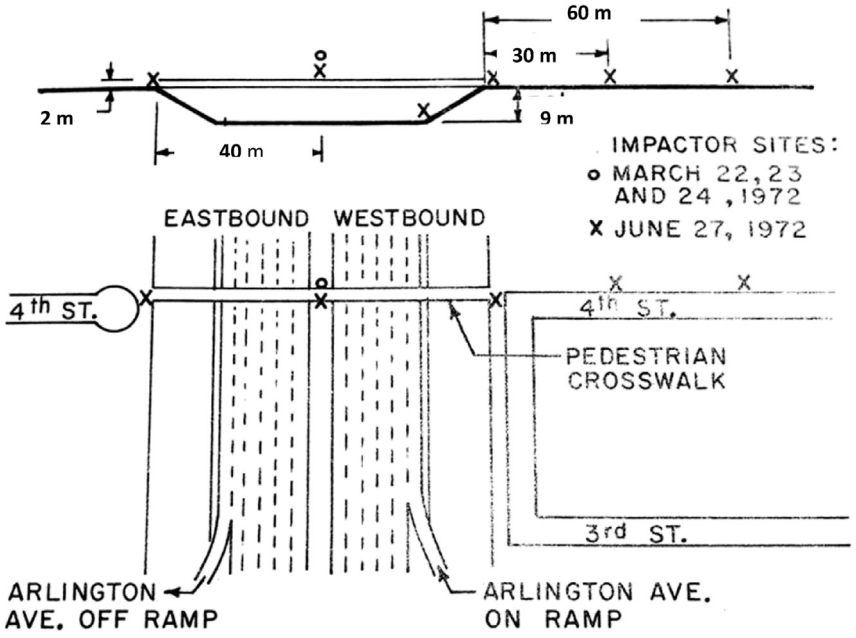

Fig. 14. Configuration and sampler placement at the Santa Monica freeway (current I-10) cut section.

Angles, with cool wind from the west. It should be tested in other metrological regimes as it provides a potential method to mitigate freeway impacts.

8. Conclusions

We present a new way to accomplish such transects accurately and inexpensively. We present and evaluate a method of tracking aerosol penetration downwind of roadway using artificial very fine and ultra-fine aerosol tracer from emergency road flares emitted from vehicles on the highways. The unique size and composition of flare aerosols allows for inexpensive, portable aerosol collection samplers and easy to analyze Teflon filters. Each measurement takes only 1 h, and can be repeated in as little as 30 min to reload filters. The method is strictly quantitative, shown by the accuracy and precision ±4% of the side by side field tests, and is capable of establishing impacts far downwind. Another option, as was done in the NEXUS study in Detroit, is using continuous collection of aerosols by rotating drum samplers, with collection onto the 0.26 to 0.09 μm DRUM size mode. The fast time response allows each study to follow diurnal patterns in traffic and meteorology. Since the very fine and ultra-fine particles are similar to the size of both "wear" and diesel aerosols, we have shown that they can mimic removal onto vegetation, a major potential means of mitigation. Thus, while the primary purpose of this work was to examine the utility of artificial ultra-fine tracer aerosols for highway transect studies under realistic conditions, the results also highlighted the need for a much more complete set of freeway transect studies including various freeway configurations, traffic conditions, downwind vegetation, and meteorology in order to predict health impacts from roadways.

Acknowledgements

The authors gratefully acknowledge the support of the Sacramento Metropolitan AQMD for this work, as well as volunteers from Breathe California/Sacramento Emigrant Trails. One of us (C. dlC) benefited from intern support from the École Nationale Supérieure de Chimie et de Physique de Bordeaux, France. We also wish to recognize the efforts made by the ALS analytical team, Dr. Yongjing Zhao, Dr. Steve Cliff, and Prof. Kevin Perry (U. Utah) for the sensitivity achieved in the filter analyses. Finally, the understanding of the Sacramento Police Department is appreciated after a bomb threat was phoned in by a resident who observed a 10th Avenue SFU sampler near the city water works. New protocols were put in place to avoid future problems.

References

ARB, 2007. Emfac2007. California Air Resources Board. www.arb.ca.gov/msei/onroad/.../docs/user_guide_Emfac2007.pdf.

Baldauf, Richard, McPherson, Greg, Wheaton, Linda, Zhang, Max, Cahill, Tom, Bailey, Chad, Hemphill-Fuller, Christina, Withycombe, Earl, Titus, Kori, 2013. Integrating Vegetation and Green Infrastructure into Sustainable Transportation Planning, Transportation Research Bulletin. National Academy of Sciences.

Brugge, Doug, Durant, John L., Rioux, Christine, 2007. Near-highway pollutants in motor vehicle exhaust: a review of epidemiologic evidence of cardiac and pulmonary health risks. Environ. Health 6, 23. http://dx.doi.org/10.1186/1476-069X-6-23.

Cahill, Thomas A., Ashbaugh, Lowell L., Barone, John B., Eldred, Robert A., Feeney, Patrick J., Flocchini, Robert G., Goodart, Charles, Shadoan, Danny J., Wolfe, Gordon W., 1977. Analysis of respirable fractions in atmospheric particulates via sequential filtration. J. Air Pollut. Control Assoc. 27, 675–678.

Cahill, Thomas A., Eldred, Robert A., Feeney, Patrick J., Beveridge, Peter J., Kent Wilkinson, L., 1990. The stacked filter unit revisited. In: Mathai, C.V. (Ed.), Visibility and Fine Particles, pp. 213–222.

Cahill, T.A., Feeney, P.J., 1973. Contribution of Freeway Traffic to Airborne Particulate Matter. Final Report of the California Air Resources Board, Contract ARB-502.

Cahill, T.A., 1980. Proton microprobes and particle-induced x-ray analytical systems. Annu. Rev. Nucl. Part. Sci. 30, 211–252.

Cahill, T.A., Barnes, David E., Spada, Nicholas J., Lawton, Jonathan A., Cahill, Thomas M., 2011. Very fine and ultra-fine metals and ischemic heart disease in the California Central Valley 1: 2003 – 2007. Aerosol Sci. Technol. 45, 1125–1134.

Cahill, Thomas A., Barnes, David E., Miller, Roger E., Wuest, Leann, Barberie, Sean, Gribble, David, Buscho, David, Snyder, Jason, De la Croix, intern Camille, Martin, Jeanette, August, 2013. Ultra-fine Tracer Transects Downwind of Interstate 5, Sacramento. Final Report to the Breathe California of Sacramento/Emigrant Trails Health Effects Task Force.

Cahill, Thomas A., Barnes, David E., Spada, Nicholas J., 2014. Seasonal variability of ultra-fine metals downwind of a heavily traveled secondary road. Atmos. Environ. 94, 173–179.

Charrier, Jessica G., McFall, Alexander S., Richards-Henderson, Nicole K., Anastasio, Cort, 2014. Hydrogen peroxide formation in a surrogate lung fluid by transition metals and quinones present in particulate matter. Environ. Sci. Technol. 48 (12), 7010–7017.

Charrier, Jessica G., Anastasio, Cort, 2015. Rates of hydroxyl radical production from

transition metals and quinones in a surrogate lung fluid. Environ. Sci. Technol. 49 (15), 9317–9325.
CalTrans, http://www.dot.ca.gov/roadsandtraffic.html (2015).
Chen, L.C., Lippmann, M., 2009. Effects of metals within ambient air particulate matter (PM) on human health. Inhal. Toxicol. Int. Forum Resp. Res. 21, 1–31.
Courtney, W.J., Rheingrover, S., Pilotte, J., Kaufmann, H.C., Cahill, T.A., Nelson, J.W., 1978. Continuous observation of particulates during the general motors sulfate dispersion experiment. J. Air Pollut. Control Assoc. 28, 225–228.
Denier Van der Gon, H., Gerlofs Nijland, M., Gehrig, R., Gustafsson, M., Janssen, N., Harrison, R., Hulskotte, J., Johansson, C., Jozwicka, M., Keuken, M., Krijgsheld, K., Ntziachristos, L., Riediker, M., Cassee, F., 2013. The policy relevance of wear emissions from road transport, now and in the future—an international workshop report and consensus statement. J. Air Waste Manag. Assoc. 63, 136–149.
EPA, 2015. Workshop on Ultra Fine Particles. http://www2.epa.gov/air-research/epa-workshop-ultrafine-particle.
Feeney, P.J., Cahill, T.A., Flocchini, R.G., Eldred, R.A., Shadoan, D.J., Dunn, T., 1975. Effect of roadbed configuration on traffic derived aerosols. J. Air Pollut. Control Assoc. 25, 1145–1147.
Fujii, Eris, Jonathan, Lawton, Cahill, Thomas A., Barnes, David E., Hayes (IASTE intern), Chui, Spada, Nick, 2008. Removal Rates of Particulate Matter onto Vegetation as a Function of Particle Size. Final Report to the Breathe California of Sacramento Emigrant Trails Health Effects Task Force (HETF) and Sacramento Metropolitan AQMD.
Gauderman, W.J., McConnell, R., Gilliland, F., London, S., Thomas, D., Avol, E., Vora, H., Berhane, K., Rappaport, E.B., Lurmann, F., Margolis, H.G., Peters, J., 2000. Association between air pollution and lung function growth in southern California children. Am. J. Respir. Crit. Care Med. 162, 1383–1390.
Gertler, Alan, Mahmoud, Abu-Allaban, William, Coulombe, Gillies John, A., Pierson William, R., Rogers Rogers Fred, C., Sagebiel, John C., Tarnay, Leland, Cahill, Thomas A., 2003. Measurements of mobile source particulate emissions in a highway tunnel. Int. J. Veh. Des. 27, 86–93.
Grigoratos, Theodoros, Martini, Giorgio, 2015. Brake wear particle emissions: a review. Environ. Sci. Pollut. Res. 22 (Issue4), 2491–2504.
Habibi, Kamram, 1973. Characteristics of particulate matter in vehicle exhaust. Environ. Sci. Technol. 7, 223.
Hagler, G.S.W., Baldauf, R.W., Thoma, E.D., Long, T.R., Snow, R.F., Kinsey, J.S., Oudejans, L., Gullett, B.K., 2009. Ultrafine particles near a major roadway in Raleigh, North Carolina: downwind attenuation and correlation with traffic-related pollutants. Atmos. Environ. 43 (6), 1229–1234.
Health Effects Institute, 2009. Traffic Related Air Pollution: a Critical Review of the Literature on Emissions, Exposure, and Health Effects, HEI 17, Boston, MA.
Jenniskens, Peter, Fries, Marc D., Qing-Zhu, Yin, , et al.Worden, Simon P., 2012. Radar-enabled recovery of the Sutter's Mill Meteorite, a carbonaceous chondrite regolith breccia. Science 338, 1583–1587. http://dx.doi.org/10.1126/science.1227163.
Johansson, T.B., Akselsson, R., Johansson, S.A.E., 1970. X-ray analysis: elemental analysis at the 10^{-12} g Level. Nucl. Instrum. Methods 84, 141.
Karner, A.A., Eisinger, D.S., Neimeier, D.A., 2010. Near roadway air quality: synthesizing the findings from real world data. Environ. Sci. Technol. 44, 5334–5344.
Lewis, T.C., Robins, T.G., Dvonch, J.T., Keeler, G.J., Yip, F.Y., Mentz, G.B., Lin, X.H., Parker, E.A., Israel, B.A., Gonzalez, L., Hill, Y., 2005. Air pollution-associated changes in lung function among asthmatic children in Detroit. Environ. Health Perspect. 113, 1068–1075.
Lin, C.C., Peng, C.K., 2010. Characterization of indoor PM10, PM2.5, and ultra-fine particles in elementary school classrooms: a review. Environ. Eng. Sci. 27, 915–922.
Lippmann, Morton, 2009. Semi-continuous speciation analyses for ambient air particulate matter: an urgent need for health effects studies. J Expo. Sci. Epidemiol. Stud. 19, 235–247.
Lundgren, Dale, 1967. An aerosol sampler for determination of particle concentration as a function of size and time. J. Air Pollut. Control Assoc. 17 (Issue 4), 225–229.
McGee, M.A., Kamal, A.S., McGee, J.K., Wood, C.E., Dye, J.A., Krantz, Q.T., Landis, M.S., Gilmour, M.I., Gavett, S.H., 2015. Differential effects of particulate matter upwind and downwind of an urban freeway in an allergic mouse model. Environ. Sci. Technol. 49 (6), 3930–3939.
NEXUS, Kimbrough EPA, Sue, Shores EPA, Richard C., Whitaker EPA, Donald A., May 2013. FHWA and EPA National Near-road Study, Detroit, MI. Final report for the Detroit EPA/FHWA study. Report No.: DTFH61-07-X-30015. http://www.fhwa.dot.gov/environment/air_quality/air_toxics/research_and_analysis/near_road_study.
Oberdorster, Gunter, Stone, Vicki, Donaldson, Ken, March 2007. Toxicology of nanoparticles: a historical perspective. Nanotoxicology 1 (1), 2_25.
Ostro, Bart, Lipsett, Michael, Reynolds, Peggy, Goldberg, Debbie, Hertz, Andrew, Garcia, Cynthia, Henderson, Katherine D., Bernstein, Leslie, 2010. Long-term exposure to constituents of fine particulate air pollution and mortality: results from the California Teachers Study. Environ. Health Perspect. 118 (number 3), 363–369.
Peters, John M., Avol, Edward, Navidi, William, London, Stephanie J., James Gauderman, W., Lurman, Fred, Linn, William S., Margolis, Helene, Rappaport, Edward, Gong Jr., Henry, Thomas, Duncan C., 1999a. A study of twelve southern California communities with differing levels and types of air pollution I. Prevalence of respiratory morbidity. Am. J. Respir. Crit. Care Med. 159 (No. 3), 760–767.
Peters, John M., Avol, Edward, Navidi, William, London, Stephanie J., James Gauderman, W., Lurman, Fred, Linn, William S., Margolis, Helene, Rappaport, Edward, Gong Jr., Henry, Thomas, Duncan C., 1999b. A study of twelve southern California communities with differing levels and types of air pollution; II. Effects on pulmonary function. Am. J. Respir. Crit. Care Med. 159 (No. 3), 768–775.
Propper*, Ralph, Wong, Patrick, Bui, Son, Austin, Jeff, Vance, William, Alvarado, Álvaro, Croes, Bart, Luo, Dongmin, 2015. Ambient and emission trends of toxic air contaminants in California. Environ. Sci. Technol. 49 (19), 11329–11339. http://dx.doi.org/10.1021/acs.est.5b02766(20015).
Raabe, Otto G., Braaten, David A., Axelbaum, Richard L., Teague, Stephen V., Cahill, Thomas A., 1988. Calibration studies of the DRUM impactor. J. Aerosol Sci. 19 (2), 183–195. Plus personal communication 1995.
Roney, Jason A., White, Bruce R., 2006. Estimating fugitive dust emission rates using an environmental boundary layer wind tunnel. Atmos. Environ. 40 (Issue 40), 7668–7685.
Smolander, Heikki, Stenberg, Pauline, 1996. Response of LAI-2000 estimates to changes in plant surface area index in a Scots pine stand. Tree Physiol. 16 (3), 345–349.
US EPA, 1972. Private Communication from a Senior EPA Scientists, R.S.
Vette, A., Burke, J., Norris, G., Landis, M., Batterman, S., Breen, M., Isakov, V., Lewis, T., Gilmour, M.I., Kamal, A., Hammond, D., Vedantham, R., Bereznicki, S., Tian, N., Croghan, C., 2013. The near-road exposures and effects of Urban Air Pollutants Study (NEXUS): study design and methods. Sci. Total Environ. 448, 38–47.
WHO, July 18, 2013. Aerosols and Health RAVIHAAP. Final Technical Report.
Zielinska, B., Goliff, W., McDaniel, M., Cahill, T., Kittelson, D., Watts, W., 2003. Chemical Analyses of Collected Diesel Particulate Matter Samples in the E-43 Project. National Renewable Energy Laboratory.
Zhu, Y., Hinds, William C., Kim, Seongheon, Sioutas, Constantinos, 2002a. Concentration and size distribution of ultrafine particles near a major highway. J. Air Waste Manag. Assoc. 52, 1032–1042.
Zhu, Y., Hinds, W.C., Kim, S., Shen, S., Sioutas, C., 2002b. Study of ultra-fine particles near a major highway with heavy duty diesel traffic. Atmos. Environ. 36, 4323–4335.

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Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 2: 1974-1991

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Available online: 12 May 2011

To cite this article: Thomas A. Cahill, David E. Barnes, Earl Withycombe & Mitchell Watnik (2011): Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 2: 1974-1991, Aerosol Science and Technology, 45:9, 1135-1142

To link to this article: http://dx.doi.org/10.1080/02786826.2011.582196

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Aerosol Science and Technology, 45:1135–1142, 2011
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ISSN: 0278-6826 print / 1521-7388 online
DOI: 10.1080/02786826.2011.582196

Very Fine and Ultrafine Metals and Ischemic Heart Disease in the California Central Valley 2: 1974–1991

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The southern part of Central Valley of California in winter has long had high PM_{10} mass, which until about 1990 included sulfate, vanadium, and nickel from the burning of crude oil used to generate steam to enhance heavy petroleum recovery. In roughly 1990, natural gas became the major energy source used for steam generation. In 1989–1991, data were collected throughout California on the mortality from strokes and ischemic heart disease (IHD). Although no spatial variability was seen for strokes, the southern San Joaquin Valley was found to have IHD mortality rates roughly 60% greater than the rest of the valley. PM_{10} was statistically identified as the major factor associated with the IHD mortality. However, when the rate of IHD was reexamined in the 2003–2007 period, a sharp reduction, about 30%, was seen in the relative rates for southern San Joaquin Valley as compared with the northern Sacramento Valley. We have measured very fine and ultrafine vanadium and nickel aerosols in a winter experiment in 2009, which shows an order of magnitude reduction in vanadium and nickel aerosols as compared with the pre-1990 data, which is a consequence of the switch from burning crude oil to natural gas to generate the steam. The inference of a causal relationship between the reduced vanadium and nickel and the improved IHD rate is supported by a growing body of laboratory and epidemiological work on the toxicity of vanadium and nickel, including from oceangoing ships burning crude or residual oil.

Received 14 October 2010; accepted 27 November 2010.
The authors wish to gratefully acknowledge the input and oversight of the project by the ALASET Health Effects Task Force under Jananne Sharpless, Chair, and Betty Turner, ALASET liaison, HETF members Tom Cahill, Mel Knight, Michael Lipsett, Ralph Propper, Marc Schenker, Steve Van den Eden, and Earl Withycombe, as well as the suggestions of William Wilson, US EPA. The authors also wish to gratefully acknowledge the financial support of the Sacramento Metropolitan Air Quality Management District under its CEO, Norm Covell, and the Yolo-Solano AQMD, under its CEO, Larry Greene. Finally, the authors wish to thank Ms. Jeanette Martin for her untiring assistance in designing and assembling the original report.
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INTRODUCTION

The Central Valley of California is well known for exhibiting in much of its area serious violations of federal PM_{10}, $PM_{2.5}$, in winter, and ozone standards, in summer, matching or exceeding those seen for any commensurate area of the United States. Yet other parts of the valley share agriculturally based land uses and meteorology and do not exhibit serious violations of these standards. Although efforts continue to control particulate matter (PM) and ozone violations, this pollutant gradient offers an ideal situation to examine the effects of pollutants on health. Many of the confounding variables seen in comparison studies, such as meteorology, land use patterns, and cigarette smoking, are very similar throughout the Valley, and a wealth of data exists on the pollutants and their sources from district air monitoring and Air Resources Board (ARB) studies. The presence of detailed analysis of mortality from ischemic heart disease (IHD) and stroke during 1989–1991 reported by the Cardiovascular Disease Outreach and Epidemiology (CORE) Program (Kao et al. 1994) and the California Department of Health Services (CADHS 2010) provides a natural opportunity to compare the pollutant data and mortality data for the identical time ranges. While this article focuses on PM effects, the original report (Cahill et al. 1998) also examined the effects of ozone and carbon monoxide (CO) on IHD and stroke mortality; some of which are presented in this article for completeness. However, complexities in the spatial and temporal gradients of ozone require further interpretation, and thus, they are not examined in any detail in this article.

BACKGROUND

The northwest-southeast trending 550 km by 100 km Central Valley of California is one of the richest agricultural areas in the world (Figure 1). In addition, there are two major metropolitan areas in the Valley, the Sacramento-Fresno regions each with about 1 million residents, and otherwise towns are generally medium (circa a few 100,000) to small and spread

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FIG. 1. Map of the Central Valley of California. The northern part is referred to as the Sacramento Valley while the southern part is called the San Joaquin Valley. The areas within the dotted circumference vary in altitude from almost sea level in the Delta to a few 100 m in elevation. The small arrows denote the typical winter wind patterns (Hayes et al. 1984).

throughout the Valley. The mean population density is about 60 people/km^2.

High summer temperatures in the Valley (mean daily high, July, 36°C ± 1°C) lower the surface pressure and draw massive inputs of cool air into the Valley from the San Francisco Bay area, bringing with it oceanic aerosols and typical urban pollutants enhanced by the major petrochemical industrial sites at the Carquinez Strait. These latter sources lie directly in the path for the cold, dense winds from the San Francisco Bay. These winds funnel down the entire San Joaquin Valley, south of the strait, but rarely penetrate north very far in the Sacramento Valley, north of the strait. Rainfall in the Valley is rare during the period from May through October.

In winter, there is slow drainage of cold air off the Sierra Nevada to the Valley floor (mean daily low, January, 3°C ± 1°C) and then, at the rate of about 50 km/day, the air drains toward the lowest point, the Sacramento–San Joaquin Delta, directly east of the Carquinez Strait. Thus, little impact from the San Francisco Bay area is seen on most winter days in the Central Valley beyond the immediate Delta region. Winter rainstorms and strong northwest winds periodically clean out the Valley. Thus, the Valley tends to fall into two distinct and very different conditions: hot, dry summers with strong diurnal winds, and cool, foggy winters with long periods of stagnation. This results in two very different aerosol types: summer and winter (Figure 2).

In Figure 2, 24 h, one day in six PM_{10} mass at the Fresno 1st Street "Super-site" is shown (ADAM 2010). The site is in a largely residential neighborhood roughly 1 km east of the

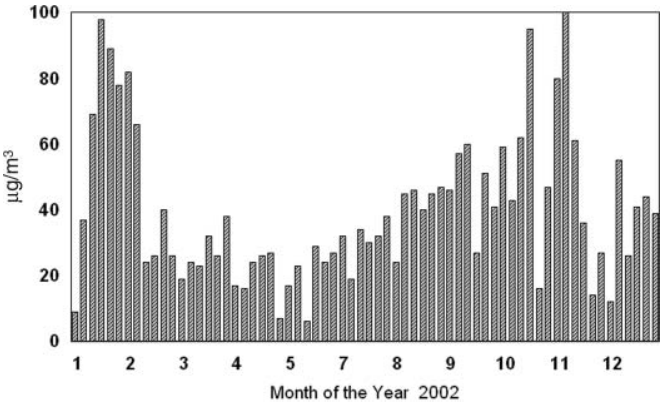

FIG. 2. PM_{10} mass at the Fresno "Super-site", 2002.

nearest major freeway, well away from agricultural operations. It is thus a good representation of what the average Fresno resident inhales. The annual pattern of PM_{10} mass has been consistent in the valley for many years, but this data only really became available around 1997, hence why Figure 2 uses more recent data to demonstrate the traditional annual cycle of particulate mass.

The health effects data are derived from CORE (Kao et al. 1996) and CADHS (2010). CORE collected city (>20,000 inhabitant) and countywide data on mortality from stroke and IHD; the latter is the largest source of mortality in the California Central Valley accounting for about one fourth of all deaths. The CORE data were corrected for age, >35 years, and reduced to incidence per 100,000 residents. The results were then presented as a ratio to the California average values the both males and females. Individual city data were weighted and averaged to obtain countywide averages in order to match the air pollution data.

The effect of race was examined over the entire California dataset. The data were available only in three classifications: "White," "Black," and "Other," with "Other" in the Central Valley being largely Latinos. No statistically significant difference was seen in the IHD rates for the dominant >75 years age group, but a slight enhancement of the rates for Blacks was seen in the 64- to 75-year cohort. For all ages, the mortality/100,000, 95% confidence limit, was 196 ± 3 for white males, 212 ± 9 for black males, and 199 ± 4 for other males; the corresponding values for females were 127 ± 3, 166 ± 5, and 135 ± 3. The stroke deaths, on the contrary, while only roughly one third of the rate of IHD mortality, showed stroke rates roughly twice as high for the "Black" and "Other" cohorts than the "White" cohort. Consideration was given to cigarette-smoking patterns, but no significant difference was seen along the length of the Valley (Table 1).

Four metrics for air pollution were studied, each with very different cardiovascular impacts: ozone (top 30 h and hours above 0.09 ppm), annual average CO, and annual average PM_{10}. The approximate cigarette-smoking patterns were calculated

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TABLE 1
Ischemic heart disease (IHD) and stroke mortality versus air pollutants in the Central Valley of California, 1989–1991

County (north to south)	IHD rate vs. CA average (%)	Stroke rate vs. CA average (%)	Ozone top 30 h (ppm)	Ozone hours >0.09 (h)	CO annual average (ppm)	PM_{10} annual average ($\mu g/m^3$)	Smoking rate average (%)
Shasta	−14	+9	0.095	20	0.54	30	22.4
Butte	−27	−3	0.078	6	0.93	38	22.4
Sutter	−4	+26	0.090	4		44	22.8
Placer	−17	−4		125		30	22.8
Sacramento	−6	+2	0.107	153	1.29	44	23.4
Yolo	+2	+13		16		30	22.4
San Joaquin	+15	+17	0.096	36	1.13	51	22.8
Stanislaus	−7	−3	0.102	119	0.75	48	22.0
Madera	+11	−23		30		53	22.0
Fresno	+3	−12	0.129	369	0.87	77	22.0
Kings	+17	+20	0.106	21		61	22.5
Tulare	+22	+8	0.093	192	0.88	67	22.5
Kern	+33	−11	0.111	605	0.80	68	22.5

from cigarette sales data. Correlations were calculated for all parameters and are presented in Table 2 and Figures 3 and 4. At some sites, measurements were lacking. No data were deleted.

To further investigate the statistical robustness of these data, we used "proc glm" on SAS version 9.1 for the analyses. Because there are only 13 observations in total, we did not feel that imputation would prove fruitful. Therefore, we ran multiple regression models with "percentage change of IHD" and "percentage change of stroke" as the outcome variables. The possible explanatory variables were "number of hours of ozone above 0.09 ppm" ("ozone"), "annual average PM less than 10 μm, measured in micrograms per cubic meter" ("PM_{10}"), and "percentage rate of smoking" ("smoking"). We checked the assumption of normality of the errors by formally using the Shapiro–Wilk test and the assumption of homoskedasticity informally using residual plots.

The overall stroke model was not significant ($p = 0.1108$). We did not proceed further for that outcome. However, the overall IHD model was significant ($p = 0.0330$). We used backward elimination as the model selection strategy, for example, that of Neter et al. (1996). Ozone and smoking were eliminated—in that order—leaving PM_{10} as the sole significant explanatory variable ($p = 0.0026$). The resulting linear regression is given by

$$\text{estimated percentage change of IHD} = -41.5 + 0.87 \times PM_{10},$$

and the corresponding r-squared value is 0.576. It is noteworthy that Fresno appears to be an outlier. If this point is removed, the slope and r-squared values jump dramatically. We have no cause to remove that point and we therefore use the model, as indicated earlier, as our finding. However, the Fresno value includes semirural sampling sites at the urban fringe that are not present in other San Joaquin Valley cities, which had at that time only a single city center site.

However, the strong association between aerosol mass and IHD posed a problem. As additional data were developed in the Central Valley from the IMPROVE program (Malm et al. 1994) and from extensive California studies (CRPAQS 2001, Cahill et al. 2003), it became clear that the major aerosol species that dominated fine mass was ammonium nitrate, with much smaller contributions from organic matter, including a wood smoke component, and ammonium sulfate. These are however water soluble and have not been closely linked to IHD in animal and laboratory studies. (Devlin 2003; Lippmann 2009).

TABLE 2
Correlation of air pollution to mortality by IHD and stroke in the Central valley of California, 1989–1991

Mortality	Ozone average top 30 h (ppm)	Ozone number hours > 0.09 (ppm)	CO (ppm)	PM_{10} ($\mu g/m^3$)
Correlation to IHD	$r^2 = 0.18$	$r^2 = 0.27$	$r^2 < 0.05$	$r^2 = 0.56$
Correlation to stroke	$r^2 = 0.21$	$r^2 = 0.19$	$r^2 < 0.05$	$r^2 < 0.05$

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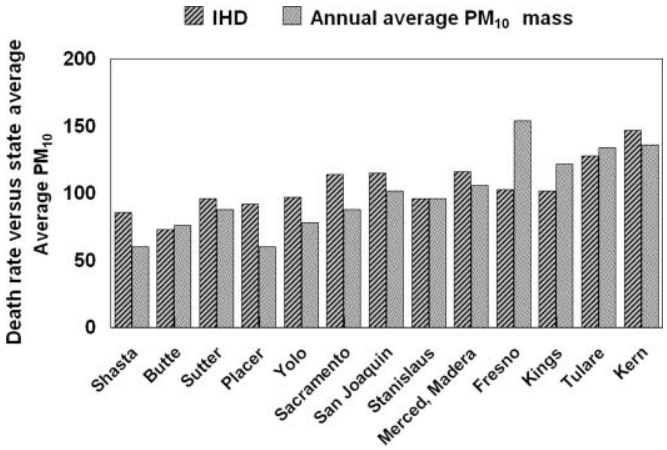

FIG. 3. Comparison of death rate from IHD, compared to the California average, and annual PM_{10} inhalable aerosol mass. Shasta County is at the very northern end of the California Central Valley, and Kern County is at the southern end.

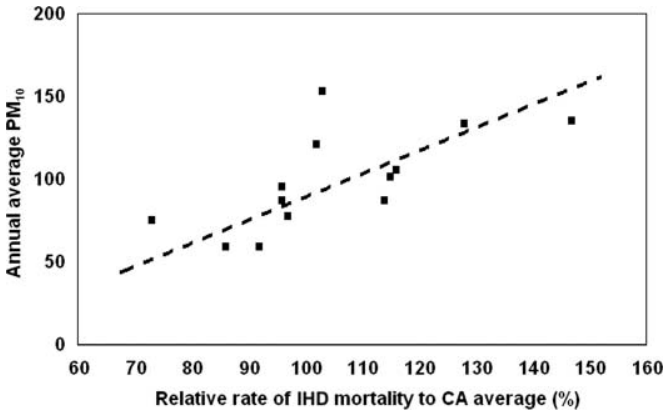

FIG. 4. IHD mortality rate relative to the California average versus PM_{10}. The parameters are associated by a regression $r^2 = 0.56$.

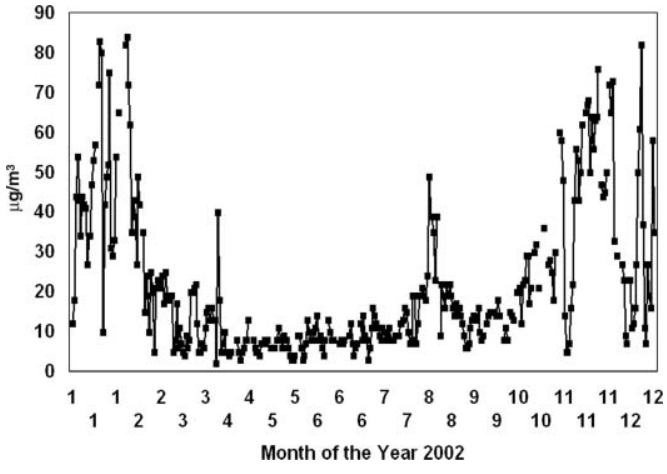

FIG. 5. $PM_{2.5}$ mass at the Fresno "Super-site," 2002, the same period used in Figure 2.

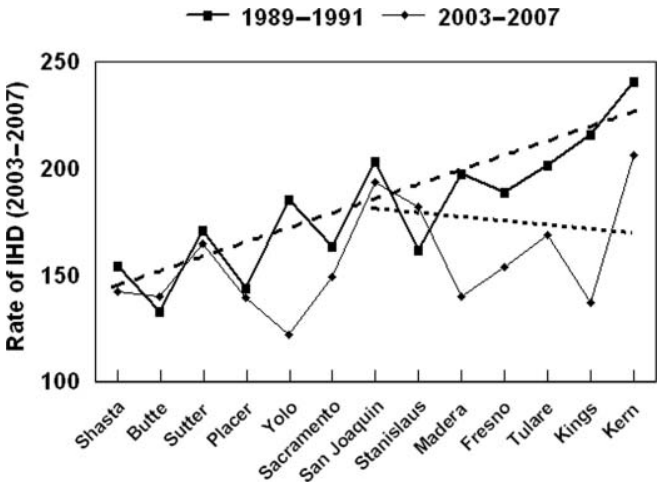

FIG. 6. IHD in the California Central valley, 1989–1991 versus 2003–2007. The 1989–1991 data are scaled to match the Shasta–Butte data, 2003–2007, as diagnostic protocols differed.

Reduction of IHD Rates: 2003–2007 Versus 1989–1991

Beginning around 1999, data on aerosol in the Central Valley were enhanced by the availability of $PM_{2.5}$ mass and chemical speciation at some San Joaquin Valley sites. In Figure 5, the same period for the Figure 2, one day in six PM_{10} mass is shown for 24 h daily fine $PM_{2.5}$ mass (ADAM 2010). The old federal 24-h $PM_{2.5}$ standard was 65 $\mu g/m^3$ and the current 24-h standard is 35 $\mu g/m^3$, which is routinely violated in winter. The annual average standard is 15 $\mu g/m^3$.

The question of IHD and aerosols was revisited for the period 2003–2007 (Cahill et al. 2010). From the recent data, it became

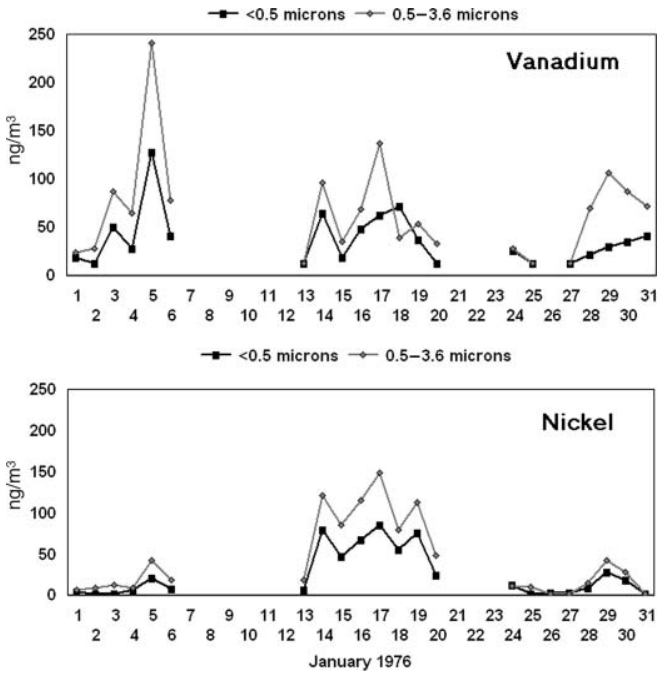

FIG. 7. Vanadium and nickel aerosols in Bakersfield, January 1976.

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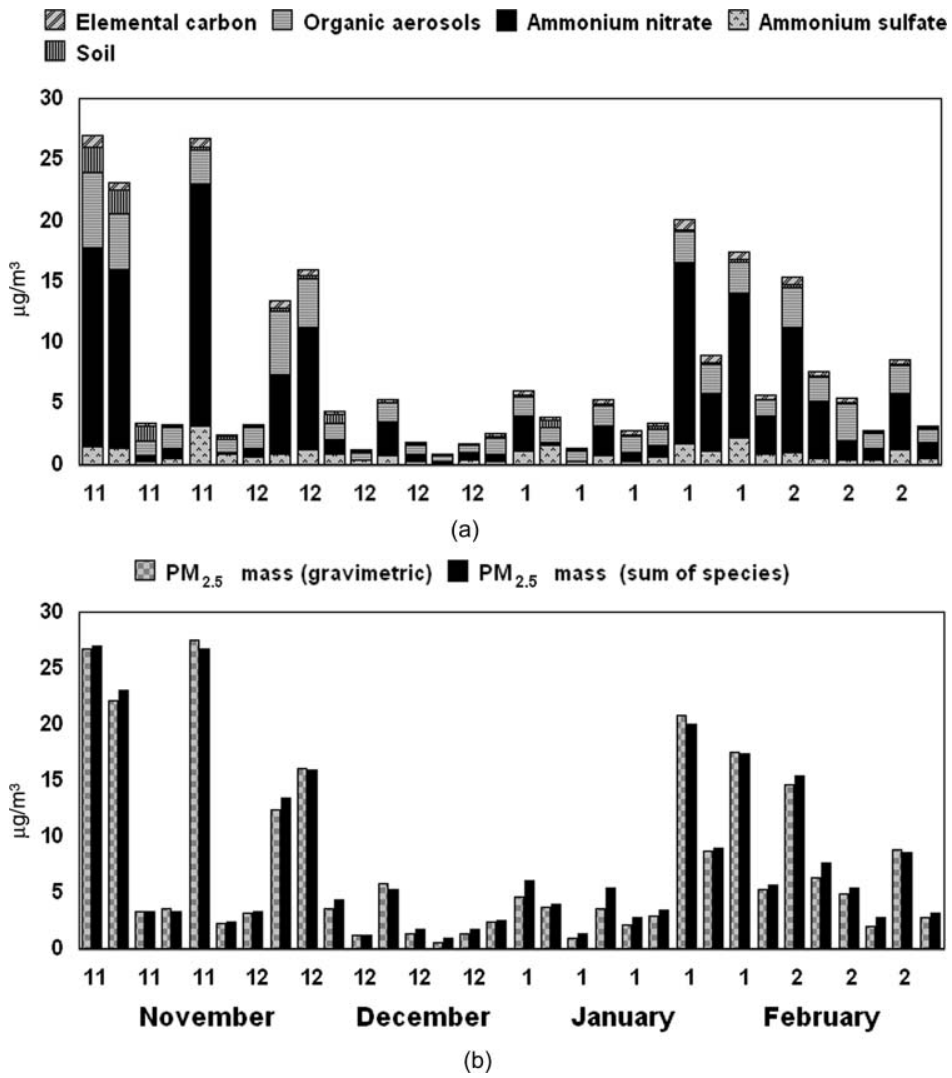

FIG. 8. (a) and (b) showing $PM_{2.5}$ mass closure and major species.

clear that a comparison of the IHD mortality, 1989–1991 versus 2003–2007, shows a major reduction, roughly 30%, that occurs in 2003–2007 for the counties north of Bakersfield (Figure 6). The trend for the northern half of the Central Valley is similar, while Bakersfield in Kern County is only slightly reduced. Thus, the question arises as to the causes for the improvement in the IHD rate.

The compositional analysis of Central Valley aerosols dates back to the early 1970s, including an innovative program of UC Davis for the California Air Resources Board (CARB), 1973–1977 (Cahill et al. 1974; Flocchini et al. 1976; Barone et al. 1978; Motallebi et al. 1990a, 1990b). A total of 14,100 daily aerosol measurements were taken in three size modes (15–3.5 μm, 3.5–0.50 μm, and 0.50–0.0 μm) and analyzed for elemental content by particle-induced x-ray emission (PIXE) (Cahill 1995) at about fourteen separate sites, including the valley sites of Chico, Sacramento, Visalia, (100 km NNE of Bakersfield), and Bakersfield. Bakersfield had one of the highest levels of vanadium and nickel aerosols in California, but port areas (Oakland, Richmond, and Los Alamitos) were also high (Figure 7).

Neither vanadium nor nickel was seen in sizes above 3.5 μm diameter. The radically different vanadium/nickel ratios occurred when winds came from the western (Taft, 40 km SW) or northern (Oildale, 5 km N) oil fields periods of stagnation, giving the highest pollution levels, favored sources in the much closer northern oil fields, some of which were within Bakersfield itself (Motallebi et al. 1990b). In addition, there was an oil refinery in Oildale, with potentially different emissions than the crude oil burned for enhanced oil recovery (EOR). Also it is noteworthy that while the vanadium and nickel concentrations can vary by over an order of magnitude, the lead levels were relatively

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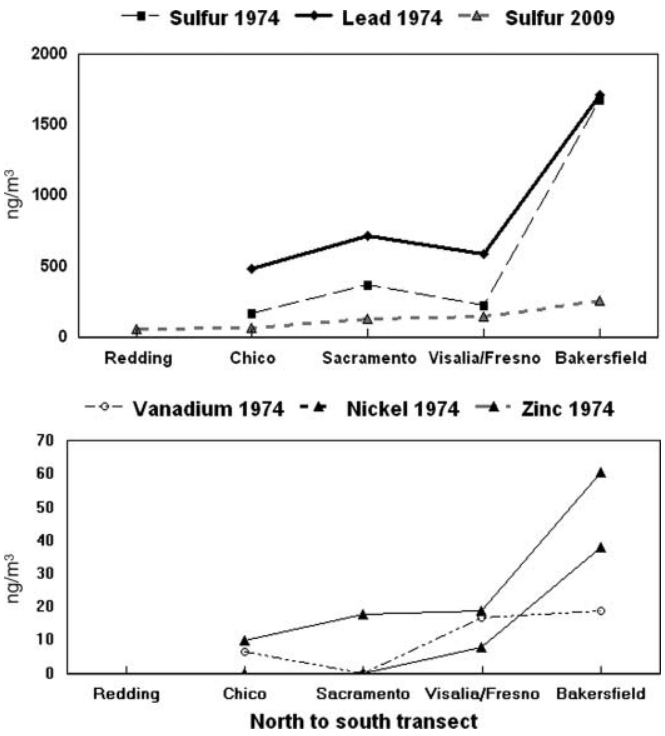

FIG. 9. Lead and sulfur, 1974–1976, versus sulfur, 2009, and vanadium, nickel, and zinc 1974–1976. Visalia lies between Bakersfield and Fresno.

constant, indicating a continuous impact of traffic-derived aerosols at Bakersfield.

Recent compositional analysis of the $PM_{2.5}$ aerosols in the southern San Joaquin Valley also became available through the IMPROVE site at Sequoia National Park (NP) starting in 1992 (Malm et al. 1994). The Sequoia NP Ash Mountain site was at low elevation, near 600 m, and thus received aerosols from the valley floor whenever the inversion lifted to that level.

IMPROVE had anticipated the value of $PM_{2.5}$ mass and full speciation, using quality assurance protocols of "integral redundancy" to measure major parameters by two or more independent methods. Sulfur from PIXE on Teflon in Channel A (Cahill 1995) is compared with sulfates after a denuder on Nylon filters in Channel B. Organic matter measured by combustion from tandem quartz filters in Channel C is compared to organic matter estimates by nonvolatile hydrogen of Teflon in Channel A (Cahill et al. 1989). Iron was measured by both PIXE and x-ray fluorescence (XRF) on the Teflon filters of Channel A. Thus, the gravimetric mass can be directly compared to the sum of all species (Figure 8b) and all major components (Figure 8a).

Figure 8 shows periodic incursions of high aerosol levels throughout the winter whenever the valley inversion rises to the altitude of Ash Mountain. Other than during these incursions, aerosol mass levels are very low, a few $\mu g/m^3$. By choosing an arbitrary concentration of 10 $\mu g/m^3$, we can be assured that we are seeing San Joaquin Valley aerosols diluted by the high inversion levels necessary for the Ash Mountain incursions. Finally, the excellent agreement between the mass of aerosol measured gravimetrically and the sum of species for all three IMPROVE channels (Figure 8a) shows that we are not missing any major component of the $PM_{2.5}$ mass.

Figure 5 showed that the violations of the annual and 24-h $PM_{2.5}$ standards in the San Joaquin Valley are driven by the winter aerosols. The high $PM_{2.5}$ values generally correspond to stable conditions with low inversions, and the clean periods to synoptic rainstorms passing through the Valley. Figure 8b shows that winter composition is dominated by fine $D_p < 2.5$ μm nitrates with smaller contributions from organic matter, wood smoke and vehicular exhaust, and some sulfates (IMPROVE 2010). The IMPROVE data also include fine metals, thus aiding our intercomparisons.

Winter data from the earlier efforts (Cahill et al. 1974, 2003; Flocchini et al. 1976) can be roughly compared with the current work (Cahill et al. 2010) by summing the four finest DRUM stages to obtain <0.56 μm particles (Table 3 and Figure 6).

Addressing the potential health impacts of these data, vanadium and nickel have the highest mortality risk coefficients of seventeen fine particulate matter (FPM) components (Lippmann et al. 2006). The elevated levels seen in 1974–1976 were sharply reduced as early as 1992–1993, using the vanadium and nickel levels in the southern San Joaquin Valley from the Sequoia IMPROVE site, although the Sequoia NP site's $PM_{2.5}$ data are not directly comparable to the valley floor's very fine (<0.5 μm) particle data. These data are shown in Figure 9. For comparison's sake, vanadium and nickel have current annual averages in FPM of 1.9 ng/m^3 across sixty metropolitan areas (MSAs) (Lippmann et al. 2006).

Examining the potential sources for the very fine (in this case <0.5 μm) particles (Table 3 and Figure 6), we see sulfur plus metals associated with crude oil combustion (vanadium and nickel), as well as lead and other vehicular metals. Kern County has very large reserves of crude oil, most of which lie just north and west of Bakersfield, although there was and is some oil extraction within the city itself. The Kern County oil fields have a heavy crude oil that requires EOR techniques such as steam injection to extract. Initially, the steam was generated by burning the crude oil itself, resulting in high pollution levels. In 1979, violations of federal air quality standards required Kern County to apply strict controls on sulfur dioxide, nitrogen dioxide, and particulate emissions, which included metals vanadium and nickel. EOR by crude oil combustion dropped slowly, 1980–1990, and then dramatically with the increasing availability of natural gas, with an immediate improvement in air quality by the early 1990s (CA Almanac). Thus, the population subject to IHD mortality in Bakersfield 1989–1991 had at least two decades of exposure to elevated high levels of very fine to ultrafine transition metals, specifically vanadium and nickel at 10–20 times the current US averages.

Laboratory data on the impact of vanadium and nickel aerosols has become more extensive (Zhang et al. 2009). Thus, we can hypothesize that the effective control of the

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TABLE 3
Comparison between January 1974–1976, averaged, and January 2009. The four finest DRUM stages of the 2009 data have been summed to be PM < 0.56 μm to better match the PM < 0.5 μm data of the earlier ARB/UCD aerosol network. The Sequoia NP and Fresno winter 2002–2003 data are of $PM_{2.5}$

	Sulfur	Vanadium	Nickel	Zinc	Lead
Valley transect 2009 [January 2009 (ng/m^3) <0.56 μm]					
Redding	88.8	0.2	1.0	13.9	2.5
Chico	136.9	0.5	0.4	5.2	2.1
Sacramento	246.0	0.4	0.1	6.9	1.6
Fresno	261.4	0.3	0.5	40.3	4.9
Bakersfield	505.0	0.2	2.3	32.0	9.4
Fresno $PM_{2.5}$ (ng/m^3)					
Winter 2002	266.2	0.47	0.22	12.7	1.2
Sequoia NP (~600 m), 10 episodes $PM_{2.5} > 10$ μg/m^3					
Winter 2002–2003 (ng/m^3)	194	0.2	0.1	4.7	1.0
Winter 1992–1993 (ng/m^3)	562	0.7	0.1	6.0	2.0
Valley transect 1974–1976 [January 1974–1976 (ng/m^3) average, <0.5 μm diameter]					
Redding	na	na	na	na	na
Chico	170	7	1	10	483
Sacramento	375	0	1	18	720
Visalia	225	17	8	19	593
Bakersfield	1685	19	38	61	1714
Port of Los Angeles					
August–September, 2008	2565	16	4	13	6

crude-oil-derived metals in the late 1980s may be responsible for the decreased IHD death rate at sites north of Bakersfield in the 1990s and beyond. This hypothesis is supported by other studies, such as the sharp drop in mortality after a sharp drop in sulfur, vanadium, and nickel in Hong Kong when the sulfur levels in fuels were lowered by edict (Hedley et al. 2002; Lippmann et al. 2006). The presence of high levels of nickel in New York City from residual oil combustion in buildings is hypothesized to be a causal factor in the enhanced mortality associated with $PM_{2.5}$ (Peltier et al. 2009; Peltier and Lippmann 2010).

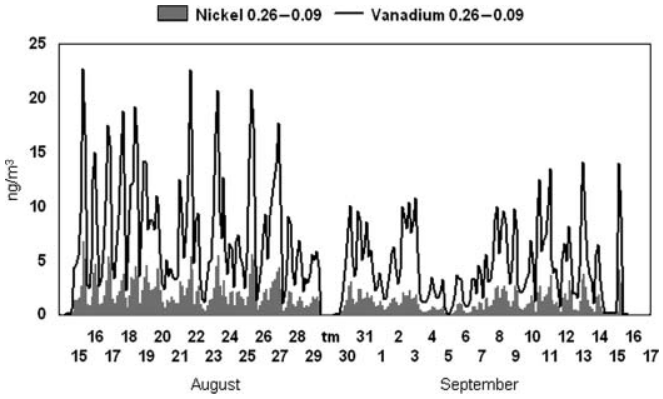

FIG. 10. Very fine ($0.26 > D_p > 0.09$ μm) vanadium and nickel in Wilmington, CA, downwind during daylight hours at the Port of Los Angeles.

The current data also have relevance to the emission of sulfur, vanadium, and nickel by oceangoing ships. Recent data in New York and New Jersey (Peltier et al. 2009), and the Port of Los Angeles (Cahill et al. 2009), show the impacts of oceangoing ships burning residual or bunker oil. In the Los Angeles study, the average concentrations of fine sulfur, vanadium, and nickel in the coastal town of Wilmington in August 2008 were 2565, 16, and 4.4 ng/m^3, respectively (Table 3). Southern winds bring aerosols from the Port of Los Angeles into Wilmington routinely during part of each day (Figure 10). Ultrafine particles were not collected in this study, so the actual values could have been significantly higher than these values. Thus, on the basis of the Bakersfield data, the enhanced rates of IHD are predicted in the area.

CONCLUSION

IHD mortality in the Central Valley of California, corrected for age, race, sex, and smoking, was almost 60% greater at the more polluted southern end of the Central Valley than the less polluted northern end in 1989–1991 despite similar meteorology and land use patterns throughout the Valley. A significant association, $r^2 = 0.56$, is seen between IHD mortality and PM_{10}, but negligible correlation, $r^2 < 0.05$, is seen with stroke mortality. When PM_{10} data are converted to an estimated $PM_{2.5}$ mass

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by using more recent measurements, these results are similar to other studies such as the "6 Cities" study (Dockery et al. 1993) in mortality increase per particulate mass; 1.9% mortality increase per $\mu g/m^3$ of $PM_{2.5}$ for "6 Cities," while 1.8% mortality increase per $\mu g/m^3$ of estimated $PM_{2.5}$ for this study, despite major differences in meteorology and pollutant mix. No association was seen between CO and any health impact. Ozone was only weakly correlated with IHD and stroke. However, strong east-west ozone gradients were not corrected for in this work, and thus, these results for ozone must be viewed as merely indicative of the possible impacts.

The sharp reduction seen, when the IHD data were reexamined in the period 2003–2007, was coincident with a reduction in the high levels of vanadium (19 ng/m^3) and nickel (38 ng/m^3) due to oil field operations from before 1974 to after 1990, when new protocols were adopted. The vanadium and nickel levels in 2009 were close to the national average values, both roughly 1.9 ng/m^3. The relatively smaller reduction in IHD rate in Bakersfield itself is associated with the continuing impacts of vehicular very fine and ultrafine metals (Cahill et al. 2010, this issue).

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REFERENCES

ADAM. (2010). *ADAM California Environmental Protection Agency—Air Resources Board, ADAM Data Summaries*. Retrieved from www.arb.ca.gov/adam

Barone, J. B., Cahill, T. A., Eldred, R. A., Flocchini, R. G., Shadoan, D. J., and Dietz, T. M. (1978). A Multivariate Statistical Analysis of Visibility Degradation at Four California Cities. *Atmos. Environ.*, 12:2213–2221.

Cahill, T., Cliff, S. S., Jimenez-Cruz, M., and Perry, K. (2003). *Aerosols by Size, Time, and Composition in Support of the Fresno Asthmatic Children's Environment Study, 2001*. Final Report to the California Air Resources Board, Sacramento, CA.

Cahill, T., Dutcher, D., Clark, C., Martin, J., McCarthy, T., and Lipnick, D. (1998). *Comparison of Cardiac and Stroke Mortality to Carbon Monoxide, Ozone, and Particulate Air Pollutant Concentrations in the Sacramento Valley Region*. Report to the Health Effects Task Force, American Lung Association Sacramento Emigrant Trails, Sacramento, CA.

Cahill, T. A. (1995). Compositional Analysis of Atmospheric Aerosols, in *Particle-Induced X-Ray Emission Spectrometry (Chemical Analysis Series, Vol. 133)*, S. A. E. Johansson, J. L. Campbell, and K. G. Malmqvist, ed., John Wiley & Sons, Hoboken, NJ, pp. 237–311.

Cahill, T. A., Barnes, D., and Smeltzer, K. (2009). *Deposition of Coarse Toxic Particles in Wilmington, CA*. Final Report for the Department of Toxic Substances Control (DTSC), Sacramento, CA.

Cahill, T. A., Barnes, D. E., Spada, N. J., Lawton, J. A., and Cahill, T. M. (2010). Very Fine and Ultra-Fine Metals and Ischemic Heart Disease in the California Central Valley 1: 2003–2007. *Aerosol Sci. Technol.*, 45:1124–1134.

Cahill, T. A., Eldred, R. A., Motallebi, N., and Malm, W.C. (1989). Indirect Measurement of Hydrocarbon Aerosols Across the United States by Non-Sulfate Hydrogen-Remaining Gravimetric Mass Correlations. *Aerosol Sci. Tech.*, 10:421–429.

Cahill, T. A., and Flocchini, R. G. (1974). *Regional Monitoring of Smog Aerosols, Annual Reports to the California Air Resources Board, Contract 2–006, 1974, 1975, 1976, 1977*, Sacramento, CA.

California Department of Health Services. (2010). *California Department of Health Services: Center for Health Statistics Office of Health Information and Research (OHIR)*. Retrieved from http://www.dhs.ca.gov/hisp/chs/OHIR/vssdata/Tables.htm

CORE. (September 1994). *Cardiovascular Disease Outreach and Epidemiology Program. The Local Burden of Cardiovascular Disease; Death from Heart Disease and Stroke in California Cities*. Report No. 1. Kao, C., Gazzinaga, J. M., Cowling, D. W., Cohen, R. D., Fox, P., Kaplan, G. A. California Department of Health Services and the University of California, San Francisco, CA.

California Regional Particulate Air Quality Study (CRPAQS). (2001). *California Regional Particulate Air Quality Study*. Retrieved from http://www.arb.ca.gov/airways

Devlin, R. (2003). *What We Know and What We Think We Know About Health Effects of Fine Particles: Is It Enough?* Annual Meeting. American Association of Aerosol Research (AAAR), Charlotte, NC.

Dockery, D. W., Pope, C. A. III, Hu, X. P., Spengler, J. D., Ware, J. H., Fay, M. E., Ferris, B. G., and Speizer, F. E. (1993). An Association Between Air Pollution and Mortality in Six US Cities. *N. Engl. J. Med.*, 329:1725–1759.

Flocchini, R. G., Cahill, T. A., Shadoan, D. J., Lange, S. J., Eldred, R. A., Feeney, P. J., Wolfe, G. W., Simeroth, D. C., and Suder, J. K. (1976). Monitoring California's Aerosols by Size and Elemental Composition. *Environ. Sci. Technol.*, 10:76–82.

Hayes, T. P., Kinney, J. J. R., and Wheeler, N. J. M. (1984). California Surface Wind Climatology, State of California Air Resources Board, Aerometic Data Division, Sacramento, CA.

Hedley, A. J., Wong, C.-M., Thach, T. Q., MStat, S. M., Lam, T.-H., and Anderson, H. R. (2002). Cardiorespiratory and All-Cause Mortality After Restrictions on Sulfur Content of Fuel in Hong Kong: An Intervention Study. *Lancet*, 360(9346):1646–1652.

Interagency Monitoring of Protected Visual Elements (IMPROVE). (2010). Retrieved from http://vista.cira.colostate.edu/IMPROVE/

Kao, C., Gazzinaga, J. M., Cowling, D. W., Cohen, R. D., Fox, P., and Kaplan, G. A. (1994). Caralio Vascular Disease Outreach and Epidemiology Program. The Local Burden of Cardiovascular Disease; Death from Heart Disease and Stroke in California Cities. Report No. 1. California Department of Health Services and the University of California, San Francisco, CA.

Lippmann, M. (2009). Semi-Continuous Speciation Analyses for Ambient Air Particulate Matter: An Urgent Need for Health Effects Studies. *J. Expo. Sci. Epidemiol. Stud.*, 19:235–247.

Lippmann, M., Ito, K., Hwang, J. S., Maciejczyk, P., and Chen, L. C. (2006). Cardiovascular Effects of Nickel in Ambient Air. *Environ. Health Perspect.* 1141(11):1662–1669.

Malm, W. C., Sisler, J. F., Huffman, D., Eldred, R. A., and Cahill, T. A. (1994). Spatial and Seasonal Trends in Particle Concentration and Optical Extinction in the United States. *J. Geophys. Res.*, 99(D1):1347–1370.

Motallebi, N., Cahill, T. A., and Flocchini, R. G. (1990a). Influence of Particulate Size on Statistical Studies of Visibility at California Regions. *Atmosfera*, 3(2):111–126.

Motallebi, N., Flocchini, R. G., Myrup, L. O., and Cahill, T. A. (1990b). A Principal Component Analysis of Visibility and Air Pollution in Six California Cities. *Atmosfer.*, 3(2):127–141.

Neter, J. W., Kutner, M. H., Nachtsheim, C. J., and Wasserman, W. (1996). *Applied Linear Statistical Models* (4th ed.). Irwin, Chicago, IL, p. 353.

Peltier, R. E., Hsu, S.-I., Lall, R., and Lippmann, M. (2009). Residual Oil Combustion: A Major Source of Airborne Nickel in New York City. *J. Expo. Sci. Epidemiol.*, 19:603–612.

Peltier, R. E., and Lippmann, M. (2010). Residual Oil Combustion: 2. Distribution of Airborne Nickel and Vanadium Within New York City. *J. Expo. Sci. Epidemiol.*, 20:342–350.

Zhang, Z., Chau, P. Y., Lai, H. K., and Wong, C. M. (2009). A Review of the Effects of Particulate Matter-Associated Nickel and Vanadium Species on Cardiovascular and Respiratory Systems. *Int. J. Environ. Health Res.*, 19(3):175–185.

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EXHIBIT 26

JOURNAL OF ADVANCED TRANSPORTATION
J. Adv. Transp. 2015; **49**:535–552
Published online 12 September 2014 in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/atr.1286

Impact of heavy vehicles on surrounding traffic characteristics

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SUMMARY

This work examines the impact of heavy vehicle movements on measured traffic characteristics in detail. Although the number of heavy vehicles within the traffic stream is only a small percentage, their impact is prominent. Heavy vehicles impose physical and psychological effects on surrounding traffic flow because of their length and size (physical) and acceleration/deceleration (operational) characteristics. The objective of this work is to investigate the differences in traffic characteristics in the vicinity of heavy vehicles and passenger cars. The analysis focuses on heavy traffic conditions (level of service E) using a trajectory data of highway I-80 in California. The results show that larger front and rear space gaps exist for heavy vehicles compared with passenger cars. This may be because of the limitations in manoeuvrability of heavy vehicles and the safety concerns of the rear vehicle drivers, respectively. In addition, heavy vehicle drivers mainly keep a constant speed and do not change their speed frequently. This work also examines the impact of heavy vehicles on their surrounding traffic in terms of average travel time and number of lane changing manoeuvres using Advanced Interactive Microscopic Simulator for Urban and Non-Urban Networks (AIMSUN) microscopic traffic simulation package. According to the results, the average travel time increases when proportion of heavy vehicles rises in each lane. To reflect the impact of heavy vehicles on average travel time, a term related to heavy vehicle percentage is introduced into two different travel time equations, Bureau of Public Roads and Akçelik's travel time equations. The results show that using an exclusive term for heavy vehicles can better estimate the travel times for more than 10%. Finally, number of passenger car lane changing manoeuvres per lane will be more frequent when more heavy vehicles exist in that lane. The influence of heavy vehicles on the number of passenger car lane changing is intensified in higher traffic densities and higher percentage of heavy vehicles. Large numbers of lane changing manoeuvres can increase the number of traffic accidents and potentially reduce traffic safety. The results show an increase of 5% in the likelihood of accidents, when percentage of heavy vehicles increases to 30% of total traffic. Copyright © 2014 John Wiley & Sons, Ltd.

KEY WORDS: heavy vehicles; passenger cars; travel time; lane changing manoeuvre

1. INTRODUCTION

The effects of heavy vehicles on their surrounding traffic are greater than passenger cars. There is potential for heavy vehicles to have a substantial impact on macroscopic and microscopic traffic flow characteristics because of the interference effect they have on surrounding vehicles. Previous studies show that heavy vehicle and passenger car drivers have fundamentally different driving behaviour [1–3]. The heavy vehicle drivers' car-following and lane changing behaviour has been investigated, and models have been developed to estimate their driving behaviour [1, 4–6].

Although heavy vehicles comprise a small proportion of traffic stream, they have an important effect on traffic flow and produce a disproportionate effect particularly during heavy traffic conditions [7]. Heavy vehicles impose physical and psychological effects on surrounding traffic [8–11]. These effects are the results of physical characteristics of heavy vehicles (e.g. length and size) and their operational

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characteristics (e.g. acceleration/deceleration and manoeuvrability). The effect of heavy vehicles' operational characteristics becomes prominent under heavy traffic conditions.

The number of heavy vehicles on roadways of the USA has increased by 75% over the past three decades, and this trend is likely to continue over the next decade [12]. Heavy vehicles have transported around 60% of US trade in 2013 [13]. Typically, the proportion of heavy vehicles ranges from as low as 2% to as high as 25% of total traffic during the day [7]. According to a series of traffic surveys conducted in Australia, the proportion of heavy vehicles could increase to 20% of total vehicles in the peak periods on some freeways [14].

Despite the increasing number of heavy vehicles on highways and freeways, the influence of heavy vehicles on their surrounding traffic has received little attention. Because of the large size of heavy vehicles and their limited operational capabilities (e.g. speed and acceleration/deceleration), they have the potential to bring psychological disadvantages for their surrounding passenger car drivers. Previous studies show that passenger car drivers try to avoid being in the vicinity of heavy vehicles. They either try to provide large space gaps to the heavy vehicle ahead/follow or move into other lanes [4, 9]. According to the literature, number of lane changing manoeuvres is a good indicator of the potential for vehicular conflicts [15, 16]. Large numbers of lane changing manoeuvres can increase the number of accidents and potentially reduce traffic safety. Therefore, the safety analysis is essential for highways/freeways with high proportion of heavy vehicles or in heavy traffic conditions. The results of analysis can be used to define appropriate lane restriction strategies or safety policies in urban highways/freeways to enhance capacity and improve traffic safety [17].

The aim of this research is to investigate the differences in traffic characteristics of vehicles in the vicinity of heavy vehicles and passenger cars. The analysis focuses on heavy traffic conditions (level of service E) and makes use of trajectory data for a section of I-80 in USA. In this paper, space gaps and relative speeds of the vehicles in front/at the rear of heavy vehicles and passenger cars are analysed and compared. Furthermore, the speed changes of heavy vehicles and passenger cars are examined. After that, the influence of heavy vehicles on their surrounding traffic is investigated in terms of travel times and number of lane changing manoeuvres using Advanced Interactive Microscopic Simulator for Urban and Non-Urban Networks (AIMSUN) (Barcelona, Spain) microscopic traffic simulation package. In addition, a term related to heavy vehicle percentage is introduced into two different travel time functions to evaluate the direct impact of heavy vehicles on average travel time. The influence of heavy vehicles on traffic safety will also be measured.

This paper begins by explaining the trajectory data used in this study. Then, traffic characteristics of the vehicles in the vicinity of heavy vehicles and passenger cars are analysed. It is followed by a detailed examination of the influence of heavy vehicles on their surrounding traffic and identifying the influence of heavy vehicles on average travel time and traffic safety using microscopic traffic simulation. In addition, the influence of heavy vehicles on travel time and safety is measured. The final section summarises the insight from this study and identifies recommendations and directions for future research.

2. TRAJECTORY DATA

The trajectory dataset used in this study was made available by Cambridge Systematics Incorporated for the Federal Highway Administration (FHWA) as part of Next Generation SIMulation (NGSIM) project. NGSIM captured video images for a section of Berkeley Highway (I-80) in California. Subsequently, a comprehensive vehicle trajectory dataset was developed through processing the video images. The lane configuration of the section of I-80 is schematically shown in Figure 1.

The section of I-80 is 503 m long and comprises five main lanes with one auxiliary lane [18]. There is one on-ramp in this section and one exit off-ramp downstream of the section. There are no lane restrictions for heavy vehicles, and the grade is almost zero. The data were collected from 4:00 to 4:15 PM and 5:00 to 5:30 PM using a video capture rate of 10 frames per second. The dataset was provided in clear weather, good visibility and dry pavement conditions. The dataset has classified the vehicles as automobiles, heavy vehicles and motorcycles. Table I shows the traffic flow parameters for the section of I-80.

The trajectory dataset used in this study provides information on vehicles and their surrounding traffic characteristics. The vehicles for which information is available are presented in Figure 2. A heavy vehicle

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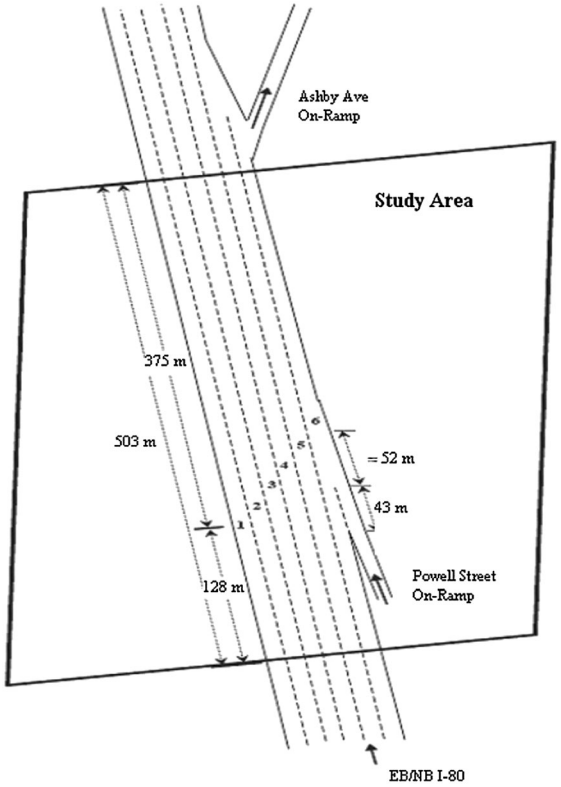

Figure 1. The schematic lane configuration of the section of I-80.

Table I. Traffic flow parameters in the section of I-80.

Time interval	Passenger car and motorcycle number (%)	Heavy vehicle number (%)	Traffic flow (veh/h)	Speed (km/h)	Density (veh/km)*	Level of service
4:00 to 4:15 PM	1956 (95.3)	96 (4.7)	8144	28.7	284	E
5:00 to 5:15 PM	1766 (96.2)	70 (3.8)	7288	22.6	322	E
5:15 to 5:30 PM	1741 (97.3)	49 (2.7)	7048	20.0	352	E
Total	5463 (96.2)	215 (3.8)	7493	23.8	315	E

*Density is calculated as the number of vehicles per kilometre length of all lanes.

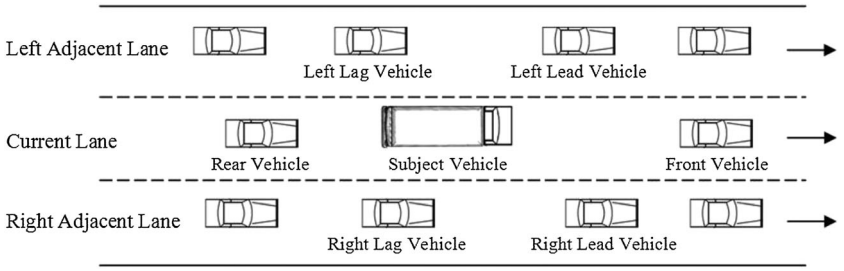

Figure 2. The subject vehicle and surrounding traffic.

and its surrounding traffic are presented in this figure. The trajectory dataset provides the opportunity to determine the physical characteristics (length and width), positions, speeds and accelerations/decelerations of individual vehicles and their surrounding traffic (Figure 2) as well as space gaps and relative speeds between each vehicle and the surrounding vehicles at discrete time points.

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3. COMPARISON OF HEAVY VEHICLE AND PASSENGER CAR BEHAVIOUR

As noted earlier, the length and size of heavy vehicles as well as the limitations in their manoeuvrability may cause physical and psychological effects on surrounding traffic. Initial analysis of heavy vehicles and passenger cars shows that some differences exist in traffic characteristics of vehicles in the vicinity of these two vehicle types [1, 9]. In this section, the traffic characteristics of vehicles in the vicinity of heavy vehicles and passenger cars are analysed and compared. To better understand the influence of heavy vehicles on their surrounding traffic, heavy vehicles are classified into two separate classes based on their length. Heavy vehicles with the length of equal to or greater than 15 m are classified as heavy trucks, and those with the length of less than 15 m are considered as light trucks. Over the period when the data were captured, a total of 30 heavy trucks, 30 light trucks and 30 passenger cars are analysed. To ensure a valid comparison, surrounding traffic characteristics of the selected heavy trucks, light trucks and passenger cars are close to each other. Moreover, the selected heavy trucks, light trucks and passenger cars passed the study area almost at the same time. To do this analysis, space gaps and relative speeds of the vehicles in front/at the rear of heavy vehicles (heavy trucks and light trucks) and passenger cars as well as the changes in the speeds of these two vehicle types are examined and compared.

As mentioned earlier, the trajectory dataset provides the opportunity to determine the positions, speeds and accelerations/decelerations of the subject vehicle and the surrounding traffic at discrete time points (0.1-s time interval). The position, speed and acceleration information cannot be extracted directly because of the noise in the NGSIM information. Therefore, the moving average method, which is a simple smoothing method, is used to reduce the noise of the NGSIM information. Meanwhile, the smoothing should be as weak as possible, to maintain the trends in driving behaviour. Therefore, the moving average with period of five is used in this study for the positions, and the moving averages with periods of 10 and 40 are used for the speeds and accelerations, respectively. According to previous studies on the NGSIM dataset, smoothing the positional information with period of five, speeds with the period of 10 and acceleration/deceleration with the period of 40 results in accurate outcomes [19].

In the following figures (Figures 3 and 4), the traffic flow characteristics are aggregated over a period of 20 s. In those figures, the length of vehicles is presented on *X*-axis (vehicle size), and observations are shown by triangles, crosses and dots for heavy trucks, light trucks and passenger cars, respectively.

Figure 3 shows the relationship between the front and rear space gaps and relative speeds in the vicinity of heavy vehicles and passenger cars. In this figure, the front/rear space gaps and relative speeds are defined as the subject vehicle position/speed subtracted from the front/rear vehicle positions/speeds. As it is shown in Figure 3a, the front space gaps for heavy trucks are considerably larger than the front space gaps for light trucks and passenger cars. The large space gaps between heavy trucks and front vehicles may be due to the limitations in manoeuvrability of heavy trucks. This is not observed in either light trucks or passenger cars. Furthermore, the large space gaps in front of heavy trucks occur because heavy truck drivers generally keep larger distances to their front vehicle in order to provide adequate distance to break safely. Heavy truck deceleration capabilities are more limited than those of passenger cars. Generally, the rear space gaps for heavy trucks are slightly larger than the rear space gaps for light trucks and passenger cars. This may be due to the safety concerns of rear vehicle drivers when following heavy trucks. This could also be partially due to the limited visibility of drivers in vehicles, which are immediately behind the heavy trucks.

The relationship between the front and rear relative speeds in the vicinity of heavy vehicles and passenger cars are presented in Figure 3b. The front/rear relative speeds are defined as front/rear vehicle speeds minus the subject vehicle speed. According to this figure, heavy trucks' speeds are generally lower than the speeds of their front/rear vehicles. This pattern is not observed for light trucks and passenger cars. It implies that the speed of heavy trucks is generally lower than the speed of their surrounding vehicles. The speed of heavy trucks is considerably lower than the speed of their front vehicles and is almost similar to their rear vehicles' speed. Because of limitations in acceleration/deceleration and manoeuvrability, heavy

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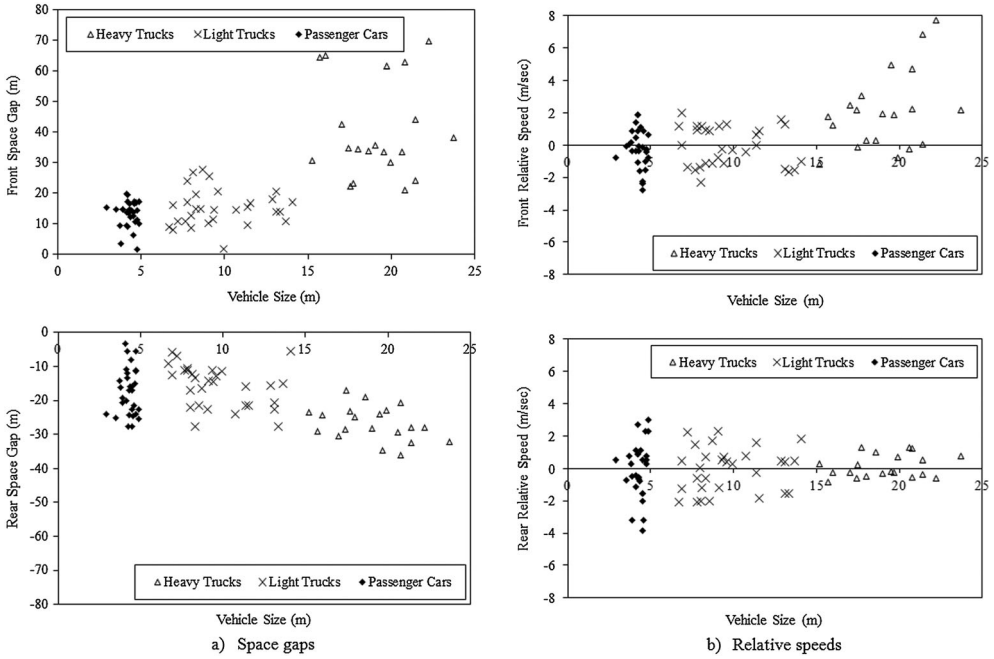

Figure 3. Traffic characteristics of the vehicles in front/at rear of heavy vehicles and passenger cars.

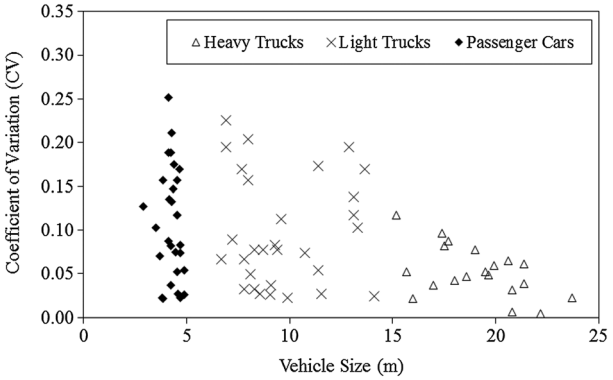

Figure 4. Speed changes of heavy vehicles and passenger cars.

trucks are generally unable to adjust their speeds according to the speed of front vehicles. Consequently, the following vehicles adjust their speed according to the speed of heavy trucks because of safety concerns.

To better understand the differences between heavy vehicles and passenger cars, their speed changes are calculated and compared. The Coefficient of Variation (CV), which is the ratio of standard deviation to mean speed, is used to analyse the speed changes of heavy vehicles and passenger cars. As it is shown in Figure 4, speeds of heavy trucks have small changes (CV of less than 0.1) while speeds of light trucks and passenger cars have considerable variation. The small values for CV of speed show that speeds of heavy trucks have inconsiderable changes while speeds of light trucks and specifically passenger cars change considerably. This implies that passenger car and light truck drivers mainly adjust their speeds according to the speeds of surrounding vehicles. However, it may be difficult for heavy truck drivers to adjust their speed according to the speed of their surrounding traffic. This may be due to the operational limitations of heavy trucks (acceleration/deceleration and manoeuvrability). Heavy truck drivers mainly keep a constant speed and do not change their speed frequently.

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Heavy trucks influence their surrounding traffic characteristics. The space gaps between heavy trucks and their front/rear vehicles are larger than the corresponding values in light trucks and passenger cars. Furthermore, speeds of heavy trucks are generally lower than the speeds of their front/rear vehicles, and they almost keep the same speed and do not change their speed frequently. This is not observed in light trucks and passenger cars, which mainly adopt their speed according to the speed of their surrounding traffic. The large space gaps in vicinity of heavy trucks and the limitations in adjusting their speed according to surrounding vehicles' speed produce a disproportionate effect on traffic flows. This problem is intensified when large percentage of heavy trucks exists in highways/freeways. Because light trucks and passenger cars have almost similar influence on their surrounding traffic and because of considerable influence of heavy trucks on their surrounding vehicles, the following section investigates the influence of different proportions of heavy trucks on traffic.

4. IMPACT OF HEAVY TRUCKS ON SURROUNDING TRAFFIC

As mentioned earlier, heavy trucks impose physical and psychological effects on surrounding traffic. Those effects result in an increase in the number of lane changing manoeuvres in vicinity of heavy trucks. The limited operational characteristics of heavy trucks as well as the frequent lane changing manoeuvres in their vicinity may cause repetitive variation of speed and traffic flow characteristics called speed and traffic flow oscillations [9, 10,20]. To better understand the influence of heavy trucks on surrounding traffic, average travel times and number of lane changing manoeuvres in the vicinity of heavy trucks are analysed in this section. In the following figures, the relationship between the number of heavy trucks, the average travel times and number of passenger car lane changing manoeuvres are investigated per individual lane at different time intervals.

The relationship between heavy truck volume and average travel times in each lane is presented in Figure 5. In this figure, the number of heavy trucks is presented as a proportion of total traffic volume on *X*-axis, and average travel times are presented on *Y*-axis. The average travel time is measured as the average time required for vehicles to pass the study area (503 m of the section of I-80).

As shown in Figure 5, proportion of heavy trucks has the highest value in lane 3. Heavy trucks have limited manoeuvrability and acceleration/deceleration characteristics, and therefore, it is difficult for heavy truck drivers to adjust their speed according to the speed of surrounding traffic. Therefore, heavy truck drivers avoid driving in the two fastest lanes (lanes 1 and 2). Meanwhile, a large proportion of vehicles in lanes 5 and 6 are the ones that took the on-ramp or wish to take the exit off-ramp. Thus, weaving manoeuvres occur in these two lanes, which may prevent heavy truck drivers from using these two slowest lanes. This may justify the larger proportion of heavy trucks in lane 3 compared with other lanes.

The average travel time rises when proportion of heavy trucks increases in each lane (Figure 5). In this figure, average travel times in lane 1 are considerably smaller than the corresponding values in other lanes. Because lane 1 is a high occupancy vehicle (HOV) lane, the average speeds are higher and the average travel times are smaller in this lane compared with other lanes. HOV lanes are restricted-use freeway lanes, which are reserved for vehicles with more than a predetermined number of occupants. According to this figure, heavy trucks comprise a small proportion of traffic in this lane. This implies that the small percentage of heavy trucks travelling in lane 1 can adjust their speed according to the average speed of passenger cars in that lane and therefore imposes less influence on travel times. Because video images are used in this research, information regarding the weight and power of heavy trucks is not available. Heavy trucks with higher power or smaller weight may use lane 1, which cannot be extracted from this research. In general, heavy trucks have lower speed compared with passenger cars. Increase in the proportion of heavy trucks in each lane may result in oscillations in the speed, reducing the average speed and therefore increasing the average travel time of that lane. This pattern is observed in lanes 2 to 6.

Figure 6 shows the relationship between the number of heavy trucks in each lane and the number of passenger car lane changing manoeuvres in that lane at 15-min time intervals in the section of I-80. In this figure, the number of heavy trucks per each lane is presented on the *X*-axis. *Y*-axis shows the number of passenger car lane changing manoeuvres from each lane.

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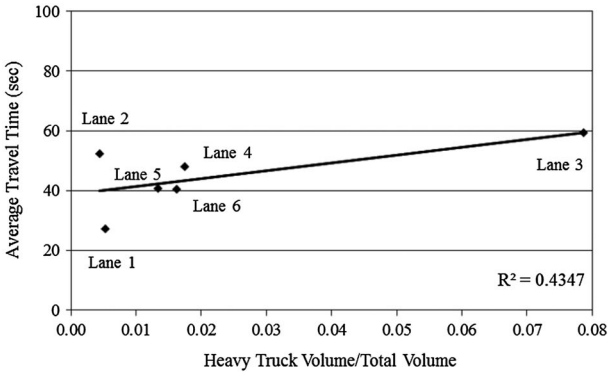

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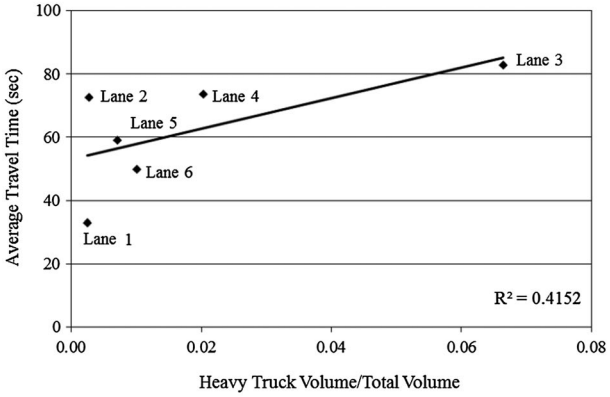

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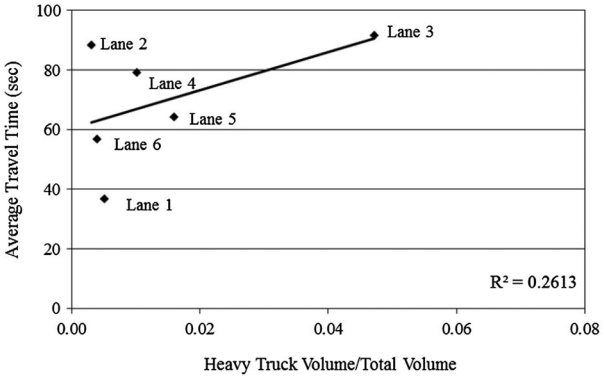

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Figure 5. Relationship between heavy truck volume and average travel times.

According to this figure, the number of passenger car lane changing manoeuvres per each lane increases when more heavy trucks exist in that lane. Generally, there is a positive relationship between the number of heavy trucks in each lane and the number of passenger cars that execute a lane changing manoeuvre to move from that lane. This shows that passenger car drivers try to avoid being in the vicinity of heavy trucks, and therefore, they may try to move into other lanes. As mentioned earlier, the number of lane changing manoeuvres is a good indicator of potential for vehicular conflicts [16]. Large number of lane changing manoeuvres can increase the number of traffic accidents and potentially reduce safety. Therefore, increase in the number of heavy trucks may reduce traffic safety and increase the risk of accidents. The positive relationship between the number of heavy trucks and the number of passenger car lane changing manoeuvres is mainly observed in lanes 2 to 6. As mentioned before, lane 1 is a HOV lane

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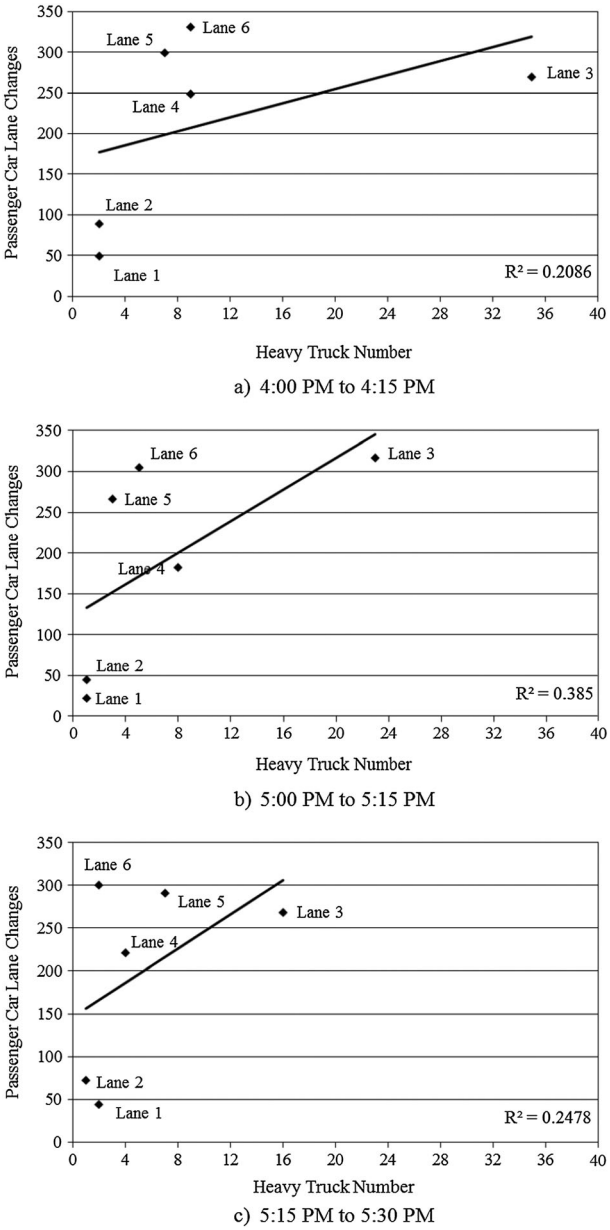

Figure 6. Relationship between heavy truck volume and number of passenger car lane changing.

with the highest average speeds (fastest lane), and vehicles in this lane are generally travelling with higher speeds compared with other lanes. The average speed in lane 1 is 48.3 km/h in the first 15-min time interval and 37.8 and 36.4 km/h in the second and third 15-min time intervals, respectively. Comparing these values with the results presented in Table I show that the average speeds in lane 1 are considerably higher than the average speeds in the study area. Therefore, passenger cars in lane 1 prefer to stay in that lane rather than moving to a slower adjacent lane (lane 2) despite the existence of heavy trucks in their vicinity. The number of passenger car lane changing manoeuvres has almost the maximum value in lane 6. In this lane, the observed lane changing manoeuvres mainly occur after taking an on-ramp or for taking the next exit off-ramp or to prevent being obstructed by weaving manoeuvres. This can justify the large number of passenger car lane changing in lane 6 compared with the corresponding values in other lanes.

According to the results obtained in this section, heavy trucks have pronounced effect on surrounding traffic characteristics. They reduce average speeds and consequently increase average travel times. This is due to the limitations in operational characteristics of heavy trucks. Furthermore, the existence

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of more heavy trucks can increase the number of passenger car lane changing manoeuvres. Generally, the vehicles in front of heavy trucks are more probable to change lanes because of psychological reasons. Passenger cars may try to prevent being followed by a heavy truck. The same behaviour is observed in passenger cars that are following heavy trucks. Passenger car drivers located behind the heavy trucks try to change lanes because they have limited vision because of the large size of heavy trucks. Besides, passenger cars avoid being obstructed by a slow moving heavy truck ahead.

The results provided in this section are based on a small proportion of heavy trucks. As shown in Table I, heavy vehicles comprise less than 5% of the traffic stream, and the proportion of heavy trucks (heavy vehicles with the length of equal to or greater than 15 m) is even smaller. To understand the influence of heavy trucks on surrounding traffic characteristics, larger proportion of heavy trucks should be analysed. However, providing a comprehensive trajectory dataset with high percentage of heavy trucks is very time consuming and costly. To this end, AIMSUN microscopic traffic simulation package is employed. The section of I-80 is simulated first. Then, proportion of heavy trucks is increased from the observed values to 30% of the total traffic using AIMSUN. Then, the influence of heavy trucks on the average travel times and number of passenger car lane changing manoeuvres is analysed in detail. The procedure is explained, and the results are presented in the following section.

5. AIMSUN SIMULATION RESULTS

The section of I-80, which is used in this study, is modelled using AIMSUN microscopic traffic simulation package. The microscopic traffic simulation model is calibrated and validated on the basis of an iterative heuristic approach. This approach is based on interactions between the driving behaviour, route choice and the O-D flows to iteratively calibrate the model. In each step, the corresponding set of parameters is calibrated, and the other parameters remain fixed at their previous values [21]. The calibration procedure, which is applied for the simulation model in this paper, is presented in Figure 7. The convergence happens, when the difference between the observed and the estimated traffic measurements ($TM^{obs} - TM^{est}$) is less than a value defined by user. Traffic measurements include traffic flows, average speeds and average travel times.

After simulating the section of I-80, the percentage of heavy trucks is increased from 2.2%, 1.7% and 1.3% of the total traffic in different time intervals in I-80 (Table I) to 30% at different stages

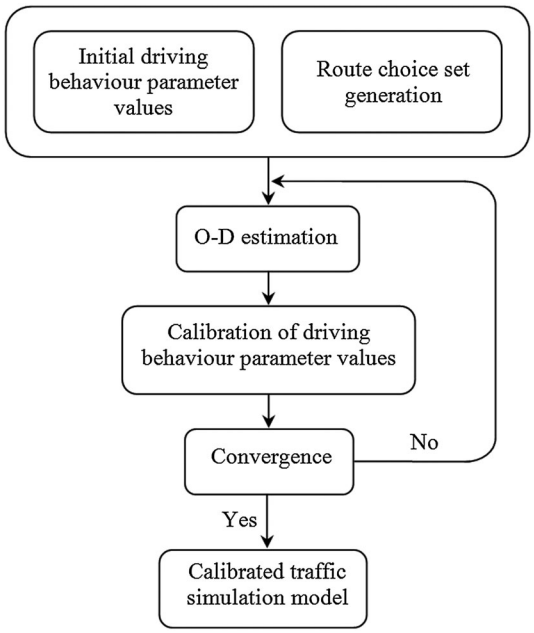

Figure 7. The calibration procedure for the microscopic traffic simulation model.

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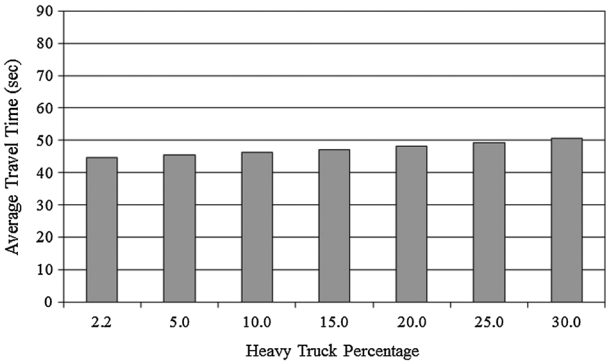
(5%, 10%, 15%, 20%, 25% and 30%). Then, the influence of changes in proportion of heavy trucks on traffic flow characteristic is evaluated using AIMSUN. Because of stochastic nature of simulation models, the model is run for 10 times at each stage (5%, 10%, 15%, 20%, 25% and 30%). The average values of travel times and the number of lane changing manoeuvres obtained from 10 times running the model are calculated and used for comparison. In the following figures, percentage of heavy trucks is presented on *X*-axis, and average travel times and the number of passenger car lane changing manoeuvres are presented on *Y*-axis (Figures 8 and 9, respectively).

The relationship between the proportion of heavy trucks and average travel times is presented in Figure 8. As shown in this figure, the average travel times will increase as the percentage of heavy trucks increases. This is consistent with the results obtained in the previous section and can be a result of limited operational characteristics of heavy trucks. Likewise, increase in average travel times (which is the result of decrease in average speeds) is clearly observed in the last 15-min time interval in which



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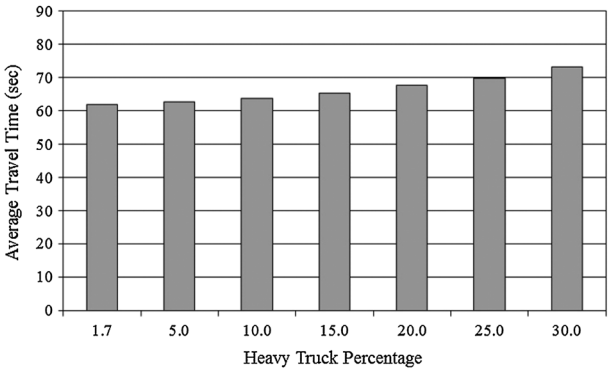

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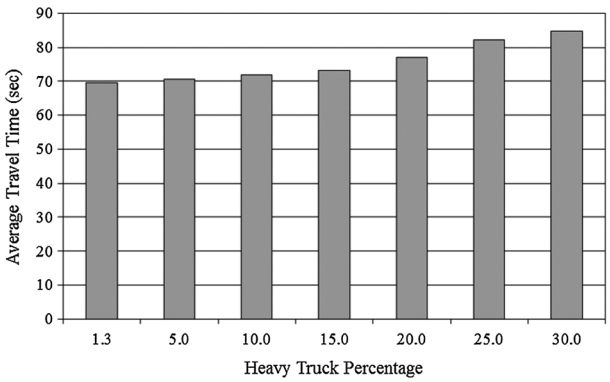

c) 5:15 PM to 5:30 PM

Figure 8. Relationship between the percentage of heavy trucks and the average travel time.

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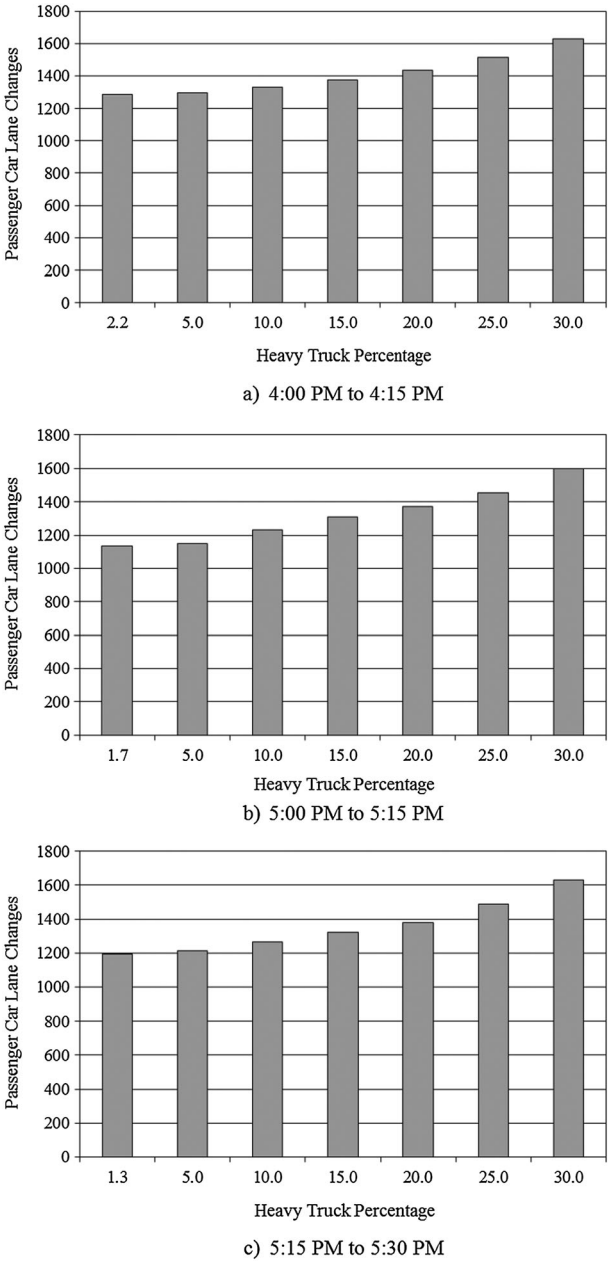

Figure 9. Relationship between the percentage of heavy trucks and number of passenger car lane changing.

the traffic congestion is higher. In this time interval, the average travel time increased from around 70 s to more than 80 s with the increase of around 30% in proportion of heavy trucks. This proves the substantial impact of heavy trucks on traffic flow characteristics in heavy traffic conditions.

Figure 9 shows the relationship between the proportion of heavy trucks and the number of passenger car lane changing manoeuvres. The number of passenger car lane changing manoeuvres increases with the increase in the number of heavy trucks. The growth is observable in higher proportions of heavy trucks. This increase is specifically observed in the last 15-min time interval (5:15 to 5:30 PM), when traffic density is higher (Table I). The number of passenger car lane changing manoeuvres increases from 1196 with the heavy truck percentage of 1.3% to 1632 when heavy truck percentage is 30% in the last time interval. This implies that heavy trucks have more influence on their surrounding traffic characteristics in higher traffic densities. The operational limitation of heavy trucks is more pronounced in higher congestion when stop and go traffic occurs.

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The results show that heavy trucks have pronounced influence on their surrounding traffic characteristics. Heavy trucks have influence on travel times (and average speeds). The average travel times are increased with the growth in the number of heavy trucks. This result is intensified in higher percentage of heavy trucks. Passenger cars in front/at rear of heavy trucks try to either provide large space gaps to heavy trucks or prevent being in front/at rear of heavy trucks and therefore move into their adjacent lanes. This may result in unsteady traffic condition or increase in the number of lane changing manoeuvres in vicinity of heavy trucks. According to the simulation results from AIMSUN, the influence of heavy trucks is prominent in higher congestion. In higher traffic densities, the number of passenger car lane changing manoeuvres has larger increase by the growth in percentage of heavy trucks. Larger numbers of lane changing manoeuvres cause higher vehicular conflicts and may enhance the probability of accidents and potentially reduce traffic safety.

The results of this section show that the increase in the number of heavy trucks can increase the average travel times as well as the number of passenger car lane changing manoeuvres. However, the influence of heavy trucks on travel time is generally ignored by travel time equations. In the following subsections, the influence of heavy trucks on travel times as well as their impact on likelihood of accidents is investigated in detail.

5.1. Influence of heavy trucks on travel time

The previous section suggests that heavy trucks have a pronounced effect on the average travel times, particularly during congestion. According to the literature, many studies have investigated the influence of heavy vehicles on travel time and speed. In these studies, the influence of heavy vehicles is mainly considered using a passenger car equivalency factor. However, heavy vehicles have psychological effects on their surrounding drivers. This may intensify the heavy vehicles' influence on traffic and cannot be estimated by simply using passenger car equivalency factors [22, 23].

Among all travel time equations in the literature, the Bureau of Public Roads equation is one of the traditional ones, which has a simple structure that estimates the link travel times and is extensively used in software packages [24]. The general type of the BPR travel time equation is shown in Equation (1). The BPR curve is close to parabolic curves in shape and is fairly sensitive to increase in traffic flows.

$$t = t_0\left[1 + \alpha\left(\frac{v}{c}\right)^{\beta}\right] \tag{1}$$

where

t = travel time for one kilometre length of road (minute)
t_0 = free travel time for one kilometre length of road (minutes)
v = traffic volume (passenger car units per hour per lane, pcu/h/l)
c = practical capacity (passenger car units per hour, pcu/h)

α and β are parameters.

In this research, the BPR travel time equation is used as a simple travel time equation to evaluate the influence of heavy trucks on travel time. To reflect the impact of heavy trucks on average travel time, a term related to heavy truck percentage is introduced into Equation (1) (Equation (2)). The new equation is used to estimate the average travel times in I-80. To ensure valid results, the parameters of the BPR travel time equation are calibrated at the first stage (α and β). Then, the heavy truck term is added to the calibrated model, and parameters of the heavy truck model are estimated (λ and δ). The free flow speed is assumed to be 130 km/h for I-80 in this procedure.

$$t = t_0\left[1 + \alpha \times f(HT) \times \left(\frac{v}{c}\right)^{\beta}\right] \tag{2}$$

f (HT) represents the influence of heavy trucks on travel time with the following structure (Equation (3)). To determine the general from of the following model, different structures were examined. Then, the structure, which resulted in the highest adjusted R^2 value and significant parameters, was selected.

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$$f(HT) = \lambda(HT)^{\delta} \tag{3}$$

where HT is equal to heavy truck proportion, and λ and δ are parameters.

To calibrate the parameters of the BPR travel time equation, the percentage of heavy trucks is increased from 2.2%, 1.7% and 1.3% of the total traffic in different time intervals to 30% with a 1% increment. Because of the stochastic nature of simulation models, the model is run for 10 times at each increment, and the average values of travel time obtained from 10 times running the model is calculated. The same dataset is used to estimate the parameters of heavy truck model, $f(HT)$.

To calibrate the heavy truck model, non-linear regression technique is adopted. Non-linear regression is a method of extracting a non-linear model based on the relationship between the dependent variable and a set of independent variables. Non-linear regression produces the least square estimates of the parameters for models in which the relationship between the variables is non-linear [25]. The estimation results for the calibrated BPR travel time equation as well as the heavy truck model are summarised in Table II. In this table, the t-statistic for each parameter is calculated as the ratio of estimated value for that parameter through non-linear regression model to the standard error.

In the BPR travel time equation and the heavy truck model, all the estimated parameters are significant at 95% confidence level. The results show that heavy trucks have a fundamental influence on travel times. According to the results summarised in Table II, using passenger car equivalency units is insufficient to replicate the influence of heavy trucks in heavy traffic conditions. Using an exclusive term for heavy trucks in BPR travel time equation can better estimate the travel times for more than 10% (adjusted R^2 has increased from 0.723 to 0.831).

As mentioned earlier, the BPR travel time function has a simple structure. However, this model is accurate in $\frac{v}{c}$ of less than 1 (unsaturated conditions). When congestion starts ($\frac{v}{c}$ is close to 1) and traffic volume, v, decreases because of lower speeds, the BPR function is not reliable in travel time prediction and results in unrealistic values. Because the current research focuses on heavy traffic conditions (level of service E), the Akçelik's time dependant travel time function [26, 27] is also used in this paper to estimate the link travel times (Equation (4)). The Akçelik's travel time functions can be used at different congestion levels.

$$t = t_{of} + 0.25T_p\left[z + \sqrt{z^2 + \frac{m_c \times x}{Q \times T_p}}\right] \tag{4}$$

where

t = travel time for one kilometre length of road (seconds)
t_0 = $3600/v_{of}$ (seconds) (v_{of} is the zero-flow travel speed in kilometres per hour or km/h)
T_p = peak flow (analysis) period in hours, which is 45 min or 0.75 h in this research
Q = practical capacity (passenger car units per hour, pcu/h)
z = $x - 1$
x = q_a/Q (q_a is the demand flow rate in passenger car units per hour or pcu/h)
m_c = delay parameters.

Similarly, a term related to heavy truck percentage is introduced into Equation (4), which reflects the impact of heavy trucks on average travel time (Equation (5)). The new equation (Equation (6)), which

Table II. Estimation results of the (BPR) travel time equation and heavy truck model*.

BPR travel time equation			Heavy truck model		
Parameter	Parameter value	t-statistic	Parameter	Parameter value	t-statistic
α	0.408	13.61	λ	4.262	3.78
β	3.754	6.48	δ	2.297	5.92
Adjusted R^2		0.723	Adjusted R^2		0.831

*Number of observations = 90.

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has a similar structure to Equation (3), is used to estimate the average travel times in I-80. To ensure valid comparison, m_c is estimated first. Then, the heavy truck term is added to the calibrated model, and parameters of the heavy truck model are estimated (γ and μ). The free flow speed is assumed to be 130 km/h for I-80 in this procedure.

$$t = t_{of} + 0.25T_p\left[z + \sqrt{z^2 + \frac{m_c \times f(HT) \times x}{Q \times T_p}}\right] \tag{5}$$

$$f(HT) = \gamma(HT)^{\mu} \tag{6}$$

where HT is equal to heavy truck proportion, and γ and μ are parameters.

Similar to the BPR function, the percentage of heavy trucks is increased from 2.2%, 1.7% and 1.3% of the total traffic in different time intervals to 30% with a 1% increment in order to calibrate the parameters of the Akçelik's travel time equation. Because of the stochastic nature of simulation models, the model is run for 10 times at each increment, and the average values of travel time obtained from 10 times running the model is calculated. The same dataset is used to estimate the parameters of $f(HT)$. The estimation results for the calibrated Akçelik's travel time equation as well as the heavy truck model are summarised in Table III. In this table, the t-statistic for each parameter is the ratio of estimated value for that parameter through non-linear regression model to the standard error.

In the Akçelik's travel time equation and the heavy truck model, all the estimated parameters are significant at 95% confidence level. According to the results, heavy trucks have a fundamental influence on travel times. Considering the direct influence of heavy vehicles by using an exclusive term for heavy trucks can improve the accuracy of the Akçelik's travel time function in estimating the travel times by around 12% (adjusted R^2 has increased from 0.738 to 0.852).

5.2. *Influence of heavy trucks on traffic safety*

As mentioned earlier, the limited operational characteristics of heavy trucks as well as the frequent lane changing manoeuvres of passenger cars in their vicinity may cause speed and traffic flow oscillations [9, 10, 20]. Frequent lane changing manoeuvres along with traffic flow and speed oscillations will increase the risk of accidents.

Previous safety studies mainly used aggregated accident data. Those studies mainly focused on the relationship between traffic accidents and corresponding variables such as traffic volume, speed and geometry conditions [28, 29]. It was identified that in locations with high heavy truck volumes, accidents occur frequently because of passenger car/heavy truck interactions. For instance, heavy trucks are about three times more likely to be struck in the rear than passenger cars [28, 29]. In this research, rear-end accidents are analysed as a common type of accidents involving heavy trucks. Some previous studies considered safety surrogate measure in developing accident trigging factors. This measure is used for rear-end accidents, which is the most common form of accidents on highways/freeways. The surrogate measure includes a safe headway distance (SHD) and a time to collision [30, 31]. In this measure, the minimum stopping distance of the leading vehicle should be larger than the minimum stopping distance of following vehicle. The same measure is used in this paper to investigate the likelihood of rear-end accidents caused by heavy trucks (Equations (7) and (8)).

Table III. Estimation results of the Akçelik's time dependant travel time equation and heavy truck model*.

Akçelik's travel time equation			Heavy truck model		
Parameter	Parameter value	t-statistic	Parameter	Parameter value	t-statistic
m_c	16.922	7.92	γ	4.156	4.83
			μ	1.834	7.12
Adjusted R^2		0.738	Adjusted R^2		0.852

*Number of observations = 90.

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Minimum stopping distance of leading vehicle > *Minimum stopping distance of following vehicle* (7)

$$2.366\times(v_{lead}\times h)+\left[\frac{v_{lead}^2}{30\times\left(\frac{acc}{g}\pm Gr\right)}\right]>2.366\times\left(v_{follow}\times PRT\right)+\left[\frac{v_{follow}^2}{30\times\left(\frac{acc}{g}\pm Gr\right)}\right] \tag{8}$$

where

v_{lead} = leading vehicle's speed (kilometres per hour, km/h)
v_{follow} = following vehicle's speed (kilometres per hour, km/h)
acc = deceleration rate (metres per second square, m/s^2)
g = gravity acceleration (9.81 m/s^2)
Gr = grade (%)
h = time headway (seconds)
PRT = perception reaction time of the following vehicle (seconds).

Using Equation (8), an individual SHD for a pair of two consecutive vehicles can be defined as the difference of two minimum stopping distances of vehicles as follows:

$$diff_i=2.366\times\left(v_{lead}\times h-v_{follow}\times PRT\right)+\left[\frac{v_{lead}^2-v_{follow}^2}{30\times\left(\frac{acc}{g}\pm Gr\right)}\right] \tag{9}$$

$$SHD_i=\max\left(-diff_i,\,0\right) \tag{10}$$

where

i = index of a pair of two consecutive vehicles
SHD_i = safe headway distance of the ith vehicle pair
$Diff_i$ = difference of two minimum stopping distances of the ith vehicle pair.

Safe headway distance indicates the likelihood of accident for two pair of vehicles. The larger SHD indicates the greater likelihood that the following vehicle will collide with the lead vehicle. In this research, perception reaction time of the following vehicle is assumed as 1.7 s, which is consistent with the previous studies [32–35]. The influence of heavy trucks on the number of accidents is evaluated at two stages. At the first stage, the SHD values for each pair of vehicles are calculated using observed trajectory data. Then, the SHD values are calculated using AIMSUN simulation results after increasing the heavy truck volume to 30% of total traffic with 5% increments. The proportion of positive SHD values is considered as an indicator of likelihood of accidents involving heavy trucks. These results are presented in Table IV.

According to the results from Table IV, the likelihood of accidents rises by around 5% with the increase in proportion of heavy trucks in I-80 (30% heavy trucks). This confirms the results obtained from the previous studies. Existence of heavy trucks increases the likelihood of accidents, and the increase in proportion of heavy trucks intensifies the likelihood of accidents and therefore reduces the traffic safety. As mentioned earlier, the section of I-80 is about 503 m long between an on-ramp and an exit off-ramp. It should be noted that the auxiliary lane and its adjacent lane between the on-ramp and off-ramp are the locations of vehicles' acceleration/deceleration and weaving manoeuvres. Frequent accelerations/decelerations and weaving manoeuvres increase the risk of accidents. However, it is ideal to have longer sections for the safety analysis.

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Table IV. The proportion of positive safe headway distance values (in %) at different heavy truck percentages.

	Heavy truck (%)						
Time interval	Observed values*	5.0	10.0	15.0	20.0	25.0	30.0
4:00 to 4:15 PM	1.7	2.3	2.8	3.1	3.7	4.5	5.6
5:00 to 5:15 PM	1.2	1.9	2.2	2.6	3.3	4.1	4.9
5:15 to 5:30 PM	1.0	1.5	1.9	2.1	2.9	3.8	4.6

*The observed percentage of heavy trucks is 2.6%, 1.7% and 1.3% for 4:00 to 4:15 PM, 5:00 to 5:15 PM and 5:15 to 5:30 PM, respectively.

6. CONCLUSIONS AND RECOMMENDATIONS

Heavy vehicles have more influence on surrounding traffic compared with passenger cars. They impose physical and psychological effects on surrounding traffic because of their physical and operational characteristics. Despite the increasing number of heavy vehicles on highways and freeways, the influence of heavy vehicles on their surrounding traffic has received little attention. In this paper, the surrounding traffic characteristics of heavy vehicles and passenger cars were analysed and compared. To examine traffic characteristics of vehicles in the vicinity of heavy vehicles and passenger cars, space gaps and relative speeds of the vehicles in front/at the rear of heavy vehicles and passenger cars as well as changes in the speed of heavy vehicles and passenger cars were examined and compared. The trajectory data used in this study was made available for a highway section in USA with heavy traffic conditions (level of service E).

To better understand the influence of heavy vehicles on their surrounding traffic, they were classified into two separate classes based on their length. Heavy vehicles with the length of equal to or greater than 15 m were classified as heavy trucks, and those with the length of less than 15 m were considered as light trucks. The results showed larger front space gaps for heavy trucks compared with the front space gaps for light trucks and passenger cars. The existence of larger front space gaps may be due to the limitations in manoeuvrability of heavy trucks. The rear space gaps for heavy trucks were slightly larger than the rear space gaps for light trucks and passenger cars. This may be due to the safety concerns of the rear vehicle drivers when following heavy trucks. This could also be partially due to the limited visibility of drivers in the vehicles, which are immediately behind heavy trucks. Furthermore, the heavy trucks' speeds were generally lower than the speed of their surrounding vehicles. Analysing the speed changes of heavy trucks, light trucks and passenger cars showed that some variations exist in the speed of light trucks and passenger cars. This implies that drivers of these two vehicle types mainly adjust their speeds according to the speeds of their surrounding vehicles. However, heavy trucks' speed had less variation. Heavy truck drivers mainly keep a constant speed and do not change their speed frequently.

Light trucks and passenger cars had almost similar influence on their surrounding traffic characteristics, and therefore, the influence of heavy trucks on surrounding traffic was examined in this paper. The average travel times increased when the proportion of heavy trucks increased in each lane. In general, heavy trucks have lower speeds compared with passenger cars. Therefore, the increase in the proportion of heavy trucks may result in oscillations in the speed and increase the average travel times particularly in higher traffic densities and larger proportion of heavy trucks. To reflect the impact of heavy trucks on average travel time, a term related to heavy truck percentage was introduced into two different travel time equations including BPR and Akçelik's travel time functions. At the first step, the parameters of the BPR function were estimated. After estimating the parameters of the BPR equation, the results showed that using an exclusive term for heavy trucks in that travel time equation can better estimate the travel times for more than 10% (adjusted R^2 has increased from 0.723 to 0.831). BPR travel time equation has a very simple structure. However, this model is accurate in unsaturated traffic conditions. When congestion starts, the BPR function is not reliable in travel time prediction and results in unrealistic values. Because the current research focuses on heavy traffic conditions (level of service E), the Akçelik's travel time function was also used to estimate average travel times. The Akçelik's travel time equation was calibrated, and the heavy truck term was added to the equation.

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According to the results, heavy trucks have a fundamental influence on travel times. Using an exclusive term for heavy trucks could improve the accuracy of the Akçelik's travel time function in estimating the travel times by around 12% (adjusted R^2 has increased from 0.738 to 0.852).

BPR and Akçelik's travel time functions were used in this research as examples to evaluate the influence of heavy trucks on average travel time. This research can be applied to other travel time equations to investigate the influence of having an exclusive term for heavy vehicles on the accuracy of the estimation results. In addition, different model structures can be used for the heavy truck exclusive term. Based on the results, it is recommended that travel time equations be modified in traffic analysis/studies and simulation software packages in order to directly consider the influence of heavy trucks on average travel times. This is more important under heavy traffic conditions or when heavy vehicles comprise a large proportion of traffic.

Furthermore, the number of passenger car lane changing manoeuvres per lane increased when more heavy trucks existed in that lane. This implies that passenger car drivers try to avoid being in the vicinity of heavy trucks and therefore may attempt to move into other lanes. The influence of heavy trucks on the number of passenger car lane changing manoeuvres is intensified in higher traffic densities and larger percentage of heavy trucks. Number of lane changing manoeuvres is a good indicator of the potential for vehicular conflicts. Large numbers of lane changing manoeuvres can increase the number of traffic accidents and potentially reduce traffic safety. To evaluate the influence of heavy truck existence on the chance of accidents, surrogate measure was used to evaluate the likelihood of rear-end accidents in I-80 (the most common form of accidents on highways/freeways). The results showed an increase of 5% in the likelihood of accidents, when proportion of heavy trucks increased to 30% of total traffic. Increase in proportion of heavy trucks intensified the likelihood of accidents and therefore reduced traffic safety.

The results in this paper showed that heavy trucks have pronounced effect on traffic characteristics (e.g. average travel time and average speed). The existence of larger percentage of heavy trucks can increase the likelihood of accidents and reduce traffic safety. To reduce travel time and improve traffic safety in highways/freeways, heavy trucks can be restricted from particular lanes especially during congestion. Defining those lane restriction strategies for heavy trucks and evaluating the influence they have on traffic characteristics and likelihood of accidents would be another direction for future research.

7. LIST OF ABBREVIATIONS

BPR	Bureau of Public Roads
AIMSUN	Advanced Interactive Microscopic Simulator for Urban and Non-Urban Networks
FHWA	Federal Highway Administration
NGSIM	Next Generation SIMulation
CV	Coefficient of Variation
SHD	Safe Headway Distance

REFERENCES

1. Moridpour S. Modelling heavy vehicle lane changing. Ph.D. Thesis, Monash University, Australia, 2010.
2. Moridpour S, Rose G, Sarvi M. The effect of surrounding traffic characteristics on lane changing behavior. *Journal of Transportation Engineering* 2010; **136**(11):937–1055.
3. Moridpour S, Sarvi M, Rose G. Lane changing models: a critical review. *Transportation Letters: The International. Journal of Transportation Research* 2010; **2**(3):157–173.
4. Moridpour S, Sarvi M, Rose G. Modeling the lane changing execution of multi class vehicles under heavy traffic conditions. *Transportation Research Record. Journal of the Transportation Research Board* 2010; **2161**:11–19.
5. Sarvi M. Heavy commercial vehicles-following behavior and interactions with different vehicle classes. *Journal of Advanced Transportation* 2013; **47**(6):572–580.
6. Aghabayk K, Sarvi M, Forouzideh N, Young W. Modelling heavy vehicle car-following behaviour in congested traffic conditions. *Journal of Advanced Transportation* 2013. DOI:10.1002/atr.1242.
7. Al-kaisy AF, Hall FL, Reisman ES. Developing passenger car equivalents for heavy vehicles on freeways during queue discharge flow. *Transportation Research A* 2002; **36**(8):725–742.

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8. Uddin MS, Ardekani SA. An observational study of lane changing on basic freeway segment. *Proceeding of the 81st Transportation Research Board Annual Meeting*, Washington, D.C., CD-ROM, 2002.
9. Al-kaisy AF, Hall FL. Guidelines for estimating capacity at freeway reconstruction zones. *Journal of Transportation Engineering* 2003; **129**(5):572–577.
10. Al-kaisy AF, Jung Y, Rakha H. Developing passenger car equivalency factors for heavy vehicles during congestion. *Journal of Transportation Engineering* 2005; **131**(7):514–523.
11. Fwa TF, Ang BW, Goh TN. Characteristics of truck traffic in Singapore. *Journal of Advanced Transportation* 2010; **30**(2):25–46.
12. Bureau of Transportation Statistics. US Department of Transportation, National Transportation Statistics BTS02-08, Washington DC, US Government Printing Office, 2002.
13. Bureau of Transportation Statistics. US Department of Transportation, National Transportation Statistics BTS 40–13, Washington DC, US Government Printing Office, 2013.
14. Frauenfelder P, Espada I. Investigation of truck lane restriction on motorways. 25th Australian Road Research Board (ARRB) Conference, Perth, Australia, 23–26 September, 2012.
15. Kobelo D, Patrangenaru V, Mussa R. Safety analysis of Florida urban limited access highways with special focus on the influence of truck lane restriction policy. *Journal of Transportation Engineering* 2008; **134**(7):297–306.
16. El-tantawy S, Djavadian S, Roorda MJ, Abdulhai B. Safety evaluation of truck lane restriction strategies using microsimulation modeling. Transportation Research Record. *Journal of the Transportation Research Board* 2009; **2099**:123–131.
17. Adelakun A, Cherry C. Exploring truck driver perceptions and preferences: congestion and conflict, managed lanes, and tolls. *Proceeding of the 88th Transportation Research Board Annual Meeting*. Washington, D.C., CD-ROM, 2009.
18. Cambridge Systematics. NGSIM I-80 data analysis. Summary Reports, Federal HighWay Administration (FHWA), 2005. https://camsys.com/ accessed on 2007.
19. Thiemann C, Treiber M, Kesting A. Estimating acceleration and lane-changing dynamics from next generation simulation trajectory data. *Transportation Research Record: Journal of the Transportation Research Board* 2008; **2088**:90–101.
20. Mauch M, Cassidy MJ. Freeway traffic oscillations: observations and predictions. The 15th International Symposium on Transportation and Traffic Theory, Pergamon-Elsevier, Oxford, 2002; 653–674.
21. Toledo T. Integrated driving behavior modeling. Department of Civil and Environmental Engineering, Massachusetts Institute of Technology. Doctor of Philosophy, 2003.
22. Seongsoon Y, Wade WW, Daniel RL, Yongqiang W. Accounting for the impact of heavy truck traffic in volume-delay functions in transportation planning models. *Transportation Research Record: Journal of the Transportation Research Board* 2005; **1931**:8–17.
23. Cruz-casas CO. Impact of trucks on signalized intersection capacity. *Computer-Aided Civil and Infrastructure Engineering* 2010; **25**(6):452–467.
24. US Transportation research Board. Highway capacity manual (HCM). TRB Report 209, Washington D.C., 2010.
25. Bates DM, Watts DG. Nonlinear regression analysis and its applications, 2007.
26. Akçelik R. Travel time functions for transport planning purposes: Davidson's function, its time-dependent form and an alternative travel time function. *Australian Road Research* 1991; **21**(3):49–59. (Minor revisions: December 2000).
27. Akçelik R. Relating flow, density, speed and travel time models for uninterrupted and interrupted traffic. *Journal of Traffic Engineering and Control* 1996; **37**(9):511–516.
28. Alassar L. Analysis of heavy truck accident severity. *Journal of Advanced Transportation* 1988; **22**(1):77–91.
29. Samba D, Park B. Development of the TRANSIMS safety evaluation module and its application on large truck safety treatments. Research Report No. UVACTS-16-0-154, 2010.
30. Park B, Chen Y, Hourdos J. Opportunities for preventing rear-end crashes: findings from the analysis of actual freeway crash data. *Journal of Transportation Safety and Security* 2011; **3**(2):95–107.
31. Samba D, Park B, Gardner B. Evaluation of large-truck transportation alternatives with safety, mobility, energy, and emissions analysis. *Transportation Research Record: Journal of the Transportation Research Board* 2011; **2265**:34–42.
32. Fairclough SH, May AJ, Carter C. The effect of time headway feedback on following behaviour. *Accident Analysis and Prevention* 1997; **29**(3):387–397.
33. TRI. Stopping sight distance and decision sight distance. Discussion Paper No. 8.A, Transportation Research Institute, Oregon State University, 1997.
34. Yadlapati SS, Park B. Development and testing of variable speed limit control logics for work zones using simulation. Research Report No. UVACTS-13-0-43, Center for Transportation Studies, the University of Virginia, 2004.
35. Yang H. Simulation-based evaluation of traffic safety performance using surrogate safety measures. Department of Civil and Environmental Engineering, the State University of New Jersey. Doctor of Philosophy, 2012.

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DOI: 10.1002/atr

EXHIBIT 27

Technical Report Documentation Page

1. Report No. FHWA/TX-0-2122-1	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle EFFECTS OF TRUCK SIZE AND WEIGHTS ON HIGHWAY INFRASTRUCTURE AND OPERATIONS: A SYNTHESIS REPORT		5. Report Date March 2001
7. Author(s) David M. Luskin, and C. Michael Walton		6. Performing Organization Code
		8. Performing Organization Report No. Research Report 0-2122-1
9. Performing Organization Name and Address Center for Transportation Research The University of Texas at Austin 3208 Red River, Suite 200 Austin, TX 78705-2650		10. Work Unit No. (TRAIS)
		11. Contract or Grant No. Research Project 0-2122
12. Sponsoring Agency Name and Address Texas Department of Transportation Research and Technology Implementation Office P.O. Box 5080 Austin, TX 78763-5080		13. Type of Report and Period Covered Research Report (9/2000 to 3/2001)
		14. Sponsoring Agency Code

15. Supplementary Notes
Project conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration, and the Texas Department of Transportation.

16. Abstract

The North American Free Trade Agreement (NAFTA) calls for harmonization of truck standards among the trade partners. Combined with the desire of U.S. industry to reduce freight costs, this aspect of NAFTA has stimulated interest in how liberalization of truck size and weight limits in the U.S. would affect highway infrastructure and safety. This report distills the findings from the extensive literature on this topic, to which a major recent addition was the Comprehensive Truck Size and Weight study prepared by the U.S. Department of Transportation. Allowing extra weight for a given type of truck can cause substantial pavement damage because of the increase in the weights of the axles. However, the truck size and weight liberalizations that have received most attention in the literature would encourage a switch from the dominant type of heavy truck, the 5-axle tractor semitrailer, to trucks that have higher payloads and additional axles. Such reforms do not necessarily create substantial pavement costs: estimates of their effect on pavement costs are generally modest and sometimes negative. More likely, they will create substantial costs for upgrading bridges to accommodate the increases in gross vehicle weights. The effects on safety are especially hard to predict. Improvements in driver performance and vehicle design can offset the safety drawbacks of larger, heavier trucks. In addition, since higher payloads reduce the number of trips required to transport a given volume of freight, allowing heavier trucks could even reduce the number of accidents. Estimation of the overall effect on safety is not possible with available data on crash rates for heavy trucks.

17. Key Words truck size and weight, regulations, vehicle characteristics	18. Distribution Statement No restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

19. Security Classif. (of report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of pages 82	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

EFFECTS OF TRUCK SIZE AND WEIGHTS ON HIGHWAY INFRASTRUCTURE AND OPERATIONS: A SYNTHESIS REPORT

by

David Luskin and C. Michael Walton

Research Report 0-2122-1

Research Project 0-2122

Synthesis Study of the Effects of Overweight/Oversize Trucks

Conducted for the

TEXAS DEPARTMENT OF TRANSPORTATION

in cooperation with the

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

by the

CENTER FOR TRANSPORTATION RESEARCH
Bureau of Engineering Research
THE UNIVERSITY OF TEXAS AT AUSTIN

March 2001

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ACKNOWLEDGMENTS

In preparing this report, the authors benefited from discussions with the TxDOT project monitoring committee and with colleagues at the Center for Transportation Research: Zhanmin Zhang, Kara Kockelman, and Robert Harrison. We also benefited from talking with staff of the U.S. Federal Highway Administration — Jim March, Karen White, and Jim Sacklas — and with Jerry Stephens of Montana State University. We thank all these individuals, whose views are not necessarily reflected in this report.

TABLE OF CONTENTS

PROJECT BACKGROUND 1
WEIGHT REGULATIONS IN TEXAS 3
Federal Regulations 3
Weight Limits 3
Length Limits 3
State Regulations 4
Load Posted Limits 4
Permits 5
Special Allowances and Exemptions 6
REVIEW OF LITERATURE: SYNTHESIS OF FINDINGS 9
Freight Distribution Patterns 9
Finding 1 9
Finding 2 11
Pavements 11
Finding 3 11
Finding 4 12
Finding 5 13
Finding 6 14
Finding 7 14
Finding 8 15
Finding 9 16
Bridges 17
Finding 10 17
Finding 11 17
Safety 18
Finding 12 18
Finding 13 20
Finding 14 20
REFERENCES 23
APPENDIX: ANNOTATED BIBLIOGRAPHHY 27
Traffic Patterns 27
Bridges 30
Truck Routing 37
Regulatory 38
Pavements 39
Geometric Design 50
Safety 56
Databases 58
Statistics and Data Analysis 59
Performance Measures of Larger Combination Vehicles 64
Driver Safety and Rights 65
Narrow Roads and Safety 66
General References 67
Glossary 69

LIST OF FIGURES

Figure 1. Alternative Combination Truck Configurations 7
Figure 2. Low-Speed Offtracking 71
Figure 3. High-Speed Offtracking..... 71

LIST OF TABLES

Table 1. Relative Pavement Impacts of Different Trucks as Measured
by Number of Equivalent Single Axle Loads 46

LIST OF ACRONYMS

AC	**Asphaltic concrete**
ALF	**Accelerated Loading Facility**
CTS&W	**Comprehensive Truck Size and Weight**
EDL	**Equivalent Distributed Load Method**
EDTF	**Equivalent Dynamic Filter Technique**
ESAL	**Equivalent single-axle load**
FBF	**Federal Bridge**
FHWA	**Federal Highway Administration**
FM	**Farm-to-Market**
FY	**Fiscal Year**
GVW	**Gross Vehicle Weight**
ITIC	**Intermodal Transportation Inventory Cost (Model)**
LEF	**Load equivalence factor**
LCV	**Longer Combination Vehicle**
MCD	**Motor Carrier Division**
NAFTA	**North American Free Trade Agreement**
OECD	**Organization for Economic Cooperation and Development**
PCC	**Portland Concrete Cement**
PSI	**Present serviceability index**
RMD	**Rocky Mountain Double**
SN	**Structural Number**
STAA	**Surface Transportation Assistance Act of 1991**
TAC	**Texas Administrative Code**
TxDOT	**Texas Department of Transportation**
TTI	**Texas Transportation Institute**
TRB	**Transportation Research Board**
TS&W	**Truck size and weight**
USDOT	**United States Department of Transportation**
VMT	**Vehicle-miles-of-travel**
WIM	**Weigh-in-motion**

PROJECT BACKGROUND

State and federal governments place various limits on the sizes and weights of vehicles on public roads. The primary purpose is to ensure compatibility of vehicle size and weight with roadway design and operations. Of particular concern are the roadway impacts of heavy trucks, which far exceed those of passenger cars.

The North American Free Trade Agreement (NAFTA) may lead to changes in truck size and weight (TS&W) regulations. NAFTA calls for unimpeded movement of trucks across the borders of the treaty partners and for the harmonization of truck standards. Although the agreement was ratified in January 1994, implementation of these provisions has been slow and the harmonization of truck standards has yet to be negotiated. Currently, Mexico and Canada allow heavier trucks than do Texas and many other states.

Even before NAFTA, segments of U.S. industry had been pressing for increased limits on TS&W to save on freight costs. These pressures and those arising from NAFTA led the Texas Department of Transportation (TxDOT) to commission the present study from the Center for Transportation Research. The study involved a review of the literature on the effects of TS&W on highway infrastructure and safety. From this literature, we have distilled certain findings that throw light on the consequences of possible changes to TS&W regulations in Texas. As TxDOT requested, we have focused in particular on possibility of increasing the limit on gross vehicle weight (GVW).

In reporting on this project, we start by describing the truck size and weight limits in place in Texas and then proceed to the lessons learned from our literature review. An annotated bibliography at the back of the report describes the studies reviewed.

WEIGHT REGULATIONS IN TEXAS

FEDERAL REGULATIONS

Weight Limits

The Federal government sets maximum axle weights for vehicles on Interstate highways: 20,000 lb for a single axle and 34,000 lb for a tandem axle. Vehicles on Interstate highways must also conform to the Federal Bridge Formula, which is designed to protect bridges from the catastrophic overloads. The formula defines a maximum weight for each axle group on a vehicle as follows:

$$W = 500 [L N/ (N-1) + 12 N + 36]$$

where

W = maximum weight in pounds carried on any group of two or more consecutive axles.

L = distance in feet between the extremes of the axle group

N= number of axles in the axle group

Federal law specifies the following exceptions to the results given by the above formula:

- The combined weight of the entire set of axles on a vehicle (the "outer bridge" group) cannot exceed 80,000 lb. In other words, gross vehicle weight (GVW) cannot exceed 80,000 lb.

- 68,000 lb may be carried on two sets of tandem axles spaced at least 36 feet apart.

- A single set of tandem axles spread no more than 8 feet is limited to 34,000 lb.

Under the "grandfather rights" accorded by federal law, some states allow vehicles to exceed the above-described weight limits on Interstate Highways. To claim these rights, a state must show that the higher weights would have been allowed under its regulations before the federal limits came into being. Texas would have difficulty making such a claim and has not attempted to do so.

Length Limits

Federal regulation of vehicle size covers the National Network defined by the Surface Transportation Assistance Act of 1982 (STAA). The National Network comprises the Interstate highway system plus designated portions of the Federal-Aid-Primary network, which predates the Interstate highway system.

STAA requires that states allow on the National Network vehicles with certain length dimensions. States are barred from limiting the length of a semitrailer in a semi trailer combination to less than 48 feet. States must also allow trailers of at least 28 feet in a twin-trailer combination; when the trailers are 28 feet, this combination is known as the STAA double (Figure 1).

STAA also restricts vehicles on the National Network to a maximum width of 8.5 feet.

STATE REGULATIONS

Texas applies the Federal limits on vehicle weight and width to all its roads. As well, it restricts tire weight to a maximum of 650 lb per square inch.

In addition, there are the following uniform limits on vehicle size:

Maximum Height	14 feet
Maximum Length:	
Semitrailer	59 feet
Double Trailers	2 x 28.5 feet
Truck and trailer	65 feet

There are no restrictions on the overall length of a tractor-semitrailer combination.

Load Posted Limits

Portions of the road and bridge network in Texas have posted weight limits that are less than the general ones described above. These limits may be imposed where "heavier maximum weight vehicles would rapidly deteriorate or destroy the road or a bridge." [1]

Both the state and county governments in Texas must base load postings on an engineering and traffic investigation that conforms to certain procedures. The procedures for determining the appropriate limits are more complicated for axle weight than for gross vehicle weight (GVW). Partly for this reason, load postings are almost always for GVW rather than axle weight, despite the engineering consensus that pavement deterioration is much less a function of GVW than of axle weight. For bridges, the posted limits on GVW make more sense because the engineering consensus is that deterioration depends mainly on GVW and axle spacing rather than axle weight.

On the state-maintained network, the load-posted stretches lie almost entirely on the network of Farm-to-Market (FM) roads. The FM roads were constructed mainly in the 1940s and 1950s to accommodate gross vehicle weights of up to 58,420 lb, the then-prevailing limit on Texas roads. Although some of these roads have since been upgraded, 58,420 lb restrictions remain on two-fifths of the nearly 41,000 centerline miles of FM roads.

[1] Texas Transportation Code, Sec. 621.102 and Sec. 621.301. See http://capitol.tlc.state.tx.us/statutes/codes.

County roads remain mostly at a standard of 58,420 lb or less, but only some are load-zoned. The establishment of load-zoned limits requires public hearings as well as an engineering study. Some county officials consider the process too troublesome to be worthwhile, particularly with holders of 2060 permits being exempt from load-posted limits (see below). Information on the proportion of county roads that are load-zoned is not readily available. In Panola County, none of the roads are load-zoned, although few can sustain even 60,000 lb trucks with any regularity.

In addition, there are many load-zoned bridges in Texas, including some 4,000 that were built to standards of less than 58,420 lb, and some that were built to a standard of only 5,000 lb. Federal law requires an inspection of each bridge every two years as part of the Bridge Replacement and Rehabilitation Program established in 1970. A bridge that receives a rating of "structurally deficient" is unsafe for legal weights and therefore must be posted and restricted. The Texas Department of Transportation (TxDOT) has advised that some stretches of pavement on the FM system are load-zoned because they lead up to load-zoned bridges, not because the pavement is structurally deficient.

Permits

As in other states, Texas issues special permits for vehicles needing to exceed these limits on portions of the road network. For a "nondivisible" load, disassembly into smaller components, in order to stay within the normal limits on vehicle dimensions, is impracticable. Such a load could be an item for heavy machinery, for example. All states issue permits for nondivisible loads and some, including Texas, issue permits for divisible loads as well.

The large majority of nondivisible-load permits issued in Texas are for single trips, the others being valid for thirty days, ninety days, or a year. To obtain a single-trip permit, an applicant must propose a route for TxDOT to review and possibly modify and pay a fee of $30 or more. The thirty- and ninety-day permits cost $60 and $120 per vehicle and allow increases in width or length only. The annual permits allow trucks up to 12 feet wide, 14 feet high, 110 feet long, and 120,000 lb in gross weight.

Nondivisible-load permits allow travel on neither load-posted stretches nor off the State-maintained network. To haul overweight on local roads, holders of the permits must seek local government approval. On the other hand, the permits may allow travel on Interstate Highways.

Since 1989, Texas has issued an annual "2060" permit that allows an additional 5 percent gross weight and 10 percent axle weight above the maximum allowable weights that would otherwise apply to the vehicle. As interpreted by the Attorney General and later by the courts, the maximum allowable weight should be calculated without regard to load-posted limits. For most vehicles with the permit, the maximum allowable gross weight without a permit would be the general cap of 80,000 lb, rather than a lower limit determined by the Federal Bridge Formula. For these vehicles, the permit allows a gross weight of 84,000 lb (5 percent above 80,000 lb).

Although the 2060 permit does not require that loads be divisible, the vast majority of loads actually carried appear to be highly divisible, such as shipments of gravel or crude oil. It is, in this respect, a "divisible-load permit." In FY 1999, nearly 15,000 of the permits were issued at an average annual fee of $238.

Special Allowances and Exemptions

The TS&W regulations in Texas, like those of other states, are replete with allowances and exemptions for special classes of vehicles. Concrete-mixer trucks are allowed tandem axle weights of up to 46,000 lb, whereas the general limit is 34,000 lb. The deal is even better when the gross vehicle weight is less than 69,000 lb; a concrete-mixer truck can then have a tandem axle weighing up to 50,600 lb. Other special tolerances include:

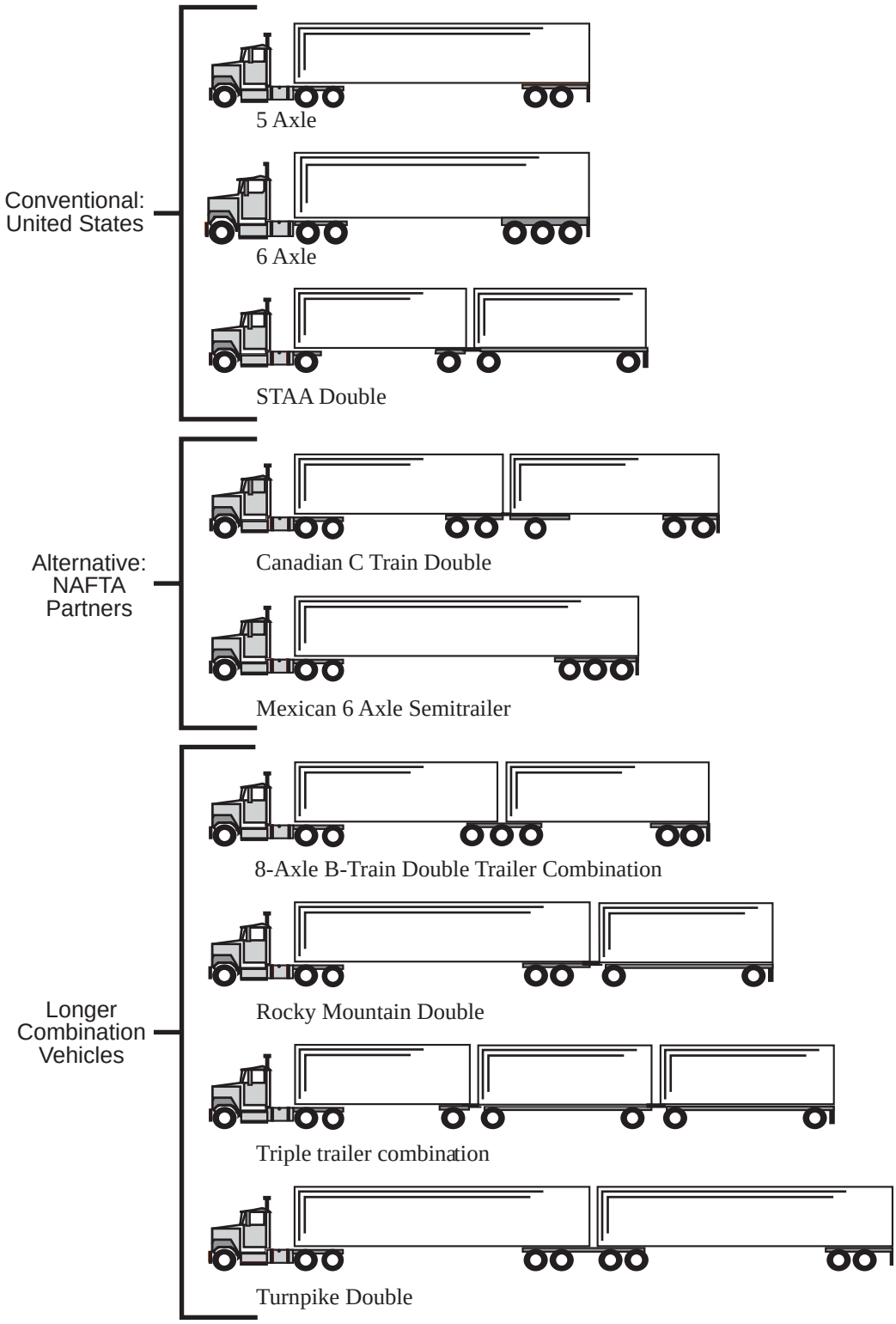
- An exemption from load-posted weight limits on state-maintained roads and bridges for vehicles delivering groceries, farm products, or liquefied petroleum gas.

- An exemption from load-posted weight limits on county roads and bridges for vehicles delivering groceries or farm products, provided that the delivery "requires" use of the road or bridge.

- An exemption from weight limits for vehicles transporting "fixed load oil field service equipment" for servicing an oil and gas well, not more than 50 miles from the equipment's point of origin.

- A 12 percent tolerance on axle weights for vehicles hauling forestry or agricultural products in their natural state.

Figure 1: Alternative Combination Truck Configurations



REVIEW OF LITERATURE: SYNTHESIS OF FINDINGS

FREIGHT DISTRIBUTION PATTERNS

Finding 1. ***The effects on freight traffic are often hard to predict, in large part because of service quality considerations.***

To understand the effects of truck size and weight (TS&W) regulations on highway infrastructure and safety, one must consider the effects on freight traffic patterns:

- *Choice of route.* For example, in states such as Florida where the weight limits are lower on the Interstate system than on other highways, this differential may cause some rerouting away from Interstate highways. Such rerouting would be likely to increase pavement damage and compromise safety, because the Interstate highways are generally the least vulnerable to damage from heavy trucks and have the lowest rates of accidents.

- *Choice among types of trucks.* To take another example, a reform modeled in the Comprehensive Truck Size and Weight study (USDOT 2000) would supersede the bridge formula by allowing tridem axles up to 51,000 lb. Its adoption would induce shippers to switch toward trucks that use tridem axles. For example, tractor-semitrailer combinations with six axles, including a rear tridem, would replace some of the 5-axle combinations with tandem axles.

- *Choice of transport mode.* In particular, TS&W regulations can affect shipper choices between rail freight and trucking.

- *The amount of freight being shipped*. By reducing the cost of freight shipments, an increase in truck size and weight limits stimulates additional demand for freight shipments. The literature on transportation often refers to this as the "induced demand" effect.

Unfortunately, to estimate the various effects with much confidence is a major challenge, given the limitations of available data. Reflecting the difficulties of this task, each of the attempts that was reviewed for this study featured some omission or simplification that could be significant.

For most reforms to TS&W regulations, the key effects to analyze are on choices among types of trucks. To see how service quality considerations complicate such analysis, consider some reform that would allow a shipper to use trucks with larger payloads. By switching to the larger trucks, the shipper would save on transportation costs—the costs of moving the goods from origin to destination. Whether the shipper actually opts for the larger trucks, however, would also depend on service quality factors such as frequency of delivery.

A potential consequence of using larger trucks is that deliveries become less frequent: with each truck carrying a larger payload, fewer trips are needed to transport a given volume of freight. Less frequent delivery, in turn, causes inventories to accumulate, which means extra costs in tied-up capital. In addition, less frequent delivery can disrupt business operations, as when a business unexpectedly needs a large shipment in a hurry. The maintenance of additional safety stocks can avoid these disruptions for certain types of freight, but will create costs of its own. Moreover, additional safety stocks will not be feasible for some perishable or highly customized items.

Alternatively, a switch to larger trucks could be accompanied by increased consolidation of freight to maintain frequency of delivery. The consolidation of less-than-truckload shipments also entails costs, however, resulting from more circuitous truck routes, additional resources needed to coordinate shipments, and double handling of freight. For the switch to larger trucks to occur, these costs of consolidation must be less than the line-haul savings.

The Comprehensive Truck Size and Weight (CTS&W) modeled the effects on freight traffic of several scenarios for TS&W reforms, using the Intermodal Transportation and Inventory Cost (ITIC) model. The modeling framework was the most elaborate among the studies reviewed, but still had significant limitations The ITIC model assumes that larger payloads lead to less frequent service, and that this results in higher inventory costs. In addition to having this consequence, however, less frequent service can disrupt business operations in various ways (as was noted above). The ITIC model recognizes neither these disruptions nor the possibility of maintaining service frequency through freight consolidation.

The documentation of the ITIC model acknowledges that the model captures service quality considerations only in a "general way." As an example of the omissions, it notes that the freight database on which the model depends used commodity categories that were too broad to factor spoilage into the model. "Food and kindred products" would have included both canned goods and highly perishable goods.

Service quality considerations present similar challenges for modeling choices of transportation mode. Choices between trucking and rail freight services (or rail combined with road) generally present a tradeoff between price and service quality. Rail freight is generally cheaper, but trucking has advantages in flexibility and speed, and often in reliability. It is difficult to quantify the service levels provided by each mode and the values that shippers assign to each service attribute.

Also difficult to estimate are the effects of TS&W limits on the total amount of freight shipped (not just by truck). The estimates in Pickrell and Lee (1998) are highly speculative and are at a national level. A study of possible changes to gross vehicle weight limits in Montana (Hewitt et al. 1999) concluded that the effects on total volume of freight shipped are small enough to ignore, but failed to take account of substitution between truck transportation and other inputs.

Of particular interest is how liberalizations to TS&W limits would affect the total vehicle miles of travel (VMT) among heavy trucks. The Comprehensive Truck Size and Weight Study estimated this effect to be negative in each of three liberalization scenarios it modeled (see finding 9, below). This finding reflects that an increase in TS&W limits allows trucks to carry larger payloads, which reduces the number of trips needed to carry a given freight task. This effect of higher payloads outweighed the increase in truck VMT attributed to diversion from rail. The same pattern emerged from the modeling conducted in an earlier study (TRB 1990).

Finding 2. ***Some reforms to TS&W limits may have large impacts on the types of trucks in use.***

The results of the CTS&W study indicate that some of the reforms modeled would have quite large impacts on the composition of the nation's fleet of heavy trucks. Returning to the scenario where 51,000 lb tridem axles are allowed, the results indicate that such reform would cause a 70 percent decline in the miles traveled by 5 axle tractor-semitrailer combinations and correspondingly large increases in the miles traveled by combinations with tridem axles. Some of the predicted increased use of combinations with tridem axles reflected a diversion away from rail freight.

For some TS&W reforms, however, the effects on the composition of the truck fleet are minor. For example, as discussed below, the introduction in Texas of the "2060" permit for overweight trucks has caused little substitution between truck types. Unlike the reforms modeled in the CTS&W study, the permit allows an increase in weight even for the currently dominant type of combination truck, the 5-axle tractor semitrailer. The permit has simply led to heavier loads on this type of truck rather than switches to trucks with more axles.

PAVEMENTS

Finding 3. ***The pavement damage from vehicle traffic depends mainly on the number of axle passes over the pavement and axle weights.***

The consensus in engineering literature is that pavement damage is a function of the number of axle passes over the pavement and axle weights. As Crockford (1993) put it:

> The fundamental cause of pavement failure is the application of a *tire contact pressure* that exceeds the *load carrying capacity* of the pavement. The *tire contact pressure* (or the next best indicator, axle load) is important to the minimization of damage. To the trucking industry, this means that the *gross vehicle weight* is almost unlimited by the pavement structure (within reason of course)… The reason gross vehicle weight is almost unlimited by pavement structure is that tire contact pressure can be reduced by increasing the number of axles, the number of tires, or by using low inflation pressure tires.

An increase in the weight of a *given vehicle* will, of course, exacerbate the stresses on pavement by adding to axle weights. If a switch to a vehicle with additional axles accompanies an increase in gross weight, however, the pavement can be neutral or even benign. An example from USDOT (2000) compares two tractor-semitrailer combinations, each with 12,000 lb on the steering axle and with 34,000 lb on one or more tandem axles. One of the combinations has a standard 5-axle arrangement with two tandem axles, making for a gross vehicle weight of 80,000 lb. The other combination has six axles—one tandem plus a tridem loaded to 44,000 lb—and so grosses to 90,000 lb. According to the study's estimates for flexible pavements, the six-axle combination would cause 18 percent less road damage per vehicle-mile than would the 5-axle combination, despite having a gross weight that is 12 percent greater.

Finding 4. ***An increase in axle weight generally causes a more than proportional increase in pavement damage. The relationship appears to approximate an exponential function, and various studies have assumed the power of the exponent to be about 4 as a rule. Estimates of the exponent's power vary substantially, however.***

The "fourth-power" rule emerged from in-situ pavement tests conducted in the 1950s by the organization now known as AASHTO, the American Association of State Highway and Transportation Officials. The tests involved subjecting a large number of pavement structures to alternative axle loads and configurations, and then measuring the resulting damage (see Highway Research Board 1962). For each type of pavement, AASHTO subsequently derived a load equivalence factor that varies by axle configuration and axle weight. The load equivalence factor expresses the pavement damage relative to that from an 18,000 lb single axle. Analysis of the variation in these factors by axle weight led to the fourth-power "rule," which is actually a rough generalization.

Subsequent studies of pavement damage from traffic have used a variety of methods. In addition to full-scale road tests like those conducted by AASHTO—which are time-consuming and expensive—studies have used accelerated pavement testing devices and computer simulations. By passing a vehicle over a short stretch of pavement in rapid succession, an accelerated device enables 20 years of serviceability loss to be obtained in several weeks or months.

The results from these various studies are, in combination, messier than those from the AASHTO study. Even when the measure of pavement condition was the same as in the AASHTO tests (the present serviceability index), some of the findings have diverged substantially from the fourth-power rule. For example, the accelerated pavement tests conducted by Chen and Shiah (2000) indicated an exponential power of about eight versus AASHTO's four. The authors speculated that the difference may have resulted partly from the use of heavier axles in their tests than in the AASHTO tests. Another contributing factor was that the vehicles in their tests traveled at slower speed (21 km/hr) than in the AASHTO tests (see below).

The present serviceability index is based on road user perceptions of ride quality. Although it includes terms for cracking and rutting, the value of the index depends

mainly on surface roughness. When a study derives separate load equivalence factors for more than one measure of road damage, the power of the exponent will often be quite sensitive to the choice of measure. OECD (1988) cited a French study in which the exponent turned out to have a power of about 2 in relation to fatigue cracking and about 8 in relation to rutting.

The power of the exponent can also differ between types of pavement. OECD (1988) concluded from its review of international evidence that while the fourth-power rule was a reasonable generalization for flexible pavements, the exponent for rigid pavements was greater than 11.

In addition, because roads designed for light duty are more vulnerable to damage from heavy loads, the exponents tend to have higher powers for these roads than for others (see, for example, Chen and Shiah 2001, p. 16). There may, however, be exceptions to this rule. In one computer simulation, the impact on pavement life of increasing axle load from 27,000 to 32,000 lb was significant for a thick pavement (SN=4.82) but negligible for a thin pavement (SN=2.92). The pavements that were simulated were flexible and their life was measured in terms of cracking (Kilareski 1989).

Finding 5. ***The effects of axle spacing on pavement damage are complex and generalizations elusive.***

The OECD (1988) found from its literature review that bunching of axles has favorable impacts on flexible pavements. For illustration, it presented load equivalence factors from the AASHTO design guide. For a flexible pavement with a PSI of 2.5 and an SN of 4.0, the load equivalence factor for a 36,000 lb tandem axle was 1.38; this means that one pass of the tandem axle over the pavement would cause the same deterioration in pavement condition (as measured by the PSI) as would 1.38 passes of a single 18,000 lb axle. Thus, distributing a 36,000 lb load over a tandem axle instead of two single axles will, according to these numbers, reduce pavement damage per mile traveled by the equivalent of 0.62 passes of a single 18,000 lb axle (0.62= 2 – 1.38). For the tridem axle, the load equivalence factor was 1.66. Kilareski (1989) reported qualitatively similar results.

For rigid pavements, the OECD reported mixed findings. The AASHTO results indicated that bunching of axles into tandems or tridems exacerbated pavement damage, whereas the results of an Italian study indicated the opposite pattern. The OECD concluded that damage to rigid pavements depends much more on load per axle component than on the spacing of components.

TRB (1990) cautioned that the “net effect of changes in axle spacing on pavement deterioration is complex and highly dependent on the nature of the pavement structure.” In line with the AASHTO results, it affirmed that increasing the distance between the axles in a tandem pair from 50 to 60 inches will generally increase wear on flexible pavements and reduce it on rigid pavements. The study also explained the ways in which axle spacing affects pavement wear:

> When widely separated loads are brought closer together, the stresses they impart to the pavement structure begin to overlap, and they cease to act as separate entities. While the maximum deflection of the pavement surface continues to increase as axle spacing is reduced, maximum tensile stress at the underside of the surface layer (considered to be the primary cause of fatigue cracking) can actually decrease as axle spacing is reduced. However, effects of overlapping stress contours also include increasing the duration of loading. (USDOT 2000)

Finding 6. ***An increase in truck speed tends to have mixed effects on pavements.***

For a truck moving over a smooth pavement, the load transmitted to the pavement would be static. An increase in the vehicle's speed would not affect the intensity of the stress on the pavement, but would reduce its duration and, hence, the amount of pavement damage. Chatti et al. (1996) conducted tests on an asphalt concrete section of track and found the effects of vehicle speed to be significant. An increase in the speed of the test vehicle (a heavy truck with air suspension) from 2.7 km/hr (1.7 mi/hr) to 64 km/hr (40 mi/hr) caused approximately a 30 to 40 percent reduction in tensile strain at the bottom of the asphalt layer.

The pavements of actual roads are somewhat uneven, however, which causes vehicles traversing them to move up and down. These movements cause the load transmitted to the pavement to vary, increasing as the vehicle moves down and makes greater contact with the pavement, and decreasing as the vehicle is lifted up. Because pavement damage tends to increase more than proportionally with vehicle load (finding 4), these dynamic fluctuations add to pavement damage.

Finding 7. ***The pavement cost per mile traveled by a heavy vehicle varies greatly between pavements, being greater on pavements designed for light duty than on sturdier pavements.***

A 5-axle tractor semitrailer that weighs 80,000 lb can serve as an example. According to estimates in the Comprehensive Truck Size and Weight study, such a vehicle typically causes about 9 cents in pavement damage per mile of travel on rural Interstate Highways, compared with $5.90 per mile of travel on rural local roads. In part, such a variation simply reflects that light-duty roads are more vulnerable to heavy vehicles than are sturdier roads. But it also reflects the major scale economies that exist in designing pavements for greater traffic loadings. TRB (1990) illustrated these scale economies with the AASHTO design manual: as the traffic loading for which a road is designed (as measured by the number of ESALs) increases, the required pavement thickness also increases but in much smaller proportion. "For example, a 10 percent increase in ESALs can be accommodated by 1.5 percent increase in pavement thickness." (TRB 1990, p. 72).

Finding 8. ***Increases in TS&W limits that lead to higher axle weights can have quite large pavement costs.***

Experience with Texas's 2060 permit can serve to illustrate this key finding. The permit is not restricted by type of vehicle or load, and can be used on all public roads except Interstate highways. It allows an additional 5 percent gross weight and 10 percent axle weight above the maximum allowable weights that would otherwise apply to the vehicle. The permit also effectively exempts a vehicle from the limits on gross weights, commonly 58,420 lb, that are posted on many bridges and stretches of pavement. Moreover, the vast majority of vehicles with 2060 permits are 5-axle tractor-semitrailer combinations, for which the maximum gross weight without a permit is normally the general cap of 80,000 lb. So as a rule, vehicles with the permit can legally operate with gross weights of up to 84,000 lb.

According to industry sources, the availability of the permit has not caused significant changes in the types of trucks used for a given freight task. Instead, the result has been that the currently predominant type of heavy truck, the 5-axle tractor-semitrailer combination, carries larger loads than before. The increase in loads has opposing effects on pavement damage. With larger loads, the same freight task can be achieved with fewer vehicle miles of travel, which reduces pavement damage. But the dominant effect, judging by the AASHTO load equivalence factors, is increased strain on pavements due to the additional weight on the load-bearing axles.

The costs of pavement damage from overweight operation under the 2060 permit depend on the types of roads on which such operation occurs. Because detailed data on this question are lacking, a recent study of the permit system (Luskin et al. 2000) considered two hypothetical scenarios. Each scenario pertains to a 5-axle combination truck that has the 2060 permit and a tare weight of 29,000 lb. The truck is loaded to 84,000 lb half the time and empty the rest of the time. Based on responses to the study's survey of permit-holders, annual mileage was assumed to be 80,000.

In the "worst-case" scenario, the truck travels exclusively on roads designed to a 58,420 lb standard, and without a permit would operate at that weight to conform to load postings. In the "best case" scenario, a truck travels exclusively on relatively heavy-duty roads—the state-maintained network other than Farm-to-Market roads—and would operate in the absence of the permit at a loaded gross weight of 80,000 lb. The rough estimates were that overweight operation under permit would cause annual pavement damage equal to $51,160 in worst-case scenario and $493 in the best-case scenario.

Although the range between these estimates is vast, reality appears to contain a significant element of the worst-case scenario. Responses to the study's survey of permit-holders indicated that trucks with 2060 permits would travel about a quarter of their miles on local roads, few of which are built to a standard exceeding 58,420 lb. Another 19 percent of the miles traveled were estimated to occur on Farm-to-Market roads, many of which were built to the 58,420 lb standard and have not been upgraded. The responses to the survey further indicate that a third of the permitted trucks are in companies that travel

load-zoned roads on at least 20 percent of their trips. Such usage of load-zoned roads may not sound particularly high, but the proportion of county roads that are load-zoned would likely be higher in the absence of the 2060 permit. At present, the permit's exemption from the load-zone restrictions discourages county governments from undertaking the time-consuming process for establishing load-zone limits.

Finding 9. ***Increases to TS&W limits that encourage the use of trucks with more axles do not necessarily lead to higher pavement costs; they can even produce savings in pavement costs.***

The Comprehensive Truck Size and Weight study modeled five scenarios for reform to TS&W limits, including three scenarios that involved liberalization:

The *North American Trade scenario* would allow heavier tridem axles, up to either 44,000 or 51,000 lb, to facilitate trade between the U.S. and its NAFTA partners. Such reform would allow the eight-axle B-train combinations used in Canada to appear on U.S. highways. It would also increase the use on U.S. highways of six-axle tractor-semitrailer combinations, which are currently much more common in Canada and particularly in Mexico.

The *Longer Combination Vehicles Nationwide* scenario would establish a national network over which these vehicles could operate. The network would comprise 42,000 miles for Rocky Mountain Doubles and Turnpike Doubles, 60,000 miles for triples, and the existing National Network for eight-axle B-train doubles. The study noted that only 21 states (not including Texas) allow Longer Combination Vehicles (LCVs), and that some of the Eastern states only allow them on their turnpike facilities. The scenario for LCVs would set nationally uniform weight limits by vehicle type—for example, 120,000 lb for a seven-axle Rocky Mountain Double—limits described as being higher than those now prevailing.

The *Triples Nationwide Scenario* would establish a national 65,000-mile network for seven-axle triple combinations weighing up to 132,000 lb.

The modeling of each scenario made use of a pavement deterioration model, NAPCOM, which has evolved since 1992. For the triples scenario, pavement restoration costs were estimated to be essentially unaffected. For the other liberalization scenarios, the modeled reform was estimated to reduce these costs. Pavement costs were measured in all cases at prices prevailing in 1994. The largest estimate pertained to the introduction of 51,000 lb tandem axles under the North American Trade scenario. This reform would reduce pavement costs over the study's 20-year planning horizon by the equivalent of a one-off reduction of $3.1 billion. At current prices, this equates to a saving of about $230 million per year for each of 20 years.[2] In the study's simulations, one source of this cost saving is

[2] The FHWA index of road construction prices increased by 19.4 percent between 1994 and the third quarter of 2000, the most recent quarter for which the index is available (FHWA 2000). Thus, $3.1 billion in pavement costs at 1994 prices equates to about $3.7 billion at near-current prices. The annualized equivalent of this amount depends on the real interest rate. The annual yield on 30-year U.S. Treasury

the reduction in total truck-miles traveled due to the increase in payload per truck. The other source of the cost saving is the switch toward using trucks with additional axles, especially, with 6 or 8 axles rather than the more conventional 5: this reduces pavement damage by spreading the truck's load over a larger number of axles.

BRIDGES

Finding 10. ***The Federal Bridge Formula is in need of revision.***

The Federal Bridge Formula (FBF) was designed to protect bridges from stress levels that would risk bridge failure. The Federal government requires that vehicles on Interstate highways conform to the formula, and some states, including Texas, require exactly the same of vehicles on all public roads.

The Comprehensive Truck Size and Weight study reaffirmed the criticisms of the Federal Bridge Formula levied in TRB (1990). The study noted that formula grants additional weight to vehicles that have more axles, even though "bridge stress is affected more by the total amount of load than by the number of axles." The formula allows long combination trucks to exceed 80,000 lb even though the resulting stresses on bridges exceed the levels that the formula was meant to allow. On the other hand, the formula is unnecessarily restrictive when applied to some short trucks.

Finding 11. ***The infrastructure costs of increasing truck size and weight limits tend to consist mainly of costs for bridges.***

The Comprehensive Truck Size and Weight study estimated that the modeled increases to TS&W limits would either reduce or leave essentially unchanged the costs for pavements. In contrast, the study found that these reforms would entail large costs for replacing bridges that would be unable to safely accommodate the increased vehicle weights. For example, the estimated increase in bridge cost that would result under the North American Trade Scenario was $254 billion with a 44,000 lb tridem, and $329 billion with a 51,000 lb tridem. These are one-off rather than annual costs, measured at 1994 prices. At current prices, the annualized equivalents over 20 years would be almost $19 million and about $24 million, respectively.

The simulations of TS&W reform scenarios in TRB (1990) show a similar predominance of bridge over pavement costs, with all costs measured at 1988 prices. The estimates for removing the 80,000 lb cap on gross vehicle weight can serve to illustrate. The estimated effects on annual infrastructure costs were an increase of $10 million for pavements, compared with $680 million for bridges, assuming that all safety-deficient bridges would be replaced. Of the bridge costs, $510 million stemmed from the replacement costs, $150 million from upgrading the design loads for new bridges, and only $20 million from

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bonds is about 5 percent at the time of writing, while inflation has recently been running at about 3 percent (as measured by the percent increase in the consumer price index during the year ending February 2001). The real long-term interest rate is therefore about 2 percent at present. At this rate, a one-off savings of $3.7 billion at present would equate to a savings of about $230 million for each of the next 20 years.

fatigue costs for existing bridges that would not be replaced. In comparison, the estimated savings in transportation costs were over $2 billion annually.

The evidence also suggests that the costs to society of bridge replacement are mainly in disruption of traffic while work is underway. Weissmann and Harrison (1998a, 1998b) considered the costs for bridge replacement that would be needed for U.S. highways to accommodate the types of trucks that Canada and Mexico allow. The Mexican truck was a 107,000 lb tractor-semitrailer with six axles; the Canadian truck was a 128,000 lb "C-train" short heavy double. The authors estimated that in Texas alone, the introduction of the Canadian truck would require $7.7 billion in expenditures on bridge replacement. Of this amount, about 80 percent consisted of the inconvenience costs to motorists of the traffic delays generated by the bridge work; the costs of the bridge work itself accounted for only 20 percent. In the findings of the CTS&W study as well, the delay costs to motorists were the main costs of bridge replacement.

Possibly, these studies have exaggerated the bridge costs of increases to TS&W limits by assuming that bridges have to be replaced when they cannot safely accommodate the increases in weights. An alternative that warrants further investigation is that the bridges could be strengthened.

SAFETY

Finding 12. ***A switch toward heavier or larger trucks need not increase the rate of accidents per vehicle mile of travel. Changes in vehicle and roadway design can offset the safety drawbacks of some heavier or larger vehicles; so can improvements in the performance and selection of drivers.***

In addition to human factors, the safety performance of a truck depends on engineering factors such as resistance to rolling over and capabilities for accelerating and maintaining speed.

Static rollovers

Trucks sometimes roll over when negotiating curves ("static rollover"), but the risk is not necessarily greater for larger, heavier trucks. Indeed, an STAA double tends to be more stable on curves than a conventional 5-axle tractor semitrailer because of its additional length. Spreading a given payload over a greater length reduces the height of the vehicle's center of gravity, which reduces the risk of static rollover. Other vehicle design factors that influence this risk are track width, the suspension, and tire properties.

Other controllable influences on the risk of static rollover include roadway design and driver performance. The risk increases with the sharpness of the curve, which highway designers can control, and with vehicle speed.

Rearward amplification

Alternatively, rollovers can occur when a multi-trailer truck travels at high speed (generally above 50 mph), and the driver abruptly maneuvers the truck either left then right, or right then left. Such maneuvers may occur when the driver encounters an unexpected obstacle in the truck's path. The result is "rearward amplification" of the vehicle, which can cause the rearmost trailer to skid sideways into adjacent lanes or even to rollover. The relationship between truck size and weight and the propensity toward rearward amplification is complex. Importantly from a regulation perspective, an increase in trailer length tends to reduce this propensity—to improve "dynamic stability." In addition, dynamic stability improves with a reduction in the number of articulation points connecting the components of a combination vehicle. Substitution of B-train and C-dolly connections for the more-widely used A-dollies would effectively eliminate an articulation point.

Acceleration and speed maintenance capabilities

The acceleration and speed maintenance capabilities of heavy trucks are also important safety factors. For example, accidents can occur when a truck, particularly a long truck, crosses a non-signalized intersection after slowing or coming to a stop. With better acceleration capabilities, the truck can clear the intersection more clearly, reducing its exposure to opposing traffic. Other accident situations can result from heavy trucks accelerating more slowly than do light vehicles. In particular, when an upward grade lacks a climbing lane for slow-accelerating trucks, accidents can result when lighter vehicles that attempt to pass these trucks.

A concern about liberalization of TS&W limits is that it will increase the rate of these sorts of accidents per mile of truck travel. Indeed, without changes in other factors such as driver performance, the heavier or larger trucks that become legal will need to match or even surpass the acceleration and speed maintenance capabilities of existing trucks, if this outcome is to be avoided. However, with suitable powertrains and braking systems, as well as higher horsepower engines, this should be largely achievable. Moreover, to the extent that such changes in vehicle design do not suffice, changes in roadway design, such as provision of climbing lanes for trucks, can compensate.

Human factors

Better selection and training of drivers can counteract the potential safety risks of larger and heavier vehicles. According to the CTS&W study, improvements in these factors contributed to the decline that occurred between 1985 and 1995 in the rate of fatal accidents involving medium-to-heavy trucks. (The rate was measured per mile of truck travel.) The study referred to the introduction of nationally uniform licensing of truck drivers, tracking of drivers' traffic violations and accident experiences, and improved industry programs for driver training.

An argument can also be made that people tend to drive more cautiously in dangerous situations—the "risk compensation" hypothesis. So even when a heavier or larger truck has features that, other things equal, would increase the rate of accidents, the driver

response to this situation may offset much of the added risk. Unfortunately, reliable evidence on risk compensation behavior among drivers is lacking (Levy and Miller 2000).

Finding 13. ***Analyses of crash statistics do not allow firm conclusions about differences in crash rates among classes of heavy trucks.***

Many studies have attempted to estimate the differences in crash rates among classes of heavy trucks, often with a focus on double-trailer combinations and, in particular, on longer combination vehicles. As the CTS&W study has noted, findings from this literature do not yield a clear picture. Depending on the study, the LCVs or double-trailer combinations may have crash rates that are slightly lower, slightly higher, or the same as the crash rates for other heavy trucks.

The murkiness of this picture owes to the limitations of available data related to truck crashes. Scopatz (2000) examined the quality of data collected in five states on crashes involving large trucks, with a focus on LCVs. Indicative of the problems uncovered are those he found in Oregon and Utah. The audits performed in those states showed that many officers do not know how to recognize and/or code the various configurations of vehicles. Oregon is unable to require officers to complete the crash reports and so relies to a significant extent on self-reports from drivers and motor carriers. A large proportion of the audited reports in both states had information in the vehicle configuration boxes that appeared to be incorrect—the remainder of the information in the report clearly pointed to a different vehicle configuration.

In addition to the data problems with the numerator of the crash rates—the number of crashes per year—there are also data problems with the denominator, that is, the vehicle miles of travel. A common source of data on VMT by truck class is the Highway Performance Monitoring System. These data tend to overstate combination truck travel, especially that of double-trailer combinations (Mingo, Esterlitz, and Mingo 1991). In addition, they provide no breakdown of double-trailer combination traffic between LCVs and other trucks.

Another caveat about the literature under discussion is that only certain states, particularly in the West (but not including Texas), allow much use of LCVs. To generalize from evidence on the relative safety performance of LCVs in these states would be risky because the highway-system characteristics of other states may be quite different.

Finding 14. ***How an increase in TS&W limits affects safety overall depends partly on how it affects the traffic volume of heavy trucks.***

Recall that an increase in TS&W limits may reduce the volume of heavy truck traffic (because with larger payloads, the same volume of freight can be moved with fewer miles of travel). Largely for this reason, it is possible that such reform will improve road safety overall, as TRB (1990) predicted for the reforms it modeled. On the other hand, the

reduction in trucking costs that result from these reforms will stimulate additional demand for trucking, which would lead to more accidents. The problems in estimating this increase in demand, which were discussed at the start of this section, will often make it unclear whether a reform would increase or reduce heavy truck traffic.

REFERENCES

ABBREVIATIONS

AASHO	American Association of State Highway Officials
FHWA	Federal Highway Administration
OECD	Organization for Economic Cooperation and Development
TRB	Transportation Research Board
USDOT	United States Department of Transportation

Bureau of Labor Statistics 2001, "Consumer Price Index, All Urban Consumers – CPI-U: U.S. City Average," available over the web: ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt.

Chatti, K., Kim, H.B., Kyong, K.Y., Mahoney, J.P., and Monismith, C.L. 1996, "Field Investigation into Effects of Vehicle Speed and Tire Pressure on Asphalt Concrete Pavement Strains," *Transportation Research Record*, vol. 1539, pp. 66–71.

Chen, J., and Shiah, M. 2001, "Development of Load Equivalence Factors for Accelerated Loading Facility (ALF) and Full-Scale Test Road," paper presented to the 80th annual meeting of the Transportation Research Board, January 7–11, 2001, Washington, D.C.

Crockford, W. 1993, *Weight Tolerance Permits*, Research Report 1323-2F, Texas Transportation Institute, Texas A&M University System, College Station, Texas.

FHWA 2000a, *Addendum to the 1997 Federal Highway Cost Allocation Study Final Report*, Publication No. FHWA-PL-00-021, United States Government Printing Office. (The report is also available on the Internet: http://www.fhwa.dot.gov/policy/hcas/addendum.htm)

FHWA 2000b, "FHWA Reports Road Construction Costs Decreased During First Quarter of 2000," News Release, November 14, U.S. Department of Transportation, Office of Public Affairs, Washington, D.C. (The news release is available on the Internet: http://www.fhwa.dot.gov//pressroom/fhwa00122.htm.)

Highway Research Board 1962, *The AASHO Road Test, Report 7, Summary Report*, Special Report 61G, Publication no. 1061, National Academy of Sciences, National Research Council, Washington, D.C.

Kilareski, W.P. 1989, "Heavy Vehicle Evaluation for Overload Permits, Rigid and Flexible Pavement Design and Analysis, Unbound Granular Materials, Tire Pressures, Backcalculation, and Design Methods," *Transportation Research Record*, vol. 1227, pp. 194–204.

Levy, D.T. and Miller, T, 2000, "Review: Risk Compensation Literature – The Theory and Evidence," *Crash Prevention and Injury Control*, vol. 2, no.1, pp. 75–86.

Luskin, D., Harrison, R., Walton, C.M., Zhang, Z., and Jamieson, J.L. 2000, *Texas Weight Tolerance Permits: Current Practice and Options*, Research Report 4036-1, Center for Transportation Research, The University of Texas at Austin.

Meyburg, A., Saphores, J.D., and Schuler, R. 1998, "Impact Assessment of the Regulation of Heavy Truck Operations, Final Report," University Transportation Research Center Region II, Project 17-7-88-B, School of Civil and Environmental Engineering, Cornell University, Ithaca, N.Y.

Mingo, R. D., Esterlitz, J. R., and Mingo, B. L. 1991, "Accident Rates of Multiunit Combination Vehicles Derived from Large-Scale Data Bases," *Transportation Research Record*, no. 1322, p. 50–61.

OECD Scientific Experts Group 1988, "Heavy Trucks, Climate and Pavement Damage," *Road Transport Research*, OECD, Paris.

Pickrell, D.H., and Lee, D.B. 1998, "Induced Demand for Truck Services from Relaxed Truck Size and Weight Policies," draft, U.S. Department of Transportation, Volpe National Transportation Systems Center, Cambridge, MA.

Roberts, F.L., and Djakfar, L. 2000, "Preliminary Assessment of the Cost of Pavement Damage due to Heavier Loads on Louisiana Highways," paper submitted for presentation at the 79th annual meeting of the TRB, January 9–13, Washington, D.C.

Scopatz, R.A. 2001, "Crashes Involving Long Combination Vehicles (LCVs): Data Quality Problems and Recommendations for Improvement," paper presented to the 80th Annual Meeting of the Transportation Research Board, January 7–11, 2001. Washington, D.C.

TRB 1990, *Truck Size and Weight Limits: Issues and Options*, TRB, Washington, D.C.

USDOT 1999, "Comprehensive Truck Size and Weight Study: The Intermodal Transportation and Inventory Cost Model Documentation", USDOT.

USDOT 2000, *Comprehensive Truck Size and Weight Study*, Publication FHWA-PL-00-029, USDOT. (The publication is also available on the Internet: http://www.fhwa.dot.gov/reports/tswstudy)

Weissmann, J., and Harrison, R. 1998a, "Impact of 44,000-kg (97,000-lb) Six-Axle Semitrailer Trucks on Bridges on Rural and Urban U.S. Interstate System," *Transportation Research Record* 1624, pp. 180-183.

Weissmann, J., and Harrison, R. 1998b, “Increasing Truck Size and Weight Regulations under NAFTA: The Bridge Dimension,” *Journal of the Transportation Research Forum*, vol. 37, no. 1, pp. 1–14.

APPENDIX: ANNOTATED BIBLIOGRAPHY

TRAFFIC PATTERNS

USDOT 2000, *Comprehensive Truck Size and Weight Study, Vol. III*: *Scenario Analysis*, Publication FHWA-PL-00-029 (Volume II), USDOT.

The Comprehensive Truck Size and Weight (CTS&W) study analyzed several scenarios for reforms to truck size and weight limits. To model the effects of these nation-wide reforms, the study divided freight traffic between short haul—operations within 200 miles — and long haul. The analysis omitted trucks with only two axles, since their dimensions are seldom constrained by the legal limits. Single-unit trucks with more than two axles were assigned to the short-haul category, since their trips are generally shorter than 200 miles. The framework for the modeling was the Intermodal Transportation and Inventory Cost (ITIC) model, which is documented in USDOT (1999).

Analysis of long-haul shipments

The CTS&W study classified combination trucks according to number of axles and number of trailers. Reforms to limits on TS&W affect shippers' choices among these truck classes and each class's vehicle-miles of travel (VMT). The CTS&W study used the ITIC model to estimate these various effects for long-haul shipments. In each reform scenario, the effects on shippers' choices among truck classes mainly took the form of substitution to, or away from, five-axle tractor semitrailers. For TS&W liberalizations, the modeling also incorporated the effects on shippers' choice of mode. By reducing the costs of trucking, increases to limits on TS&W induce shippers to divert some of their freight from rail modes to truck-only mode. The rail modes in the analysis were intermodal—containers or trailers go by rail for only part of their journey—and rail carload.

The framework for modeling long-haul shipments, the ITIC model, recognizes that choices among shipment options can entail tradeoffs between transportation and inventory costs. The assumption is that for any shipment, the shipper chooses the option that minimizes the sum of these costs.

The model adopts the conventional categorization of inventory stock as safety, cycle, or in-transit. For the calculation of safety stock, the model includes parameter values that measure the reliability of lead time for delivery. These values indicate lower reliability for rail carload than for other shipment options. However, the documentation of the model does not explain how these values were derived.

The ITIC model specifies that the amount of cycle inventory increases proportionally with the payload of the freight-moving unit. This means, for example, when a shipper switches to a truck with 20 percent more payload than a truck used previously, the amount of cycle inventory increases by 20 percent. The underlying assumption is that the

frequency of delivery declines by the same proportion by which payload increases: with delivery less frequent, companies must hold higher levels of inventory to tide them over between deliveries.

The documentation of the ITIC model acknowledges that the model only "generally captures" considerations of service quality, and omits some of them. As an example of the omissions, the study noted that the freight database on which it depended used commodity categories that were too broad to factor spoilage into the model. "Food and kindred products" would have included both canned goods and highly perishable goods.

Another limitation of the ITIC model is that it takes the total volume of freight that is shipped as given. The model only explains the distribution of this total across types of trucks and modes. In reality, a change in TS&W limits could affect the total volume of freight by changing the cost of freight. In the case of increased TS&W limits, for example, the resulting gain in truck freight volume would consist partly of a net increase in the total volume of freight (all modes) rather than diversion from other modes. Based on Pickrell and Lee (1998), the CTS&W study concluded that this component of the induced increase in truck freight traffic would be small enough to ignore without much loss of realism. (See below for description of Pickrell and Lee's paper.)

Analysis of short-haul shipments

For short-haul shipments, the study notes that rail is not competitive with truck and considers only truck-to-truck substitution. For single unit trucks, the ITIC model represents substitution between three and four-axle trucks as a function of the change in their relative operating costs (induced by changes in TS&W limits). Short-haul combination trucks are assumed to have diversion that mirrors the diversion of long-haul combination trucks.

Estimated effects on heavy truck VMT

Of the reform scenarios that the CTS&W study modeled, three involved increases to TS&W limits. These liberalization scenarios are described below in the section under **BRIDGES**. For each one, the ITIC modeling indicated that liberalization would reduce heavy truck VMT: the easing of the limits allows trucks to carry larger payloads, which means that fewer trips are needed to carry a given volume of freight. The effect of higher payloads outweighed the increase in truck VMT attributed to diversion from rail. The estimated reduction in heavy truck VMT among the liberalization scenarios varied between 10 and 23 percent.

Pickrell, D.H., and Lee, D.B. "Induced Demand for Truck Services from Relaxed Truck Size and Weight," Draft working paper prepared for the U.S. Federal Highway Administration. (The authors' affiliation is listed as the U.S. Department of Transportation, Volpe National Transportation Center, Cambridge, MA.)

Abstract from paper: "To the extent that truck operators are constrained by regulations to operate differently from what they would choose to do without restrictions, the relaxation of truck size and weight regulations would allow truckers to carry more cargo at less cost. If it is assumed that trucking is a competitive industry, these savings will be passed on to shippers. Lower prices to shippers will induce some additional amount of freight movement, more so in the long run as producers and consumers respond directly and indirectly to the relatively lower prices. The question addressed here is how much additional truck freight?"

Additional description: This working paper was prepared as an input to the CTS&W study described above; hence, the focus is on effects at the national level. In addressing the question posed in their abstract, the authors distinguish two ways in which a reduction in truck freight costs could stimulate an increase in total freight shipments:

(1) *Changes in the composition of national output.* "Prices for goods whose production and distribution costs include a significant trucking cost component would decline, and demand for these goods would increase in response. Producing and distributing the larger volumes of these goods demanded at their reduced prices would require an increase in the use of trucking services."

(2) *Substitution of trucking for other inputs to production*. "Suppliers of goods would attempt to substitute trucking services for non-transportation inputs in their production and distribution processes, further increasing the number of ton-miles carried by truck. This could occur, for example, as suppliers relocated production or warehousing facilities to take advantage of lower shipping rates by distribution networks or even reorganized production processes to substitute transportation for other inputs in response to reduced costs for truck shipping."

For a hypothetical 10 percent reduction in trucking costs, the authors estimated the increase in truck shipping that would result through each of these two channels. The choice of 10 percent was for comparability with the reductions in trucking costs of between 5 and 12 percent that the CTS&W study estimated for its truck size and weight liberalization scenarios.

The authors concluded that output compositional effects (the first of the channels identified above) would cause only a slight increase in truck freight, less than 0.3 percent. Although uncertainties about the parameter values underlying this estimate make it rather illustrative, the authors' conclusion appears sound. As the authors explain, trucking costs account for only a small share of production costs for most commodities; among the 48 commodity groups in their calculations, that share is less than 5 percent in all cases, and

typically less than 2 percent. Therefore, a 10 percent reduction in trucking costs would produce only very small changes in the relative output prices of these commodities.

Regarding the effects of input substitution (the second of the above-identified channels), the authors estimated that they would cause about a 2.5 percent increase in truck freight. However, this estimate is based on a highly conjectural value (0.25) for the elasticity of substitution between trucking and other inputs (a parameter that measures the extent to which these inputs are substitutable).

BRIDGES

TRB 1990, *Truck Weight Limits: Issues and Options*, Special Report 225, TRB (National Research Council), Washington, D.C.

The report discusses basic concepts in bridge design and analyzes the impacts on bridges of potential changes to TS&W policies. The discussion of bridge design includes the following points:

Overstress: The costs associated with overstress are incurred once a bridge has been found to have inadequate load-bearing capacity to accommodate legal loadings, in which case, the owner of the bridge has three options: a) replace the bridge, b) strengthen the bridge, or c) restrict the bridge indefinitely to lighter traffic by posting a special weight limit. The report asserts that strengthening is not a viable option for many bridge types such as reinforced or prestressed concrete spans—the cost is close to the cost of replacing the bridge.

Fatigue: Bridge fatigue results from repeated loadings, and is signaled by cracks developing at points of high stress concentration. The costs associated with fatigue are due to the reduction in bridge life. "Generally, only steel bridges are susceptible to fatigue, although some studies suggest that commonly used prestressed concrete spans, if overloaded, are also susceptible to fatigue damage."

Bridge Formula and Ratings: The report faults the Federal Bridge Formula for setting overly cautious limits on the weights of shorter trucks and for allowing too much extra weight for trucks with additional axles. The number of axles on a truck has little impact on bridges. The report also discusses alternatives to the bridge formula. Recommended are new methods for bridge rating that would make better use of remaining bridge capacity. Suggested approaches are LRFD, autostress, bridge testing, and finite-element analysis.

The scenarios for nationwide reform that are analyzed include adoption of alternative bridge formulae, retention of the current FBF but without any limit on GVW, importation of the higher TS&W limits from Canada, and the introduction of special overweight permits for special hauling vehicles.

The impacts of reforms on bridge costs had three components. The dominant component was the costs of replacing existing bridges that would be made deficient by the reform. A bridge was judged deficient if the inventory stress level (75 percent of the yield level) would be exceeded by more than 5 percent. The costs of replacement were estimated assuming that all deficient bridges would be replaced and, alternatively, that only bridges on primary highways would be replaced. Following bridge replacement costs in importance were the added costs for new bridges, due to the change in design standards that the reforms would necessitate. The fatigue impacts on existing bridges that would not need to be replaced were also costed, but were only a small component of the total estimated bridge costs. The results indicated that bridges accounted for the bulk of the infrastructure costs arising from more liberal TS&W limits. Generally, the additional infrastructure costs were much less than the estimated savings in transportation costs that the liberalization would produce.

These patterns can be illustrated with the scenario in which the Federal Bridge Formula governs without the 80,000 lb cap on GVW. The estimated increase in pavement costs was a mere $10 million per year, compared with $680 million per year assuming replacement of all deficient bridges. Of the bridge costs, $510 million stemmed from the replacement costs, $150 million from upgrading design loads for new bridges, and only $20 million from fatigue costs for existing bridges that would not be replaced. In comparison, the estimated savings in transportation costs were over $2 billion annually. (All the dollar estimates were at 1988 prices.)

USDOT 2000, *Comprehensive Truck Size and Weight Study: Volume II, Issues and Background*, Publication FHWA-PL-00-029 (Volume II), USDOT,

USDOT 2000, *Comprehensive Truck Size and Weight Study, Vol. III*: *Scenario Analysis*, Publication FHWA-PL-00-029 (Volume II), USDOT.

The study repeats statistics from the 1997 *Status of the Nation's Surface Transportation System*: that 11.7 percent of bridges on the nation's arterial systems are structurally deficient and 15.2 percent are functionally obsolete. The report also places the annual cost of maintaining current bridge structural and functional conditions at $5.6 billion (1995 dollars).

The study reaffirms the proposition that the impact of trucks on bridges varies primarily with the weight on each group of axles and with the distance between axle groups. The impact increases with axle group weight and, except on some continuous bridges with long spans, generally decreases with the separating distance.

The significance of distinguishing between simple and continuous-span bridges is discussed. The Federal Bridge Formula (FBF) was based on consideration of stresses on simple-span bridges only and, therefore, allows trucks to operate that could overstress certain continuous spans.

The FBF is also faulted for granting additional gross weight to trucks with more axles, even though the bridge stress depends more on the total amount of load than the number

of axles. To further evaluate the formula's adequacy, the study calculated the critical weights above which the stress tolerances on which the FBF is based would be exceeded. (The tolerances are 5 percent above the design stress for HS-20 bridges, which predominate on the Interstates, and 30 percent for H-15 bridges, which are geared toward somewhat lighter loads.) These critical weights were compared with the weights actually allowed by the FBF and, alternatively, by the bridge formula developed by the Texas Transportation Institute (TTI). For semitrailer combinations with five or six axles and for Rocky Mountain doubles, the critical weights generally exceeded the allowances in the FBF and the TTI formula; that is, both of these formulas appeared to be too conservative. For multi-axle short, straight trucks, the FBF was again found to be too conservative. But for some of the larger of the Longer Combination Vehicles (LCVs), such as the nine-axle turnpike doubles, the FBF was found to allow too much weight and the TTI formula too little. The study concludes that the FBF "is not effective in modeling the actual physical phenomenon." (Much the same deficiencies in the FBF had been previously identified by TRB 1990.)

To estimate the bridge costs that would result from certain potential changes to TS&W regulations, the study developed a model that took input data from the National Bridge Inventory. For each reform scenario, the model was used to identify bridges that would be structurally deficient and to estimate the cost of replacing them. (Structurally deficient meant exceeding the stress tolerances that underlie FBF.) Importantly, the study's estimates of bridge replacement costs include the inconvenience costs to bridge users while the work is underway. Costs of bridge fatigue, on the other hand, were not considered. In part, this was because fatigue depends on axle weight and most of the vehicles in the study's reform scenarios did not have greater axle loads than vehicles in the current fleet.[3] Overall, the study considered bridge fatigue costs to have minor relevance to the reform scenarios. The study was less dismissive of the bias in estimates that resulted from the assumption that deficient bridges would need to be replaced rather than strengthened or load-posted; this would have exaggerated the impact of reforms on bridge costs.

Three of the reform scenarios involved increases to TS&W limits:

The *North American Trade scenario* would allow heavier tridem axles, up to either 44,000 or 51,000 lb, to facilitate trade between the U.S. and its NAFTA partners. Such reform would allow the eight-axle B-train combinations used in Canada to appear on U.S. highways. It would also increase the use on U.S. highways of six-axle tractor-semitrailer combinations, which are currently much more common in Canada and particularly Mexico. The estimated increase in bridge cost that would result under the North American Trade Scenario was $254 billion with a 44,000 lb tridem, and $329 billion with a 51,000 lb tridem. These are one-off, rather than annual, costs and are measured at 1994 prices.

[3] The study also asserted that the fatigue damage is generally inexpensive to repair. Yet another reason for the study's omission of fatigue costs was that existing evidence was deemed inadequate to quantify them. Further research was called for to determine relationships between truck traffic, axle loads, and bridge (fatigue) deterioration.

The *Longer Combination Vehicles Nationwide scenario* would establish a national network over which these vehicles could operate. The network would comprise 42,000 miles for Rocky Mountain Doubles and Turnpike Doubles, 60,000 miles for triples, and the existing National Network for eight-axle B-train doubles. The study noted that only 21 states (not including Texas) allow LCVs, and that some of the Eastern states only allow them on their turnpike facilities. The scenario for LCVs would set nationally uniform weight limits by vehicle type—for example, 120,000 lb for a seven-axle Rocky Mountain Double—limits described as being higher than those now prevailing. The estimated cost of bridge replacement to accommodate the more numerous and heavier LCVs under this scenario was $319 billion.

The *Triples Nationwide scenario* would establish a national 65,000-mile network for seven-axle triple combinations weighing up to 132,000 lb. The estimated cost of bridge replacement that would result from this reform was $117 billion.

For all these scenarios, the estimates underscored the significance of the disruption to traffic from replacing a bridge. The estimated costs of the inconvenience to bridge users were much more than the capital costs entailed in bridge replacement. For example, in the LCVs Nationwide scenario, the inconvenience costs were $266 billion compared to capital costs of $53 billion.

Another finding common to the scenarios was that costs for bridges were the main infrastructure cost of implementing the reforms. The costs for pavement restoration were found to be either reduced by the reforms or, in the Nationwide Triple Scenario, virtually unaffected. The other infrastructure cost would be for upgrading roadway geometry to deal with the increased traffic from larger vehicles that have relatively poor offtracking performance. According to the study estimates, however, these costs would be quite small compared to the bridge replacement costs.

Weissmann, J., and Harrison, R. 1998a, "Impact of 44,000-kg (97,000-lb) Six-Axle Semitrailer Trucks on Bridges on Rural and Urban U.S. Interstate System," *Transportation Research Record*, no. 1624, pp. 180–183.

Abstract from article: "The impact of a 44,000-kg (97,000-lb) tridem semitrailer truck on bridges on the urban and rural U.S. Interstate system is examined. The impacts are determined using a suite of models developed for Federal Highway Administration (FHWA) policy use, and both agency and user costs are estimated. Bridges on the Interstate system that are already deficient at current loads are excluded from this analysis, which utilizes the National Bridge Inventory database and reports results for the rural and urban Interstate systems."

Additional description: The authors classified a bridge as deficient if the reference vehicle would produce stress exceeding 5 percent of the inventory rating. The authors noted that the TRB (1990), in analyzing which bridges that would become deficient as a result of reforms, also used a 5 percent tolerance, but applied this tolerance to the

operating rating level of stress. The authors' justification for using the inventory rating was a survey finding that over 60 percent of states use this rating rather than the operating rating.

The reference vehicle for the base case was an 80,000 lb five-axle semitrailer truck. After determining how many bridges would be unable to safely accommodate these vehicles, the analysis was repeated for the 97,000 lb semitrailer truck with six axles (including a tridem axle). The results indicated that the number of deficient bridges on Interstate highways nearly doubles when the 97,000 lb, semitrailer trucks are allowed. The estimated cost of replacing the additional deficient bridges was about $30 billion; about $25 billion of this sum consisted of user costs, which would arise from the disruption to traffic while a new bridge is being built.

Corresponding estimates at the state level were offered in the article upon request. Substantial differences between states were noted in the estimated cost of bridge reconstruction, ranging from $33 per square foot in Texas to $155 per square foot in Rhode Island.

Weissmann, J., and Harrison, R. 1998b, "Increasing Truck Size and Weight Regulations under NAFTA: The Bridge Dimension," *Journal of the Transportation Research Forum*, vol. 37, no. 1, pp. 1–14.

Abstract from article: "In the North American Free Trade Agreement (NAFTA) nations, Canadian and Mexican truck size and weight limits are substantially higher than those permitted on the Federal aid system of the United States. Currently, a NAFTA Land Transportation Standards subcommittee is considering a variety of truck related issues, including size and weight harmonization. If this process selects a typical Canadian or Mexican heavy truck as the NAFTA configuration, productivity gains will need to be balanced against the marginal increase in infrastructure costs. This paper evaluates the impacts of adopting two of the most widely used truck types—one Mexican, one Canadian—on the bridge system of the U.S. Interstate highway network. It uses a model specifically designed to calculate bridge impacts at the network level, and reports both replacement costs for the deficient structures and the user delay costs incurred when the structures are being reconstructed."

Additional description: The Mexican truck was a 107,000 lb tractor-semitrailer with six axles; the Canadian truck was a 128,000 lb "C-train" short heavy double. The methodology for estimating the additional bridge costs associated with these vehicles was the same as Weissmann and Harrison (1998a). Results were presented at national and state levels. For Texas, the costs of allowing the Mexican-configured trucks were about $6.6 billion, comprising $1 billion in bridge capital costs and $5.6 billion in user delay costs. For the Texas bridges to accommodate the Canadian-configured trucks, the total cost was an estimated $7.7 billion.

Laman, J. A., and Ahsbaugh, J.R. 2000, "Highway Network Bridge Fatigue Damage Potential of Special Truck Configurations," *Transportation Research Record*, no. 1696, February.

The objectives of this study were to: (1) evaluate several special truck configurations over a statistically representative sample of steel highway bridges to determine relative fatigue damage potential on a network-wide basis; (2) develop a methodology and algorithm to accurately quantify relative fatigue damage to bridges resulting from all types of vehicles, and (3) evaluate the influence of impact (IM) values and endurance limits specified in bridge codes for fatigue analysis. The paper provides a detailed evaluation of the relative fatigue damage potential for 78 vehicle configurations. It also purportedly incorporated significant improvements to previous studies in that it was able to more accurately determine fatigue damage resulting from changes in legal and permit loading.

The study used the stress life method (S-N diagram) and developed an analytical tool to determine the fatigue damage induced by each of the study vehicle configurations. It simulated vehicle crossings over analytical bridge models. The analysis then determined stress range histories at each identified AASHTO fatigue-prone detail on the bridge. Fatigue damage factors were determined by relating the calculated stress ranges to the appropriate AASHTO classifications using rainflow counting, a modified AASHTO S-N relationship, and the "Palmgren-Miner hypothesis."

The paper states that weight distribution and axle spacing are the factors responsible for variation in vehicle damage potential for a given gross vehicle weight (GVW), and that vehicles with heavy, closely spaced axles will induce greater fatigue damage than vehicles with similar GVW, but relatively uniform weight distributions over a longer length. Close spacing of heavy axles results in large stresses at fatigue-prone details when the axle groups pass critical points along the span. A longer vehicle, with a uniform weight-distribution, limits the magnitude of stress induced by spreading the vehicle weight. The study also found that there was a weak (0.65) correlation between GVW and fatigue damage potential for the 78 special vehicles studied and that certain vehicle axle configurations would induce significantly lower fatigue damage to bridges for a given GVW. The paper concludes that longer vehicles tend to induce an average of 15 percent of the damage induced by shorter vehicles for a given GVW and that short rigid-body vehicles, or tractor semitrailer vehicles, induce on average, 6.5 times more damage than longer combination vehicles.

Mohammadi, J., S. A. Guralnick, and R. Polepeddi. 1998, "Bridge Fatigue Life Estimation from Field Data," *Practice Periodical on Structural Design and Construction*, vol. 3, no. 3, August, pp. 128–133.

The paper presents the results of an Illinois study that investigated the effects of traffic growth and gross vehicle weight (GVW) on bridge fatigue. The study estimated the remaining life of several highway bridges by compiling strain data that were used together with roadway traffic data. The results were then used to investigate the

significance of truck weight increase and traffic growth on fatigue life of the studied bridges. The paper considers a 10 percent increase in GVW (72,000 lb to 80,000 lb) and the effect of a 5 percent traffic growth factor. The authors conclude that "weight increase alone does not dramatically affect" the bridges analyzed.

The paper acknowledges that it is costly to collect comprehensive stress data and as such, used strain data to estimate remaining life. "Stress spectrum" was developed using "cycle counting" methods; in particular the "rainflow" technique was employed. The paper suggests that the methods described may be used in practice to estimate remaining fatigue life of existing bridges and to assess bridges for various conditions of truck weight and/or traffic volume.

Thater, G., P. Chang, D. R. Schelling, and C. C. Fu. 1998, "Estimation of Bridge Static Response and Vehicle Weights by Frequency Response Analysis," *Canadian Journal of Civil Engineering*, vol. 25, pp. 631-639, NRC Canada.

The paper asserts that determining truck weights and their dynamic effect are integral parts of bridge life estimation and bridge ratings, a task that has traditionally been done using weigh stations. The authors state that the use of weigh stations is "inconvenient, and that they can neither be operated continuously, nor can they provide a good estimate of the dynamic effects (of trucks on bridges)." The paper notes that more recently, weigh in motion (WIM) techniques have been employed. Weighing trucks in motion is preferable to the use of weigh stations. The paper reports that lighter and more flexible bridges, which have more significant dynamic effects, have resulted from the use of sophisticated materials and analysis techniques used in the last few decades. It states furthermore that more frequent fatigue failures of bridge components and connections indicate the need for more accurate predictions of dynamic effects. The paper proposes use of the equivalent dynamic filter technique (EDFT), which determines the dynamic and pseudo static responses. The proposed method "determines the dynamic and pseudo static responses using the Fast Fourier Transform. The reported advantage of EDFT over WIM techniques is that the EDFT predicts truck weights up to 5 percent of the actual weight, compared to 10 percent errors by WIM techniques.

The paper next gives an overview of past studies, which are judged inadequate because they gave "poor approximations to the correct static curves." The past studies also negate the assumption that static responses occurred at low frequencies and dynamic responses at high frequencies. The paper describes methods currently in use and proposes a method to distinguish static and dynamic responses. Application of the EDFT to the actual WIM data has the claimed benefit of including all of the parameters that influence bridge response, such as vehicle configuration, vehicle springing, bridge stiffness, and road surface roughness. The paper purports that the proposed method is highly accurate in estimating static vehicle weight on dynamic response untainted by other miscellaneous vibrations. It acknowledges, however, the need for further analysis before practical application of the proposed method.

TRUCK ROUTING

Osegueda, R., Garcia-Diaz, A., Ashur, S., Melchor, O., Chang, S.H., Carrasco, C., and Kuyumcu, A. 1999, "GIS-Based Network Routing Procedures for Overweight and Oversized Vehicles," *Journal of Transportation Engineering,* vol. 125, no. 4 (July/August), pp. 324–331.

This article proposes a computerized support methodology for automated routing of overweight vehicles with vertical and horizontal clearance requirements. The suggested procedure would automatically identify all bridges on a route and evaluate the adequacy of each bridge structure for a given vehicle. The procedure, which is based on a geographic information system (GIS), could be tailored to meet the requirements of the permitting agency, either to minimize travel distance or to maximize the margin of safety (in terms of bridge stress). The article also suggests the use of BRINSAP—the Texas bridge database.

The article's analysis is geared toward the administrative task of the Motor Carrier Division (MCD) of the Texas Department of Transportation, which processes over 35,000 permits each month for oversize and/or overweight vehicles. The process for finding feasible routes consists of (1) establishing a tentative route with adequate width and height clearances; (2) manually identifying all of the bridges along the route; (3) retrieving the files for each bridge; (4) analyzing each bridge to evaluate the adequacy of the structure; and (5) identifying an alternate route when at least one requirement is not satisfied.

The MCD evaluates most overweight permit requests by following the Texas Administrative Code, which limits the gross weight on each axle group as well as the load on each tire. If either the axle group weight or the tire load exceeds the specified limit, a procedure known as the Equivalent Distributed Load (EDL) method is employed. The EDL method converts the total weight of any axle group to a distributed load per linear foot. The suggested method would improve on the current procedures by incorporating bridge information, such as bridge geometry and bridge type, that the current procedures ignore. In addition, it would save considerable time in the issuance of permits.

Osegueda, R.A., Gourabathina, S., Noel, J.S. 1992, University of Texas at El Paso Research Report 1266-2, *Towards the Implementation of an Overload Permit Formula using Network Models and BRINSAP,* National Technical Information Service, Springfield, VA.

The aim of this research was to improve the process for issuing overload permits in Texas by incorporating more information on bridges. The result was a conceptual methodology that uses simple network models to determine the route of travel given in general directions. The methodology also identifies bridges along the route and retrieves information about these bridges from the BRINSAP database, which it links to maps (control section and digitized geographic).

REGULATORY

Fu, G., and O. Hag-Elsafi. 2000, "Vehicular Overloads: Load Model, Bridge Safety, and Permit Checking," *Journal of Bridge Engineering*, vol. 5, no. 1 (February), pp. 49–57.

Abstract from article: "All states in the U.S. issue special permits for nondivisible and/or divisible truck overloads exceeding the weight limit of the highway jurisdiction. This causes stress levels higher than those induced by normal truck traffic. The rationality of such overstress levels has not been documented. This paper addresses several aspects of this issue. It presents: 1) a method to develop live load models including overloaded trucks; 2) associated reliability models for assessing structural safety of highway bridges; and 3) proposed permit-load factors for overload checking in the load and resistance factor format. It shows that the proposed overload checking procedure leads to relatively uniform reliability of bridge structures. A sensitivity analysis is also presented here to assure that possible variations of the input data used to prescribe the proposed load factors will not adversely affect bridge safety. The proposed procedure is intended to be used by engineers responsible for checking overload permits. It may be included in evaluation specifications for highway bridges."

Keating, P.B., Litchfield, F.C., and Zhou, M. 1995, *Overweight Permit Rules*, Texas Transportation Institute Report 1443-1F, National Technical Information Service, Springfield, VA.

Abstract from article: "This document defines standards for issuing permits for overweight vehicles crossing standard H-type and HS-type Texas highway bridges. A general formula and a bridge specific formula were developed for simple spans of both bridge types. Several reinforced concrete continuous-span slab bridges were then evaluated according to the proposed criteria to ensure the validity of the proposed formulae for continuous spans as well as simple spans. The general formula limits the axle-group weight according to only the 'X' rating and the vehicle dimensions, while the bridge specific formulae also include the span length. Currently, the vehicle dimensions are the only criteria used by the Texas Department of Transportation (TxDOT) to determine whether or not an overweight permit will be issued. The proposed restrictions allow only one permit vehicle on the bridge at a time and ensure that the maximum stress does not exceed the operational stress level. In addition to determining the maximum weight, which may be safely carried by a given axle configuration over a specific bridge or an unknown bridge, the proposed formulae may also yield the 'X' rating for any specific truck. Being able to quickly convert any truck to an equivalent HX or HSX rating will greatly simplify and increase the accuracy of the permitting process."

Additional description: As of the report writing, the Central Permit Office
for TxDOT was issuing more than 20,000 oversize/overweight permits each month, some of which were for superheavy vehicles requiring an engineering analysis for each bridge along the proposed route.

The study explains that Texas regulations limit the axle weights by two methods: (1) basing the limits on the number of axles in any subgroup; or (2) converting total weight of any axle group to a distributed load per linear foot, which may then be modified by additional factors for wider than average axle widths, and more than four tires per axle. The study faulted the current methods for being based on limited data regarding the overweight vehicles and for not taking into account bridge design.

The general formula proposed by the study bore some similarities to the existing Texas rules, but was significantly more restrictive. The bridge-specific formula would allow safe higher permit weights without additional engineering analysis. Its advantage over the general formula is the accuracy achieved in permitting the greatest allowable load for a particular bridge – the general formula would tend to be conservative.

Moreover, as the study points out, there is negative bending at the interior supports of continuous span bridges; a vehicle with axles near the center of the spans, adjacent to the support, would maximize the stress at this point. Thus, the assumption that a distributed load may approximate the critical axle configurations would not hold for continuous span bridges. Furthermore, the study infers that some reinforced concrete slab bridges with short spans and narrow widths, which were designed for H-type rather than HS-type live loads, may be critical, in that the H-type loading used in design would result in lower negative bending moment capacity.

The study concludes that the proposed formulae are much more versatile than those currently used and that by considering bridge design type and the span length, greater loads may be allowed without a detailed engineering analysis.

PAVEMENTS

Chatti, K., Kim, H.B., Kyong, K.Y., Mahoney, J.P., and Monismith, C.L. 1996, "Field Investigation into effects of vehicle speed and tire pressure on asphalt concrete pavement strains," *Transportation Research Record*, vol. 1539, pp. 66–71.

Abstract from article: "An asphalt concrete section on a test track in the PACCAR Technical Center in Mount Vernon, Washington, was fitted with strain gauges at the surface and in pavement cores and tested using an instrumented truck operated at different speeds and with different tire pressures. The field test results are presented. The results indicate that the effects of both vehicle speed and tire pressure-contact area on pavement strains are significant. Increasing vehicle speed from 2.7 km/hr (1.7 mi/hr) to 64 km/hr (40 mi/hr) caused a decrease of approximately 30 to 40 percent in longitudinal strains at the bottom of the asphalt concrete layer, which was 137 mm (5.4 in.) thick. The speed effect on transverse strains is lower, causing only a 15 to 30 percent decrease. Reducing tire pressure from 620 kPa (90 psi) to 214 kPa (30 psi) caused a decrease of approximately 20 to 45 percent in the horizontal strains at the bottom of the asphalt concrete layer. The pressure effect on surface strains was significantly lower, causing

only a 5 to 20 percent decrease. The speed effect was somewhat reduced at lower pressures, and the pressure effect was reduced at higher speeds."

Chen, J., and Shiah, M. 2001, "Development of Load Equivalence Factors for Accelerated Loading Facility (ALF) and Full-Scale Test Road," paper presented to the 80th annual meeting of the Transportation Research Board, January 7–11, 2001, Washington, D.C.

Abstract from paper: "The Accelerated Loading Facility (ALF), located at the Federal Highway Administration Turner-Fairbank Research Center, was used to simulate the effect of traffic on pavement performance. Data from two full-scale test roads (i.e., the AASHO Road Test and one conducted in Taiwan) were also compared with these from the ALF. The purpose of this study was twofold: (1) to investigate the difference between ALF and in-service pavements, and (2) to evaluate the effect of heavy traffic loading on pavement distress. An enhanced procedure was developed in this study to calculate the load equivalence factors (LEF). Results indicated that this procedure is feasible to evaluate the effect of heavy axle loadings on pavement performance under an accelerated rate. ALF pavement performance followed the trend observed on full-scale test roads. Based on present serviceability index (PSI) loss of the ALF pavement performance data, it was found that an eighth power law existed for the ALF in contrast to the fourth-power law in full-scale test roads. This implied that the LEF for ALF single-axle load of the same configuration was equal to the ratio of the axle weights raised to the eighth power. This finding explained why pavements tested by the ALF failed much faster than regulated loading. Critical loads, however, appeared to be present for pavements tested by the ALF. Pavements tested beyond the critical load might fail predominantly by traffic loading."

Additional description: The authors speculated that the difference between the eighth-power relationship suggested by their results and the AASHTO fourth-power relationship may have resulted partly from the use of heavier axles in their tests than in the AASHTO tests. Another contributing factor was that the vehicles in their tests traveled at slower speed (21 km/hr) than in the AASHTO tests. The ALF tests were performed on both thin and thick flexible pavements. The pavements had an asphalt concrete surface of either 12 cm or 18 cm, and a crushed aggregate of either 18 cm or 30 cm. When pavement damage was measured by rutting, the exponential relationship between damage and axle load had a power of about eight for the thin pavement versus about three for the thick pavement. This difference simply reflects that pavements designed for light-duty are more vulnerable to damage from heavy loads.

Crockford, W. 1993, *Weight Tolerance Permits,* Report to the Texas Department of Transportation, Texas Transportation Institute, National Technical Information Service, Springfield, VA.

Abstract from report: "The Texas legislature has authorized the issuance of annual permits allowing commercial motor vehicle operators to operate nonagricultural vehicles exceeding the legislative mandated axle weight by 10 percent and the allowable gross

vehicle weight by 5 percent, with heavier loads allowed for agriculture. The $75 permit (and $15,000 bond) allows operation on state and county roads except the interstate system. The interpretation has been that this effectively allows 84,000 lb vehicles on roads designed for 58,420 lb vehicles. The movement of goods on Texas surface transportation infrastructure is an important factor in the economic health of the state; truck shipping productivity is a key element in this movement. There is often a trade-off between vehicle weight management policies and pavement management policies in the maximization of productivity. AASHTO pavement design procedures indicate that the effect of the Texas legislation should be accompanied by a permit costing significantly more than $75. The study included a full-scale truck loading experiment on two county roads and one state highway. General agreement with AASHTO damage models was found. Surveys of state and county agencies as well as the trucking industry were conducted. In general, the trucking industry showed substantial cost savings with the increase in load. Government agencies responsible for pavement and bridge management did not obtain receipts from the permit fee sufficient to offset maintenance and enforcement costs associated with this management activity."

Additional description: The survey of the trucking industry yielded a sample of only nine responding companies. However, the conclusion that the permit yields substantial savings to industry accords with the anecdotal evidence reported in a subsequent evaluation of the permit that is described below (Luskin et al. 2000).

Crockford notes that damage to pavements he considered is mainly caused by the synergistic effect of rainfall and heavy loads. Field experiments conducted for the study produced estimates of pavement damage from a 5-axle tractor semitrailer, loaded to a gross weight of either 84,000 lb or 58,420 lb. The experiments took place on light-duty rural roads. The ratios of the damage from the heavier truck to that from the lighter truck spanned from a low of 1.8 to the AASHTO-based prediction of 5.57. The study also reports that the rut depth produced by the heavier vehicle should be approximately 2.8 times that produced by a 58,420 lb vehicle.

Kilareski, W.P. 1989, "Heavy Vehicle Evaluation for Overload Permits, Rigid and Flexible Pavement Design and Analysis, Unbound Granular Materials, Tire Pressures, Backcalculation, and Design Methods," *Transportation Research Record*, no. 1227, pp. 194-204.

Abstract from article: "Highway agencies often receive requests for permits to allow the movement of overloaded machinery, structures, and other commodities. Many highway departments issue permits up to a standard-axle loading of approximately 27,000 lb; however, they do not have sufficient data to respond to requests for other loads and axle configurations. A study for the Pennsylvania Department of Transportation analyzed the expected pavement damage resulting from overloaded axle configurations, in particular, four- and five-axle configurations with loads up to 34,000 lb. A computer simulation approach was used to model both flexible and rigid pavements. Flexible pavements were analyzed with structural numbers of 2.92 and 4.82 representing a low and high structural capacity, respectively. Rigid pavement was analyzed as a 10-inch slab on 6 inches of

crushed aggregate base. Calculated strains and deflections were compared to limiting tensile and vertical strains (flexible pavements) and stress ratios (rigid pavements). The remaining life of each pavement was evaluated. It was found that four- and five-axle configurations developed the same tensile stresses as the single and tandem-axle configurations for a thin flexible pavement, but the strains were lower for the thick pavement cross section. The stress ratios for the rigid pavement for all axle loads and configurations were below 50 percent, which implies that an unlimited number of repetitions can be applied."

Additional description: The author estimated the number of axle passes that could occur before the pavement started to crack. Axle passes were measured in 18 kip single-axle equivalents. For the thick flexible pavement (SN=4.82), his estimates indicated that single axles are worse for pavement than tandem axles, which, in turn, are worse than four- or five-axle configurations. (Tridem axles were not studied.) "For example, a single-axle load of 22 kips will cause cracking after 880,000 passes. A tandem axle causes cracking after 1.15 million passes. The four- and five-axle configurations cause cracking after 1.25 million passes."

Luskin, D., Harrison, R., Walton, C.M., Zhang, Z., and Jamieson Jr., J. L. 2000, "Texas Weight Tolerance Permits: Current Practice and Options," Report to the Texas Department of Transportation, National Technical Information Service, Springfield, VA.

This report evaluates the "2060" permit in Texas, which allows a 5 percent tolerance on gross vehicle weight and a 10 percent tolerance on axle weight. Although not limited to divisible loads, the freight that is carried under these permits is overwhelmingly of a divisible nature. A survey of permit-holders was conducted for the study and yielded over 300 responses indicated that the commodities carried are mainly aggregates (sand, gravel and the like), followed by agricultural and food products; forestry-related products; and chemicals, petroleum, or petroleum-related products.

After describing the regulations of truck weights in Texas, the report sketches a simplified theoretical framework for determining the optimal fee for an overweight permit. The optimality criterion is economic efficiency. In a completely efficient system, the report notes, the amount charged for each road trip would equal the costs of the externalities that the trip generates. These externalities include pollution, congestion and damage to road infrastructure (The costs of road accidents are only partly external.) To allow for the political obstacles to comprehensive reform, the framework focuses on the optimal permit fee and takes as given the provisions of other taxes and charges on road users (which consist mainly of fuel taxes and registration fees). As the analysis shows, the optimal permit fee can be very difficult to determine when other taxes and charges on road users remain economically inefficient.

The report also notes that insufficient information is available to pin down the costs of pavement damage that result from overweight operation under permit. In view of the uncertainties, it provides only "best-case" and "worst-case" estimates of the annual

damage: $493 and $51,160. The authors note that even the smaller of these estimates exceeds the average permit fee of $238 in FY 1999. From a survey of permit-holders that was conducted for the study, and to which 239 companies responded, the authors found that reality contains a significant element of the worst-case scenario. The conclusion drawn from this is that fees for the permit are probably below the economically efficient levels. In addition to recommending a fee increase to more fully recover the costs of pavement damage, the report offers other recommendations for the permit system.

Meyburg A., Saphores J., and Schuler, R. 1988, "The Economic Impacts of a Divisible-Load Permit System for Heavy Vehicles," *Transportation Research A*, vol. 32, no.2, pp.115–127.

Abstract from article: "A methodology is demonstrated for analyzing the economic impacts of various weight limits for heavy vehicles through an application to New York State. Truck usage data were gathered from truck operators in 1990-1991 through three seasonal mail surveys, which allowed the collection of sensitive truck usage data while guaranteeing anonymity to the respondents. The benefits of this permit system are primarily lower business costs for those operators who hold permits; in the long-run, part of the savings realized by the truck operators flow to most sectors of the state's economy. On the cost side, increased infrastructure damage is assumed to result primarily from increased pavement damage. The authors find that direct benefits of the permit system (to the transportation industry and its users) exceed its costs (to society) by a factor of 17 to 1. An important finding of this study is the surprising level of non-compliance with permitted weight limits that was reported voluntarily. This may be due to the complexity of the New York state permit system and to the enforcement levels of the weight limits by state and local authorities."

Additional description: The permit system operating at the time of the surveys allowed generous weight tolerances: for example, gross weights of up to 120,000 lb and tandem axles up to 69,000 lb. The mail surveys conducted for the study requested permit-holders to provide detailed information on the characteristics of a specific truck and its usage on a randomly chosen day of the week. Other questions elicited information on the characteristics of the respondent's company. Only about one-third of the companies receiving the surveys responded

To estimate pavement costs per ESAL-mile, the authors conducted a literature review and held discussions with state highway officials. The figures they settled on were 2 cents for federal (i.e., Interstate) highways, 6 cents for state highways, and 40 cents for local highways. (These estimates are in 1987 prices, and road construction costs have since increased to the tune of 38 percent, as measured by the FHWA's road construction price index; FHWA 2000b.) In New York and other states with freeze-thaw cycles, the vulnerability of pavement damage to heavy trucks varies across seasons, variation that the study did not factor into its estimates. The study also omitted the costs of bridge deterioration and, apparently, the costs of administering the permit system. Yet, as the study noted, these costs would have to be many times the pavement damage costs to overturn the study's finding of a high benefit-cost ratio for the permit system.

OECD Scientific Experts Group. 1988, "Heavy Trucks, Climate, and Pavement Damage," *Road Transportation Research*, OECD, Paris.

This study examines the effects of heavy trucks and climate on pavements distinguished by type: flexible, semi-rigid, and rigid. A key conclusion is that axle load is a much stronger determinant of pavement damage than is gross vehicle weight. Estimates are presented for the exponent in the exponential relationship posited between pavement damage and axle load (a relationship termed the "load equivalence law"). The estimates of this parameter were based on European road tests. From the tests on Italian flexible pavements, the study estimated exponents that varied between 1.58 and 2.95 depending on the type of axle, and that had a mean value of 2. From tests on French flexible pavements, the study obtained an exponent of 2 in the case of fatigue cracking of a bituminous course and 8 in the case of permanent deformation. For flexible pavements generally, an exponent of about 4, the same as in the AASHTO-based fourth-power law, was considered a reasonable value. For semi-rigid and rigid pavements, the study estimated an exponent of between 11 and 33.

On the basis of the various tests, the authors also found that:

- For a given load and type of axle, driving axles are more destructive than carrying axles.

- For flexible pavements, the clustering of axles on a vehicle is beneficial. The use of a tandem axle in place of single axles reduces pavement damage, as does the use of tridem axles in place of singles and tandems. For illustration, the OECD used load equivalence factors from the AASHTO design guide. For a flexible pavement with a PSI of 2.5 and an SN of 4.0, the load equivalence factor for a 36,000 lb tandem axle was 1.38; for the tridem axle, the load equivalence factor was 1.66.

- For rigid pavements, the evidence on the relationship between axle clustering and pavement damage is mixed. The AASHTO load equivalence factors indicated that bunching of axles into tandems or tridems exacerbates pavement damage, whereas the results of an Italian study indicated the opposite pattern. Damage to rigid pavements depends much more on load per axle component than on the extent to which axles are clustered.

- For a given load and number of components, a supersingle (wide-based tire) axle is more damaging than a twin-wheel axle.

A related focus of the OECD study was dynamic versus static loading. A previous study explained the distinction thus:

> A heavy truck travels along the highway, the axle loads applied to the pavement surface fluctuate above and below their average values. The

> degree of fluctuation depends on factors such as pavement roughness, speed, radial stiffness of the tires, mechanical properties of the suspension system, and overall configuration of the vehicle. (TRB 1990, p. 86)

The OECD found that dynamic loads will range from 90 percent to 110 percent of the static loads according to the conditions of the road.

Roberts F., Djakfar L. 2000, "Preliminary Assessment of the Cost of Pavement Damage Due to Heavier Loads on Louisiana Highways," 79th Annual Meeting of the Transportation Research Board, Washington, D.C.

Abstract from paper: "The current study makes a preliminary assessment of the impact of increasing the gross vehicle weight (GVW) from current legal limits to 100,000 lb (45,360 kg) on vehicles hauling sugarcane, rice, timber, and cotton. Sample sections of road in each area of the state where the commodities are hauled were identified, the amount of each commodity hauled on the road estimated, and the effect of increasing the GVW evaluated for each section of road using pavement design models. Design data were secured from the Louisiana Department of Transportation and Development computer database and project files to determine the pavement design parameters and traffic estimates for each road. The number of vehicles hauling the 1998 harvest payload was estimated, the projected increase in the production of each commodity was based on government statistics, and rehabilitations were designed using the 1986 AASHTO Design Guide for a 20 year analysis period. Net present worth (NPW) was calculated for each GVW scenario for each roadway. Comparisons of NPW between the weight scenarios showed that increases in GVW have more effect on Louisiana state and US highways than on interstate highways. Any elevation in GVW over current limits increases the cost of overlays and decreases the length of the time before an overlay is required. The cost increase due to raising the GVW is substantial. Fee structures need to be modified by the legislature to pay for these costs through the current registration and overweight-permit fee structure or some new tax such as a ton-mile tax."

Additional description: One of the authors of the study, Professor Freddy Roberts of Louisiana Tech University, provided the Center for Transportation Research with estimates of the cost in pavement consumption per ESAL-mile of travel, based on the study. The estimates were: 48.9 cents for state-numbered routes, 16.2 cents for U.S. highways, and 2.7 cents for Interstate highways. Professor Roberts is familiar with the road network in Texas and considers its FM roads to be structurally similar to the state-numbered routes in Louisiana. He also perceives substantial similarity between these states in the standards of their U.S. and Interstate highways. The estimates for each Louisiana road category are averages among sampled roadways—four state-numbered routes, four U.S. highways, and two Interstate highways. Within the state-numbered category, there was an outlier with an estimated cost per ESAL-mile of $1.55. The outlier, according to Professor Roberts, resembles roads in Texas that are load-zoned to 58,420 lb.

Transportation Research Board. 1990, *Truck Weight Limits: Issues and Options*, Special Report 225, TRB (National Research Council), Washington, D.C.

Like so many other studies, this study affirms that pavement damage from heavy vehicles depends mainly on axle weights. To compare the impacts of axles of different weight, it uses the concept of an equivalent single axle load (ESAL), which originated with AASHTO. The benchmark in this concept is an 18,000 lb single axle: for example, an axle with 3 ESALs can be expected to cause the same pavement damage as three passes of the benchmark axle. The AASHTO tables of ESALs were based on road tests conducted in the 1950s; they indicate that ESALs increase in roughly exponential fashion with axle weight, with the exponent having a value of about 4. This is the so-called fourth-power rule (an approximation, really).

The total pavement impact for a given vehicle can thus be measured by the ESALs summed across all axles. Using the AASHTO tables, the TRB calculated for illustration the numbers of ESALs on typical vehicles. The results, shown in the following table, illustrate that heavier trucks can be pavement-friendlier than some lighter trucks with fewer axles. This pattern emerges from comparison of the two tractor-semitrailers: at 88,000 lb and six axles, the pavement damage is less than at 80,000 lb and five axles. The possibility of configuring trucks to carry heavier loads and at the same time cause less pavement damage inspired the proposal for "Turner trucks" in a companion TRB study.

Table 1: Relative Pavement Impacts of Different Trucks as Measured by Number of Equivalent Single Axle Loads

Truck Type	GVW (lb)	ESALs for Flexible Pavements	ESALs for Rigid Pavements
3-Axle Single-Unit Truck	48,000	1.48	2.10
4-Axle Single-Unit Truck	56,000	1.11	1.78
5-Axle Tractor-Semitrailer	80,000	2.37	4.07
5-Axle Double	80,000	4.05	4.09
6-Axle Tractor-Semitrailer	88,000	1.88	3.57
7-Axle Double	101,000	2.57	3.56
8-Axle B-Train Double	122,000	2.97	5.52
9-Axle Double	129,000	2.66	4.43

Source: Transportation Research Board (1990), Figure 4-3

Another important observation in the TRB's study is that there are strong economies of scale in designing new pavements for higher traffic loadings. "For example, a 10 percent increase in ESALs can be accommodated by a 1.5 percent increase in pavement thickness." The construction cost per ESAL thus tends to be much lower for a high-volume highway.

The TRB modeled several scenarios for reforms to TS&W limits (see the discussion in the bridge section of this annotated bibliography). The results from the scenario for the Uncapped Bridge Formula B (with the 80,000 lb limit on gross vehicle weight removed) indicate that this reform would have a negligible effect on pavement costs. As the study explains, such reform would induce a shift toward freight from the conventional 5-axle tractor-semitrailer toward heavier combinations with more axles. In terms of per ton of freight carried, these combinations generally cause less pavement damage than the conventional 5-axle combinations, consistent with the fourth-power rule. This explains the prediction of essentially no change in pavement damage cost, even though the reform is also predicted to increase the total road freight tonnage (owing to substitution of freight from rail to truck).

The following findings from the TRB study are also germane:

- A 10 percent increase in the number of ESALs on the nation's highways would increase pavement-related costs to highway agencies by about $375 million per year. This is the extra amount of spending required to maintain pavements in the same condition as without the increase in ESALS. Of this amount, $350 million (93.3 percent) would be for existing pavement and $25 million (6.7 percent) would be new and reconstructed pavements.

- At the national level, if all pavements in poor condition (PSI of 2.0 or less) were upgraded to good condition (PSI of 3.0 or more), highway users would save about $1 billion per year through reductions in fuel, repair, and other vehicle operating costs.

- Current tire pressures are much higher than those in the 1950s. These high tire pressures increase the rate of both rutting and cracking in flexible pavements. The effect is more significant for thinner pavement surface.

- The substitution of single tires for dual tires also increases pavement wear. The differential wear effect of single tires diminishes with increases in pavement stiffness, the width of the single tire, and the tire load.

- Whereas researchers generally agree that an increase in tire pressure and the use of single tires on trucks have adverse effects on pavements, there is no agreement on the size of the these effects. Regulation of tire pressure and the use of single tires could be warranted if more pessimistic analysis proved to be correct. Ongoing and future studies of these effects should be monitored carefully to determine whether regulation is needed.

USDOT 2000, *Comprehensive Truck Size and Weight Study: Volume II, Issues and Background*, Publication FHWA-PL-00-029 (Volume II), USDOT.

USDOT 2000, *Comprehensive Truck Size and Weight Study, Vol. III*: *Scenario Analysis*, Publication FHWA-PL-00-029 (Volume II), USDOT.

This study includes a background discussion of the effects of vehicles on pavements. The following observations in the study have particular relevance to the analysis of truck size and weight (TS&W) policies:

- Although the fourth-power "law" has been the rule of thumb since the AASHTO tests of the 1950s, more recent evidence indicates that the relationship between axle load and pavement deterioration generally may have a power closer to 3 than to 4.

- Increasing the spread of axles within an axle group reduces damage to rigid pavements, but increases fatigue damage to flexible pavements.

- On the Interstate highway system, half of the mileage has rigid or semi-rigid pavements. Among all hard-surface highways in the U.S., however, flexible pavements predominate: only 11 percent of highways have rigid or semi-rigid pavements.

- A vehicle's impact on a pavement depends partly on pavement characteristics and weather conditions. It also depends on the characteristics of the vehicle, especially the number of axle loadings, axle weight, and the spacing within axle groups. Of secondary importance are the type of suspension system on the vehicle, tire pressure, and tire type.

For each reform scenario, and for the scenario of no change in TS&W policies, the study estimated the costs required for pavement rehabilitation over 20 years (from 2000). Costs were measured at 1994 prices and discounted to a year 2000 present value. The analysis omitted the influence on pavement deterioration of differences among vehicles in suspension system, tire pressure, and tire type. In addition to considering these characteristics to be of secondary importance, the study saw "no reason to suppose" that they generally differ among the alternative truck configurations in the scenarios modeled.

As was mentioned above (see entry for USDOT 2000 under **BRIDGES**), the analysis indicated that one of the modeled liberalizations—the establishment of a national network for triples—would have virtually no effect on pavement costs.

The other liberalizations that were modeled would, according to the study's estimates, reduce pavement costs. The simulation of allowing 51,000 lb tridem axles (in the North American Trade scenario) produced the largest estimated reduction, about $3.1 billion. By increasing the average payload per truck, this reform would reduce the total miles that trucks must travel to carry a given volume of freight. This is one reason why the

simulation indicated savings in pavement costs. The other reason is that the reform would cause the mix of heavy trucks to shift toward vehicles with more axles. The reform would favor, for example, tractor-semitrailer combinations with six axles (steering, tandem, and tridem) rather than five axles (steering plus two tandems). Spreading the weight of a vehicle over a larger number of axles does much to reduce pavement damage. Indeed, the study's illustrative calculations indicate that a six-axle tractor-semitrailer combination that weighs 90,000 lb causes less pavement damage per vehicle mile than does a 5-axle tractor-semitrailer combination that weighs 80,000 lb.

Zhang, Z., Kawa, I., and Hudson, R. 2000, "Impact of Trunnion Trucks on the Performance of Highway Infrastructure," Report to the Texas Department of Transportation, Center for Transportation Research, The University of Texas at Austin.

This study evaluates the impacts of trunnion trucks on pavements and bridges and compares them to the impacts of tridem axles. Performance-based fatigue models are introduced for flexible pavements with an asphaltic concrete (AC) surface and for rigid pavements with a Portland cement concrete (PCC) surface.

For flexible pavements, the study finds that tridem axles are more damaging than trunnion axles, with the percent difference being greater for thinner pavements. At the bottom of a 3-inch AC surface layer, a tridem axle imposes a peak strain that is 9.67 percent greater than that imposed by a trunnion axle under the same axle load condition. Increasing the surface layer to 6 inches reduces the maximum values of peak strains of both axle types and also reduces the percent differential between them: the tridem axle now imposes only about 3 percent more strain than does the trunnion axle. In terms of damage to an AC pavement surface, the estimated differences between axle types are more striking: compared to a trunnion axle of the same weight (60 kips), a tridem axle causes more than three times as much damage.

In contrast, for rigid pavements, the study finds that tridem axles are less damaging than trunnion axles, and that the percentage difference is not sensitive to pavement thickness. On PCC pavement slabs of either 8 inches or 12 inches, the tridem axle imposes a maximum stress that is about one-third less than that imposed by a trunnion axle. Translated to pavement damage, the trunnion axles are about 1.28 times worse than the tridem axles, when the axle loads are both 60 kips.

GEOMETRIC DESIGN

Beckham 1994, S. 1994, *Regional Trucking Issues: Truck-Routing Alternatives, Geometric Considerations for Large Trucks, and Regulation of Texas Trucking*, prepared for North Central Texas Council of Governments, Arlington. Available on the Web (www.bts.gov/smart/cat/TEX.html).

This report examines some issues pertaining to trucking in Texas: intrastate regulation, geometric design for large trucks, and routing restrictions on municipal roads. A framework for evaluating truck routing alternatives (including the no-restriction alternative) is presented for use by municipalities. The framework incorporates such factors as the impacts on roads, traffic conditions, safety, and the environment. The history of truck size and weight (TS&W) standards in Texas is discussed along with the then-current standards. The section on geometric design summarizes some design considerations necessary for large trucks and contains some general guidelines. Briefly discussed are the effects of intrastate trucking regulation— of control of entry into the industry and of freight rates.

Blue, D., and B. Kulakowski. 1991, "Effects of Horizontal—Curve Transition Design on Truck Roll Stability," *Journal of Transportation Engineering* vol. 117 no. 1: pp. 91–102.

This article describes a study on the effects of horizontal-curve transition design on truck roll stability. The study was done on twelve different curves using three types of transition geometry for each. One of the transition types considered was a spiral curve; another was a curve with all of the superelevation developed on the tangent. The other transition type was a combination: The entire curve has a constant radius, with two-thirds of the maximum superelevation developed on the tangent and one-third developed at the beginning of the curve. The study entailed computer simulation using a modified version of the program PHASE-4, as applied to a three-axle tractor with a 48 foot two-axle semitrailer. The assumed gross weight of this combination was 80,000 lb, and a center of gravity location was 90 inches. For all cases studied, the obtained critical speeds exceeded the AASHTO design speeds. The spiral curve was found to provide the best transition, followed by the two-thirds – one-third transition curve.

Batelle Team. 1995, "Roadway Geometry and Truck Size and Weight Regulations," working paper 5 for Comprehensive Truck Size and Weight Study Phase 1 Synthesis, prepared for FHWA (U.S. Department of Transportation). Available on the Web (www.fhwa.dot.gov/reports/tswstudy/TSWwp5.pdf).

USDOT 2000, *Comprehensive Truck Size and Weight Study: Volume II, Issues and Background*, Publication FHWA-PL-00-029 (volume II), USDOT. (The publication is also available on the Web: http://www.fhwa.dot.gov/reports/tswstudy.)

The working paper draws on many studies to examine the roadway-geometry-related effects of changes in truck size and weight (TS&W) regulations. Performance

characteristics of large trucks that are covered include traction, low- and high-speed offtracking, and changes in, or maintenance of, speed. The paper considers the interaction between these characteristics and specific roadway geometric features, including interchange ramps, intersections, alignment, and cross sections. Also discussed are the implications of possible changes to regulations of vehicle or trailer lengths, distance from the kingpin to rear axle, rollover threshold, and length for double combinations. The paper concludes with a summary of knowledge gaps and research needs.

The same issues are covered in the final report. Of particular interest, the report finds that many intersections on the existing highway and street network are inadequately designed for offtracking by combination vehicles. The most common combination vehicle — the 5-axle tractor-semitrailer — will have to encroach on other lanes when turning at these intersections, or otherwise strike the curb, curbside objects, or other vehicles. A relatively long wheelbase exacerbates low-speed offtracking, which poses a problem for the expanded use of some types of longer combination vehicles.

Ervin, M., Barnes, M., MacAdam, C., and Scott, R. 1985*, Impact of Specific Geometric Features on Truck Operations and Safety at Interchanges*, prepared for the FHWA (U.S. Department of Transportation), Report FHWA/RD-86/057, National Technical Information Service, Springfield, VA.

The study entailed a collection of accident data from several state agencies and isolating the truck accidents caused by geometric design attributes. The computer simulation model, PHASE-4, was run for six cases with varying speeds and frictional conditions. The cases investigated were situations of excessive levels of side friction demand, awkward compound curves, a short deceleration lane leading to a tight-radius curve, a curb placed along the outside of the curve, a downgrade leading to a tight curve, and poor pavement friction-level on a high-speed curve. The simulations indicated that:

- Loss-of-control accidents for trucks on interchange ramps were usually rollover and jackknife events.
- Jackknife accidents were most common at sites with high-friction demand.
- For certain trucks, the AASHTO policy for geometric design provides virtually no margin of safety against rollover.
- The AASHTO policy does not provide long enough deceleration lanes for truck combinations.
- The length of acceleration lanes provided frequently does not meet the needs of truck accelerating characteristics.

- The AASHTO policy of accepting ramp downgrades as high as 8 percent may need to be reconsidered when there is a sharp curve to be negotiated at the end.

- In some cases, curve warning signs were improperly placed (i.e., not in accordance with the Manual of Uniform Traffic Control Devices).

Finally, some recommendations are given.

Fambro, D., Mason, J., and Cline, N. 1988, "Intersection Channelization Guidelines for Longer and Wider trucks," *Transportation Research Record*, no. 1195, pp. 48–63.

This paper summarizes a study that simulated vehicle offtracking using a computer model, the Truck Offtracking Model. The simulations tracked the traveled paths with different turning radii at several angles of turn for five large-truck combinations. The truck combinations used were the WB-50, WB-55, WB-70, WB-105, and WB-100. The WB-105 was found to be the most critical vehicle tested because it has the worst turning characteristics.

Glauz, W., and Harwood, D. 1991, "Superelevation and Body Roll Effects on Offtracking of Large Trucks," *Transportation Research Record*, no. 1303, pp. 1–10.

This study investigated whether superelevation of a curve and body-roll effects influence offtracking of large trucks. It found that independent of vehicle speed, superelevation increases low-speed, but reduces-high speed, offtracking. This means that offtracking to the inside of the curve increases. The effect of superelevation depends upon the truck weight, the tire-cornering coefficient, and the roll-steer coefficient. The effect increases with truck weight and the roll-steer coefficient, but is weaker for trucks with worn tires.

Harkey, D., Council, F., and Zegeer, C. 1996, "Operational Characteristics of Longer Combination Vehicles and Related Geometric Design Issues," *Transportation Research Record*, no. 1523, pp. 22–28.

In assessing the operational characteristics of longer combination vehicles that relate to geometric design issues, this paper focuses on Rocky Mountain doubles, turnpike doubles, and triples. Differences in low and high-speed offtracking for the longer combination vehicles (LCVs) are reported, along with the design implications for lane width and turning radius. The stability of LCVs in terms of checking rollover, trailer sway, and rearward amplification are compared to that of conventional tractor semitrailers. LCVs were found to be comparatively unstable, a problem that increases when shorter trailers are used and when the number of articulation points increases. Studies on braking and stopping distance are discussed, along with field observations of LCVs. Evidence on whether LCVs have worse than average braking characteristics was determined to be inconclusive. Finally, some accident studies that would add to our knowledge of LCVs are recommended.

Harwood, D., Glauz, W.D., Elefteriadou, L., Torbic, D.J., and McFadden, J. 1999, "Distribution of Roadway Geometric Design Features Critical to Accommodation of Large Trucks," *Transportation Research Record,* no. 1658, pp. 77–88.

This study evaluated the geometric design of the current roadway system for its ability to accommodate large trucks. The design elements examined were horizontal curves and grades on mainline roadways, horizontal curves on interchange ramps, and curb return radii for at-grade ramp terminals and intersections. Data on geometrics of interchange ramps and at-grade intersections were collected from California and from two states in each of the four regions into which the rest of the U.S. was divided (west, midwest, northeast, and southeast). The data revealed a relatively low incidence of steep mainline grades and of mainline and ramp curves with sharp radii. Much more common, however, are curb return radii of 12 m (39 ft) or less that would cause trucks to encroach on other lanes. Urban areas have a greater number of curb returns with sharp radii than rural areas and are more often found at intersections than at ramp terminals.

Harwood, D., and Mason, J. 1994, "Horizontal Curve Design for Passenger Cars and Trucks," *Transportation Research Record,* no. 1445, pp. 22–33.

This paper evaluates the 1990 AASHTO geometric design policy for vehicle safety on horizontal curves. Low-speed curves were considered along with high-speed or open-highway curves. A sensitivity analysis was conducted for passenger cars and trucks traveling at the design speed on minimum-radius curves conforming to AASHTO policy. The results indicated that the existing design policy for high-speed curves provided adequate margins of safety against skidding and rollover. For low-speed curve design, however, it was recommended that the design criteria be revised.

Harwood, D., W. Glauz, and L. Elefteriadou. 1999, "Roadway Widening Costs for Geometric Design Improvements to Accommodate Potential Larger Trucks," *Transportation Research Record,* no. 1658, pp. 89–97.

This paper presents a study of the costs of widening existing roads that would be required to accommodate larger trucks. Low-speed offtracking was the criterion for judging where widening would be needed. Among the twelve truck types considered, the amount of offtracking (as measured by the swept-path width) was least for the benchmark truck, a tractor pulling a single 48 ft semitrailer.

Institute of Transportation Engineers (ITE) 1992, "A Summary of an ITE Informational Report: Geometric Design and Operational Considerations for Trucks," *ITE Journal* vol. 62 no. 8, pp. 12–15.

Institute of Transportation Engineers (ITE) 1992, *Geometric Design and Operational Considerations for Trucks,* Pub. no. IR-062, ITE, Washington, D.C.

Abstract of the report: "The information in this report has been obtained from experiences of transportation engineering professionals and research. The purpose was to

assemble in one document current information on large trucks that will be useful to highway and traffic engineers in adequately accommodating trucks on roadways. The report contains information on truck dimensions and performance characteristics. It also provides details for use in the design of roadway elements, such as intersections and horizontal and vertical geometry. Other areas covered include the impact of trucks on highway capacity and methods for handling trucks in work zones."

Additional description: Among the truck performance characteristics considered are rollover stability, stopping sight distance, turning radii and offtracking, and acceleration characteristics. For rearward amplification, the report found that triples create the most amplification, followed by the shorter doubles; the longer doubles are more stable comparatively. The geometric design issues covered include sign placement.

Keller, J. 1993 "Interchange Ramp Geometrics — Alignment and Superelevation Design," *Transportation Research Record*, no. 1385, pp. 148–154.

This paper considered several aspects of interchange ramp design that pertain to alignment and superelevation. Trucks were not the main focus but situations in which special considerations are necessary for trucks were discussed. Sight distance and superelevation were the two main components related to trucks that were addressed. The paper reported that the growth in large truck-trailer combinations was eroding safety margins because these vehicles have superelevation and stopping distance requirements that exceed those of automobiles. It also concluded that "spiral curves provide the most appropriate means to effect superelevation and be certain that the roadway and motorist interact in the manner expected."

Mason, J., Fitzpatrick, K., Harwood, D.W., and True, J. 1993, "Intersection Design Considerations to Accommodate Large Trucks," *Transportation Research Record*, no. 1385, pp. 32-40.

In this paper, the authors review evidence from studies related to geometric and operational considerations for large trucks and offer some recommendations. Topics considered include truck physical characteristics, offtracking, intersection sight distance, channelization, and traffic engineering elements. The paper notes that where the curb radius is large enough to accommodate trucks without encroachment, the paved area of an intersection may become so substantial that drivers may not know where to position their vehicles. In these situations, intersection channelization becomes a necessity for controlling and directing traffic movements.

Miaou, S., and Lum, H. 1993, "Statistical Evaluation of the Effects of Highway Geometric Design of Truck Accident Involvements," *Transportation Research Record*, no. 1407, pp. 11–23.

The effects of highway geometric design on truck accident involvement rates were modeled using Poisson regression for this study. Also considered were expected

reductions in accidents from improvements in various highway geometric design features. The study focused on Utah data from the Highway Safety Information System.

Miaou, S. 1994, "The Relationship Between Truck Accidents and Geometric Design of Road Sections: Poisson Versus Negative Binomial Regressions," ***Accident Analysis and Prevention*** **vol. 26 no. 4, pp. 471–482.**

Article abstract: "This paper evaluates the performance of Poisson and negative binomial (NB) regression models in establishing the relationship between truck accidents and geometric design of road sections. Three types of models are considered: Poisson regression, zero-inflated Poisson (ZIP) regression, and NB regression. Maximum likelihood (ML) method is used to estimate the unknown parameters of these models. Two other feasible estimators for estimating the dispersion parameter in the NB regression model are also examined: a moment estimator and a regression-based estimator. These models and estimators are evaluated based on their (1) estimated regression parameters, (2) overall goodness-of-fit, (3) estimated relative frequency of truck accident involvements across road sections, (4) sensitivity to the inclusion of short road sections, and (5) estimated total number of truck accident involvements. Data from the Highway Safety Information System are employed to examine the performance of these models in developing such relationships."

Additional description: Using the ML estimation, the author found that estimated regression parameters are similar for all three models, with no relative difference in estimated truck accident involvements across road sections. For developing a relationship in an initial model, the use of Poisson regression model is suggested. Caution is advised in using the NB regression model, estimated using either the moment or regression-based method.

Perera, H., Ross, H., and Humes, G. 1990, "Methodology for Estimating Safe Operating Speeds for Heavy Trucks and Combination Vehicles on Interchange Ramps," ***Transportation Research Record,*** **no. 1280, pp. 208–215.**

Presented in this paper is a methodology for estimating safe operating speeds for heavy trucks and combination vehicles on interchange ramps. The methodology entails a modified version of the computerized model PHASE-4; the input information includes specifications of the ramp geometry and the design vehicle. The critical speed is the threshold beyond which the vehicle rolls over or runs off the ramp. A safe operating speed is calculated by dividing critical speed by a factor of safety. An example is given in which the safe operating speeds are less than those given in the AASHTO Green Book. This suggests that the Green Book designs for ramps may provide large trucks with an inadequate margin of safety against rolling over or running off of the ramps.

SAFETY

USDOT 2000, *Comprehensive Truck Size and Weight Study: Volume II, Issues and Background*, Publication FHWA-PL-00-029 (Volume II), USDOT. (The publication is also available on the Web: http://www.fhwa.dot.gov/reports/tswstudy)

USDOT 2000, *Comprehensive Truck Size and Weight Study, Vol. III*: *Scenario Analysis*, Publication FHWA-PL-00-029 (Volume II), USDOT. (The publication is also available on the Web: http://www.fhwa.dot.gov/reports/tswstudy)

This study cites several initiatives that have contributed to the marked decline in commercial truck accident rates from 1985 through 1995:

- Introduction of nationally uniform licensing of truck drivers and tracking of drivers' traffic violations and accident experiences
- Increased safety technology in truck designs, such as improved seat belt designs and antilock braking systems
- Audits and inspections performed under the Motor Carrier Safety Assistance Program
- Industry-sponsored initiatives such as upgraded driver training

The accident risk associated with different types of heavy trucks is discussed extensively. The study was skeptical about the ability of analyses of crash records to yield a clear picture. It noted, for one thing, that analyses of this type have produced disparate findings:

> Many past studies have attempted to estimate the singular effect on crash propensity of size and weight differences among various truck configurations, with particular focus on double-trailer combinations, or more specifically longer combination vehicles (LCVs). Their conclusions vary from slightly positive to slightly negative, to no difference. This disparate in findings is explained, in large part, by the different methodologies and data sets used to conduct the various studies. (vol. III, p. VIII-2)

Also noted was that few of these past studies had statistical controls for vehicle operating environment and other confounding influences on crash rates. Without such controls, the results can be deceptive: for example, a truck with poor safety characteristics could have a relatively low crash rate if it happens to travel more than other vehicles on relatively safe roadways. Another problem identified was the scarcity of crash data in which LCVs are distinguished from other double combinations.

In light of these problems with crash data, the study relied instead on the evidence from tests of vehicle and driver performance.

One source of evidence was a study sponsored by the FHWA Office of Motor Carriers to investigate whether drivers experience more stress or fatigue when driving longer

combination vehicles (LCVs). The investigation entailed a test in which twenty-four experienced LCV drivers operated under representative daytime schedules on limited access highways. The findings suggested that the most significant contributions to driver fatigue were individual driver characteristics, the number of hours worked since the last rest period, and the number of consecutive days of work. The type of vehicle played a "marginal" role. Drivers appeared to perform somewhat better in tests involving a single-trailer (48 foot trailer) combination than in the tests with triple combinations. The measures of performance were based on lane tracking, fatigue/physiological recovery, and subjective workload.

Other evidence came from investigations of particular aspects of vehicle performance. In brief, the study's discussion ran as follows:

Low-speed offtracking causes the rear of a vehicle to track inward of the swept path of the vehicle's front. Although longer wheelbases on trailers generally worsen offtracking, this does not mean that offtracking increases with overall vehicle length. In fact, the standard STAA double and triple combinations (with 28 foot trailers) offtrack less than a standard tractor and 53-foot semitrailer combination. This is partly because the individual trailers in these multi-trailer combinations have relatively short wheelbases. The other reason is that additional points of articulation on a combination reduce the extent of offtracking. Low-speed offtracking is not a serious safety problem; it has minimal effect on the likelihood of serious crashes (fatal or injury-producing). More significant consequences are traffic disruption and damage to infrastructure (such as curbs).

High-speed offtracking has the opposite effect of low-speed offtracking, causing the rear of a vehicle to track outward of the swept path of a vehicle's front. Conceivably, a combination truck that high-speed offtracks on a curve could hit the curb and then roll over. However, high-speed offtracking has not been linked to any appreciable number of truck crashes.

Vehicle acceleration and speed maintenance are especially important for preventing accidents on grades and at non-signalized intersections. The use of higher horsepower engines and suitable powertrains can enable large and heavy trucks to perform adequately in these respects. On steep grades, special truck climbing lanes can be provided to prevent traffic conflicts between slow-moving trucks and other, faster-moving vehicles.

Braking performance "is a general concern that applies to all trucks and is not particularly influenced by changes in TS&Ws, if the requisite number of axles and brakes are added as the vehicle's weight increases and all the vehicle's brakes are well-maintained." (vol. III, p. V-20)

Sight distance requirements increase with vehicle length. The additional lengths of LCVs increase the accident risk for vehicles attempting to pass them. To offset this added risk, cars passing LCVs on two-lane roads need as much as 8 percent more sight distance. Additional truck length also increases the sight distance that trucks need to safely traverse

non-signalized intersections. Equipping longer vehicles with powertrains that ensure adequate acceleration can, however, minimize the need for additional sight distance.

The summary of the evidence on safety and truck performance states:

> Multi-trailer combinations without compensating design features have inferior performance capabilities compared to single-trailer combinations and these differences, especially if frequently challenged in traffic conflict situations, result in incrementally higher crash likelihoods. (vol. II, p. V-23)

DATABASES

Insurance Institute for Highway Safety and Highway Loss Data Institute, *Large Trucks,* available on the Web (http://www.iihs.org/safety_facts/qanda/trucks.htm).

This web site presents facts and figures on large-truck safety, though often without full references to sources. To the question, Are multiple-trailer trucks more likely to crash than single-trailer trucks?, the site provides this answer:

> Multiple-trailer trucks have more handling problems than single-trailer trucks. In general, the additional connection points contribute to greater instability, which can lead to jackknifing, overturning, and lane encroachments. But the relationship between multiple-trailer trucks and crash risk isn't firmly established. A study in Washington State found doubles (tractors pulling two trailers) were two to three times as likely as other rigs to be in crashes, but a study in Indiana found doubles didn't show increased crash risk except on roads with snow, ice, or slush. Doubles often are operated by drivers with good safety records working for large companies with active safety programs.

The site also contains links to the Institute's publications.

"Traffic Safety Facts 1998: Large Trucks," USDOT and National Highway Transportation Safety Administration, DOT HS 808 952, available on the Web (http://www.nhtsa.dot.gov/people/ncsa/factsheet.html).

This factsheet contains many of the same statistics as does the USDOT's Truck Crashes, except that its data are more current. The data show that large trucks (over 10,000 lb GVW) were involved in 475,000 traffic crashes in 1999. These crashes caused 5,362 fatalities and another 142,000 injuries; fatalities per fatal crash were 1.095.

Large trucks have a relatively high rate of fatal accidents per mile traveled. They accounted for 7.4 percent of vehicle miles traveled in 1998, the most recent year for which the factsheet gives a VMT breakdown. In comparison, in 1999, large trucks accounted for 8.6 percent of vehicles involved in fatal crashes. Yet in the same year, they accounted for only 4.4 percent of vehicles involved in nonfatal crashes. These numbers show, as one would expect, that large truck involvement increases the severity of traffic

accidents. Indeed, in 1999, one out of eight traffic fatalities resulted from a crash involving a large truck.

Of the fatalities resulting from crashes involving large trucks, 78 percent were occupants of the other vehicle, 8 percent were non-occupants, and 14 percent were occupants of a large truck. Of the nonfatal injuries resulting from large truck crashes, 74 percent were occupants of another vehicle, 3 percent were non-occupants, and 23 percent were occupants of a large truck.

The factsheet also reveals a continuing decline in the rate of accidents involving large trucks per mile they travel. For fatal accidents, the annual rate per 100 million large truck miles declined from 3.5 to 2.5 between 1989 and 1999.

The factsheet also contains data on points of impact for two-vehicle fatal crashes involving large trucks. The four situations that claim the most lives are truck front/car front (29 percent of crashes), truck front/car left side (17 percent), truck rear/car front (15 percent), and truck front/car right side (14 percent).

Center for National Truck Statistics n.d., "1996 Trucks Involved in Fatal Accidents," available on the Web (http://www.umtri.umich.edu/cnts/release.htm).

The statistics contained in this report are based on investigation of over 3,200 fatal accidents involving trucks. Light trucks, such as pickups, were evidently excluded from this sample, which was drawn from the Fatal Accident Reporting System file. For each sampled accident, the Center for National Truck Statistics contacts a knowledgeable person, usually the driver, owner, or safety director, for a complete physical description of the truck at the time of the accident. Tractor-semitrailer combinations accounted for 60 percent of the cases; about 28 percent were straight trucks without trailers.

STATISTICS AND DATA ANALYSIS

Chira-Chavala, T. 1991, "Data from TRB-Proposed National Monitoring System and Procedures for Analysis of Truck Accident Rates," *Transportation Research Record*, no. 1322, p 44.

Abstract from article: "To follow trends of truck accident involvement rates requires reliable information on truck accidents and travel. Procedures for estimating truck accident involvement rates and their confidence limits on the basis of variabilities inherent in the sample design of the TRB-proposed National Monitoring System (NMS) are presented. Formulas for computing confidence limits of national and state truck accident involvement rates per mile of travel are given for any level of disaggregation. The quality of truck accident and travel data that may be expected from implementing the NMS, together with consistent estimation of confidence limits of accident involvement rates, would represent significant improvement over truck safety statistics available from existing data programs."

Additional description: This article notes significant discrepancies between databases in the numbers of truck accidents by region and period. In the TRB-proposed monitoring system, police officers would be required to provide very detailed information about accidents involving trucks, including: vehicle type, carrier, driver information, accident description, type of roadway, environment at time of accident (i.e., weather, light condition). A pilot test of this system was conducted in several Midwest states and none reported any major problems. The estimates based on the TRB-proposed system would nevertheless be subject to random errors. The author's proposed procedure for deriving confidence limits would provide an indication of the likelihood of errors of given magnitudes.

Lyles, R. W., Campbell, K. L., Blower, D. F., and Stamatiadis, P. 1991, "Differential Truck Accident Rates for Michigan," ***Transportation Research Record*****, no. 1322, pp. 62–69.**

Abstract from article: "Major changes in the trucking industry have resulted from federal legislation that relaxed the regulation of trucks in interstate commerce, allowed the use of double-trailer combinations nationwide on Interstate highways, and required states to regulate trailer length instead of overall length. Because Michigan has long had extremely liberal truck size and weight regulations, its experience with truck safety is of significant interest. A project by the University of Michigan and Michigan State University was undertaken to develop statistical information on accidents, travel, and the risk of accident involvement for Michigan-registered trucks in Michigan. The study objective was to calculate disaggregate truck accident rates by road class, day or night, and urban or rural operating conditions for tractors without trailers (bobtails) and in single- and double-trailer configurations. Major findings included the following: bobtails consistently have the highest accident rates; all-accident and casualty rates for single and double configurations are similar to one another; the most significant and consistent factor associated with truck accident rates was the roadway class (highest rates on the "local" road system, lowest on limited-access highways); urban accident rates were lower than rural rates; night rates were higher than day rates for casualty accidents but lower for all accidents; and tractor drivers aged 19-20 have an accident rate five times the average. The findings indicate that differences in truck safety by roadway class are more important than those between singles and doubles. Discussion and recommendations concerning improvements in truck accident and exposure data as well as further work on the relationship between truck accidents and geometry are included."

Additional description: The accident data came from the state police accident reports for the period May 1987 through April 1988. Drivers over the age of 60 were found to have accident rates 1.5 times the average. Urban accident rates for doubles varied according to time of day (20 per million vehicle miles during the day versus 35 per million vehicle miles during the night).

Mingo, R. D., Esterlitz, J. R., and Mingo, B. L. 1991, "Accident Rates of Multiunit Combination Vehicles Derived from Large-Scale Data Bases," *Transportation Research Record*, no. 1322, p. 50-61.

Abstract from article: "The operating characteristics of multitrailer vehicles could be expected to make them more dangerous than other vehicles, but previous accident involvement studies have produced mixed results, with no consistently strong indications of greater hazard. A review of these studies, however, indicates sufficiently severe limitations in their sample sizes and data reliability to readily explain the great degree of scatter in their findings. The size and reliability issues of previous studies are overcome by using large national data sources to calculate overall involvement rates of various vehicle configurations. No suitable sources of nonfatal accidents or disaggregate travel information were located. Use of national data rather than state and highway-type-specific data obscures the safety effects of differences in vehicle operations but at least allows an overall comparison of fatal accident involvement rates. Because current multitrailers are concentrated more than single trailers on the safest highways, rural Interstates, multitrailers appear in this study to be safer than they would if differences in operations were considered. The most reliable sources of fatal accident and travel data indicate that multitrailers, single trailers, and single-unit trucks have fatal accident involvement rates of 9.96, 6.01, and 3.00 per 100 million miles traveled, respectively. The ratio of fatal accident involvement rates for multitrailers to single trailers is 1.66. The multitrailer to single-unit truck ratio is 3.32. Most previous studies have indicated doubles or multitrailer fatal accident rates to be higher than singles, but with less difference. The higher ratios here can be attributed in part to larger and more reliable data sources than have been used in the past."

Additional description: The data for 1988 are discussed with comparisons to earlier years. Data on fatal accidents were obtained from the Fatal Accident Reporting System and the database used for the publication, "Trucks Involved in Fatal Accidents" (see above entry, under Center for National Truck Statistics). Estimates of vehicle miles of travel by state and vehicle type were derived from the Highway Performance Monitoring System and from the Truck Inventory and Use Survey. Fatality involvement rates per 100 million vehicle miles are presented by state and vehicle type. For Texas, the rates are similar to the national figures when it comes to passenger cars and single-trailer combinations. But for single-unit trucks and for double-trailer combinations, the rates are substantially lower for Texas than for the rest of the nation. As the authors caution, the variation between states partly reflect random variations. (Fatal accidents are rare events relative to miles traveled, so one could expect a fair amount of year-to-year variation for some of the smaller vehicle classes in smaller states.) One must also bear in mind the problems with the data on vehicle miles traveled. As the authors note, the Highway Performance Monitoring System relies on traffic counting and classification procedures that tend to overstate combination truck travel, especially that of double-trailer combinations.

Cerelli, E.C. 1998, *Trends in Large Truck Crashes*, NHTSA Technical Report HS-808 690, National Technical Information Service, Springfield, VA. (An abbreviated version is available on the Web (http://www.nhtsa.dot.gov/people/ncsa/LargeTruck.html).

Abstract from report: "Large trucks account for about 3.5 percent of all vehicles and for approximately 7 percent of all motor vehicle travel, while accounting for about 12 percent of all traffic fatalities. However, large truck travel has more than doubled during the 1975-1995 time period, while the number of all large truck-related fatalities has not changed appreciably. When occupant fatalities in crashes between large trucks and other vehicles are examined, another pattern appears to emerge, i.e., large-truck occupant fatalities have declined during the 1975-1995 period, while fatalities of occupants of the other vehicle have remained at the 3,000-4,000 per year level. This study examines data on driver licenses, vehicle registrations, vehicle miles traveled, all crashes, fatal crashes and fatalities involving large trucks and other vehicles for the period 1975-1995. The involvement of various driver age groups in large truck crashes is examined more closely for the last three years, i.e., 1993-1995. Younger drivers appear to be under-represented in large truck crashes. The risk of fatality to passenger vehicle drivers involved in large truck crashes was found to be greater for younger drivers than for older drivers."

Additional description: According to this report, the number of vehicle miles of travel by large trucks increased 113 percent between 1975 and 1995. As a percentage of all traffic fatalities, large truck accidents have consistently accounted for 12 percent over this period. Thus, for other vehicle classes, the picture is broadly similar to that for large trucks: the number of the fatal accident involvements has changed little, at the same time that vehicle-miles traveled have grown.

Levy, D.T., and Miller, T. 2000, "Review: Risk Compensation Literature – The Theory and Evidence," *Crash Prevention and Injury Control,* vol. 2, no.1, pp. 75–86.

Abstract from article: "Risk compensation denotes offsetting behavioral responses to safety improvements. Theoretical arguments suggest that, when drivers are required to drive safer cars or drive in a safer manner, they will tend to increase their driving speed or drive in some other risky manner. The purpose of this paper is to review critically the theory and evidence on risk compensation. The general conclusion is that the application of risk compensation theory, especially to some types of regulations, is questionable, and the empirical support for significant offsetting behavior is weak. Specifically, 1) the role of limitations in processing information is not appreciated, especially regarding risk perceptions and the learning component associated with new regulations; 2) the types of regulations and types of driving behavior are not adequately distinguished; and 3) the empirical studies have mixed results and are subject to important limitations."

Scopatz, R.A. 2001, "Crashes Involving Long Combination Vehicles (LCVs): Data Quality Problems and Recommendations for Improvement," paper presented to the 80th Annual Meeting of the Transportation Research Board, January 7–11, 2001. Washington, D.C. (available on the pre-print CD-ROM distributed by the Transportation Research Board, Washington, D.C.).

Abstract from paper: "In 1999–2000, the AAA Foundation for Traffic Safety conducted a research program to identify the barriers to analysis of large truck safety experience in the US. Their primary focus was on so-called longer combination vehicles (LCVs) — the "doubles" and "triples" running on major highways throughout the country. Five states (Florida, Idaho, Nevada, Oregon, and Utah) participated in a review and evaluation of their data collection and analysis practices. Two of the states (Oregon and Utah) also participated in an audit of completed crash reports for crashes involving large trucks and specifically doubles and triples. The results show that none of the five states has a crash reporting system that adequately supports the analysis of LCV safety. In general, there is a lack of reliable data on the exact configuration of vehicles involved in crashes, and a lack of specific measures of exposure for LCVs. Without good data on configuration and good measures of exposure, the main question about LCV safety (i.e., are they more or less safe than other large commercial motor vehicles?) cannot be answered empirically. The report concludes with a series of recommendations for improving the quality of data for crashes involving large trucks and for improving the states' ability to analyze LCV crashes specifically."

Additional description: The study defined an LCV as "any combination vehicle with two or more cargo spaces, in which one of the spaces is longer than 28 feet, and which is operating at greater than 80,000 pounds Gross Vehicle Weight Rating." The study found that only Utah among the surveyed states uses crash report forms with sufficient detail to identify LCVs. Florida, for example, codes double combinations without distinguishing between Turnpike Doubles—the only LCV allowed in the state—and STAA doubles (not an LCV). Other findings included these:

- Each of the surveyed states collects supplementary information on crashes involving commercial motor vehicles. In the three states that collect this information on a form separate from the primary crash report, non-completion of the supplementary form occurs often enough to be a concern. The states that integrate the primary and commercial motor vehicle crash reports into a single form—Idaho and Utah—have better chances of receiving the CMV-related information.

- An important problem is that persons completing the crash report forms are inadequately trained for this task. The audits performed in Oregon and Utah showed that many officers do not know how to recognize and/or code the various configurations of vehicles. Oregon is unable to require officers to complete the crash reports and so relies, to a significant extent, on self-reports from drivers and motor carriers. A large proportion of the audited reports in both states had information in the vehicle configuration boxes that appeared to be incorrect—the

remainder of the information in the report clearly pointed to a different vehicle configuration.

PERFORMANCE MEASURES OF LARGER COMBINATION VEHICLES

Fancher, P.S., Campbell, K. L. 1995, "Vehicle Characteristics Affecting Safety," *Truck Size and Weight Study, Phase I: Working Papers 1 and 2 combined.* 6 February, available on the Web (http://www.fhwa.dot.gov/reports/tswstudy/).

Abstract from paper: "This paper addresses the relationship of truck size and weight (TS&W) policy, vehicle handling and stability, and safety. Handling and stability are the primary mechanisms relating vehicle characteristics and safety. Vehicle characteristics may also affect safety by mechanisms other than handling and stability. For example, vehicle length may affect safety through interactions with other vehicles, such as passing maneuvers and in clearing intersections, in addition to its influence on vehicle handling and safety. However, the safety effect of vehicle length due to its influence on handling and stability is within the scope of this paper, while safety effects arising through mechanisms other than handling and stability, such as passing and intersection clearance, are not."

Additional description: The vehicle performance measures discussed in this paper are roll threshold, rearward amplification, braking, and offtracking. The authors conclude that liberalization of TS&W policy does not necessarily compromise safety. Liberalization could even occur along with an increase in safety under certain conditions. For this to happen, vehicles would need to be redesigned to maintain stability with the new dimensions. Also necessary would be more powerful engines (for ease of acceleration), better brakes (for safer stopping), and changes to highway geometric design (to decrease problems of sway and off-tracking).

Another theme of the paper is that performance standards may deal with concerns about truck safety somewhat better than regulations of vehicle dimensions. Such standards would require that performance measures—the rollover threshold or degree of offtracking, for example—stay within acceptable bounds. The paper also reviews the Turner Truck Study, which proposed higher gross combination weights for vehicles with axle loads below the current limits.

Harkey, D. L., Council, F. M., and Zegeer, C. V. 1995, "Operational Characteristics of Longer Combination Vehicles and Related Geometric Design Issues," *Transportation Research Record*, no. 1523, pp. 22-28.

Abstract from article: "As the size and configuration of trucks operating on public highways continues to change, how these vehicles operate needs to be better understood to accommodate them through better geometric designs or regulate them through more stringent laws and better enforcement. Longer-combination vehicles (LCVs), a group that includes Rocky Mountain doubles, turnpike doubles, and triples, fall into this category.

LCVs handle and perform differently from tractor semitrailers or twin trailers because of their increased lengths and weights. These differences in handling and performance may jeopardize the safety of the LCV as well as other vehicles on the roadway. Several of the LCV's operational characteristics are believed to have an impact on transportation safety and the relationship of these characteristics to geometric design. There is a clear need to conduct additional research to further evaluate LCV operations. Several such research efforts are recommended."

Additional description: In looking at LCVs and sway, this article reports that triple trailers have been shown to sway up to 1 foot—encroaching into adjacent lanes. The influence of "in-lane" trailer sway on passing and or queuing vehicles is identified as still requiring testing. The larger number of brakes on LCVs is identified as a safety concern in light of evidence that brake maintenance is often neglected. The evidence cited comes from a survey conducted in Maryland and California, which found that approximately one-fourth of trucks checked had 40 percent of their brakes out of adjustment. The article also examines the safety issues pertaining to rearward amplification, stopping distance, acceleration and speed differentials. The importance of speed differentials emerges clearly from these estimates: When a truck travels 10mi/hr less than the prevailing speed, its likelihood of being in an accident increases by 3.7, a difference of 20 mi/hr increases the likelihood of an accident by a factor of 15.5. After the examination of various performance characteristics, it is still undetermined whether LCVs are less stable than other trucks.

DRIVER SAFETY AND RIGHTS

"Application of the Fourth Amendment to the Inspection of Commercial Motor Vehicles and Drivers," ***National Cooperative Highway Research Program, Legal Research Digest,*** **March 2000, no. 43.**

This report reviews legal issues surrounding the search and seizure of commercial vehicles and their drivers. This has relevance to the enforcement of potential regulatory arrangements for truck size and weight. For example, some people might see a fourth amendment violation in the use of Global Position Systems to monitor and collect data on truck travel (routes, mileage, etc.). This article indicates how tricky it can be to collect accurate data and assure the safety of the driver and others while allowing truckers their fourth amendment rights.

Bogren, S. 1989, "CDLs: A Move Toward Safety," ***Community Transportation Reporter,*** **December, pp. 8–9.**

This article provides a brief review of what the Commercial Motor Vehicles Safety Act of 1986 mandated. It focuses mostly on the Act's implementation, particularly regarding the commercial drivers' license requirements. The article brings to light that many truckers lack the reading and writing skills necessary to pass the license tests, despite having clean driving records.

Jovanis, P. P., Kaneko, T., and Lin, T-D. 1991, "Exploratory Analysis of Motor Carrier Accident Risk and Daily Driving Patterns," *Transportation Research Record*, no. 1322, pp. 34–43.

Abstract from article: "Driving at different times of day within one day and over several days is associated with different levels of accident risk. Analyses of accident and nonaccident data from a less-than-truckload carrier representing six months of operation in 1984 are used to explore changes in daily and multiday accident risk. Cluster analysis is used to extract a distinct pattern of driving over a seven-day period from a sample of 1,066 drivers (including those with accidents and nonaccidents on the eighth day). The analyses yielded clear interpretable driving patterns that could be associated with levels of relative accident risk. Higher risk was generally, but not exclusively, associated with extensive driving in the two to three days before the day of interest. The two patterns with the highest risk of an accident were those that contained heavy driving during the preceding three days and consisted of driving from 3:00 p.m. to 3:00 a.m. (Pattern 1) and from 10:00 p.m. to 10:00 a.m. (Pattern 8). The lowest risk was associated with driving from 8:00 p.m. to 6:00 a.m. but with limited driving on the preceding three days. Given the virtually limitless possible combinations of driving schedules, it is encouraging that interpretable distinct multiday patterns could be extracted from a data base of more than 1,000 observations. Within each pattern, drivers experienced similar duty hours: cumulative driving during the seven days ranged from 47 to 49 hr. Continuous driving (between mandatory eight-hr off-duty periods) ranged from 7.8 to 8.4 hr. Individual drivers also experienced a cycle of on-duty and off-duty time that ranged from 22.3 to 23 hr, closer to the 24-hr period that is desirable from the perspective of human performance theories. The findings suggest that it is possible to identify and extract patterns of multiday driving and that these patterns are associated with different levels of accident risk. Additional empirical tests and the development of refined accident risk models are suggested for future research."

Additional description: The article reports that the most accident-prone drivers are those who consistently drive 12 hour stints that overlap with the times of a natural diurnal drop in arousal (4 a.m. to 6 a.m.).

NARROW ROADS AND SAFETY

Zegeer, C. V., Hummer, J., and Hanscom, F. 1990, "Operational Effects of Larger Trucks on Rural Roadways," *Transportation Research Record,* no. 1281, p. 28–39.

Abstract from article: "Ability of various truck configurations to negotiate rural roads with restrictive geometry was examined in addition to effects of such trucks on traffic operations and safety. Truck sizes included truck-tractor semitrailers with trailer lengths of 40, 45, and 48 ft (i.e., semi-40, semi-45, and semi-48) and twin-trailer combinations with 28-ft trailers (i.e., twins or double 28). Test sites consisted of approximately 60 mi of rural, two-lane roads in New Jersey and California with a variety of lane widths,

shoulder widths, and horizontal and vertical alignment. Field testing involved following control trucks of each truck type along the selected routes. Photographic and radar equipment were used in a data collection caravan to measure the effects of the trucks on oncoming vehicles in terms of speed changes and lateral placement changes. Statistical testing was used to compare operational differences between various truck types for specific geometric conditions. Results showed that semi-48 and twins caused some changes in operation of oncoming vehicles, particularly on narrow roadways. However, careful driving by drivers of larger trucks may have partially compensated for operational differences in oncoming vehicles between truck types. Overall, truck driving behavior and site differences had more of an effect on vehicle operations than the effects of the different truck types. Potential safety problems as evidenced by extreme maneuvers were observed for a few oncoming motorists in reaction to the twins and longer tractor semitrailers."

Additional description: The authors examined the reactions of other drivers to wide trucks (102 inches) of varying lengths on narrow roadways. They found that drivers recognized "double trailers as a formidable vehicle" and would move away from the centerline. Drivers did not generally take this precaution, however, with the equally dangerous 53-foot single-trailer combinations. The authors make a good case for requiring better markings (i.e., more lights) on heavier and larger trucks, as well as for restricting these vehicles to wide, well-maintained roads (i.e., the National Network).

GENERAL REFERENCES

Hanscom, F. R. 1990, "Operational Effectiveness of Truck Lane Restrictions," ***Transportation Research Record*****, no. 1281, pp. 119–126.**

Abstract from article: "The operational effectiveness of restricting trucks from designated lanes on multilane roadways is addressed. Three locations with no truck restrictions were treated with signing restricting trucks to certain lanes. The applied field study was of a before-and-after design (with matched control sites). Truck lane restrictions were implemented at two three-lane sites and one two-lane location. Favorable truck compliance effects were evident at all three locations. Before-and-after comparisons indicated significant truck lane use shifts; however, violation rates were higher (i.e., 10.2%) at the two-lane site in comparison with the three-lane sites (i.e., 0.9% and 5.7%). Higher violation rates at the two-lane site resulted from increased truck densities caused by restricting trucks to a single lane. An emphasis was placed on determining traffic flow effects to nontrucks in the traffic stream. Beneficial effects on three-lane roadways were realized in terms of reduced congestion and fewer trucks impeding vehicles (at both sites) and shorter following queue lengths (at one site). This finding supports the conclusion that traffic congestion at three-lane sites was reduced as the result of the restriction. An adverse effect, observed at the two-lane restriction, was reduced speeds of impeded vehicles following trucks. However, a slight benefit was found in that fewer trucks impeded following vehicles. All-vehicle speed comparisons were examined to determine whether increased differential speeds were likely to occur between the restricted and

adjacent lanes. No speed changes were observed to indicate an adverse effect of the truck lane restriction."

Additional description: The study sites were in the U.S. Midwest. The author noted the need to examine the impact on pavement conditions and cost of highway repairs before implementing lane restrictions.

Hewitt, J., Stephens, J. , Smith, K., and Menuez, N. 1999, "Infrastructure and Economic Impacts of Changes in Truck Weight Regulations in Minnesota," *Transportation Research Record*, no. 1653, pp. 42-51.

Abstract from paper: "The overall impacts of changes in truck weight limits on the economy in Montana were determined. Four scenarios were considered with different maximum allowable gross vehicle weights (GVWs). Three scenarios, with maximum GVWs of 36,300 kg (80,000 lb), 39,300 kg (88,000 lb), and 47,900 kg (105,500 lb), represented reductions in GVWs. The fourth scenario represented an increase in allowable GVW to 58,100 kg (128,000 lb). Predictions were made of the vehicle fleets under each scenario and of the changes in demands and performance of the highway infrastructure. Only nominal changes in infrastructure demands were observed across all scenarios (maximum of $1.5 million). Case studies of the impacts expected on selected industries within the state were conducted. Changes in transportation costs of 4 to 54 percent were predicted under the 36,300 kg (80,000 lb) scenario, which were estimated to be 0.2 to 4.1 percent of the value of the goods produced. Changes in transportation costs typically were at least an order of magnitude larger than changes in infrastructure costs. Statewide economic impacts in terms of forgone gross state product amounted to -0.4 percent and, in the first year alone, were 2 to 20 times the infrastructure impacts, depending on the scenario."

Additional description: The article describes truck weight limits in Montana that are identical to the federal limits, except that the 80,000 lb cap on gross vehicle weight (GVW) is absent. "Maximum GVWs are determined by the Federal Bridge Formula." Trucks that operate under these rules include combinations that weigh 114,000 lb with seven axles, 118,000 lb with eight axles, and 123,000 lb with nine axles.

Among the study's scenarios, the restriction of GVW to 80,000 lb has the largest estimated impact on pavement costs, an increase of 1.2 percent. The increase reflects the predicted effect of such a restriction on the composition of the truck fleet. Vehicles with lower GVWs and fewer axles would replace the vehicles that now operate over 80,000 lb. The lower GVWs would increase the number of trips required to perform the same freight tasks, which, combined with the reduction in the number of axles, would increase pavement damage.

In the study's liberalization scenario, relaxation of the bridge formula makes possible an increase in GVW up to the new limit of 123,000 lb. The estimated impacts on infrastructure costs are marginal increases for both pavements and bridges. The estimate

for bridges is only about 25 percent larger than that for pavements, but neither estimate includes the cost of disruption to traffic during repair or replacement of infrastructure.

The estimates of infrastructure impacts have the further limitation of not reflecting induced changes in the volume of freight moved by truck. The study identifies two ways in which the modeled changes to GVW limits could affect the volume of truck freight moved on Montana highways. One way is to cause diversion of freight between truck and other modes; however, based on discussions with truckers and evidence from TRB studies, the authors assess this effect as negligible.

The other way is for the modeled changes in weight limits to affect the total demand for freight services (all modes) that involve movements within Montana. This demand for freight services depends on activity levels throughout in Montana industries. From its statewide economic modeling, the study concludes that while the simulated changes in weight limits would affect the Montana economy, these effects would "not be so dramatic as to immediately affect the [total] demand for transportation services."

The statewide economic modeling in the study was based on the REMI (Regional Economic Modeling System, Inc.) model, which can be customized to any region of the United States. The study notes that changes in trucking productivity, such as would result in changes to vehicle weight limits, cannot input directly into the REMI model; they can only be represented as a change in overall productivity. For this reason, the modeling does not capture the possibilities for substitution between trucking and other inputs to an industry's production.

GLOSSARY

Equivalent single-axle load (ESAL). A single-axle load of a specified weight, conventionally 18,000 lb, serves as the benchmark for the ESAL measure of pavement damage. A traffic stream that generates, say, 200,000 ESALs has the same pavement impact as 200,000 passes of the benchmark axle.

High-speed offtracking. "High-speed offtracking … results from the tendency of the rear of the truck to move outward due to the lateral acceleration of the vehicle as it follows a curve at higher speeds. As the speed of the truck increases from very slow, offtracking to the inside of the curve [low-speed offtracking] decreases until, at some particular speed, the rear trailer axles follow exactly the tractor steering axle trailers. At still higher speeds, the rear trailer axles will track outside the track of the tractor steering axle [high-speed offtracking]" (USDOT 2000). See figure 3**.**

Jackknife. "Vehicle controllability during braking is related to the lockup of the wheels on one or more of the axle sets. When lockup occurs on the wheels of the tractor's rear axle or on the wheels of a dolly's axle, the tractor or dolly is unstable in yaw; the ensuing rapid rotational motion is commonly termed jackknifing" (TRB, *Twin Trailer Trucks*,

Special Research Report 211, TRB, National Research Council, Washington, D.C., 1986, p. 276).

Load equivalence factor (LEF). An LEF measures the extent to which pavement damage increases with axle weight. Conventionally, the benchmark axle is an 18,000 lb single axle. If a 20,000 lb axle has an LEF of 1.5 that means, under this convention, that each pass of such an axle causes 50 percent more damage than one pass of an 18,000 lb axle.

Longer combination vehicle (LCV). The Intermodal Surface Transportation Efficiency Act of 1991 defined an LCV as "any combination of a truck tractor and 2 or more trailers or semitrailers which operates on the Interstate System at a gross vehicle weight greater than 80,000 pounds" (http://iti.acns.nwu.edu/clear/infr/gopher90.txt). The Comprehensive Truck Size and Weight study (USDOT 2000) adhered to this definition, as have many other discussions of TS&W issues. Some discussions, however, have added to this definition a length criterion for the cargo-carrying units. Scopatz (2001) added the criterion that one or more of the cargo-carrying units be longer than 28 feet. This excludes from the definition of an LCV the STAA double combinations as well as most triples.

Low-speed offtracking. "When a combination vehicle makes a low-speed turn—for example a 90-degree turn at an intersection—the wheels of the rearmost trailer axle follow a path several feet inside the path of the tractor steering axle. This is called low-speed offtracking" (USDOT 2000). See Figure 2.

Present Serviceability Index. A measure of pavement condition that is based on road user perceptions of ride quality. Although it includes terms for cracking and rutting, the value of the index depends mainly on surface roughness.

Rocky Mountain Double. A combination of a truck-tractor, a front trailer between 40 feet and 48 feet long, and a shorter 20-foot to 28-foot rear trailer.

Structural number (SN). A measure of pavement strength that is a weighted sum of the thickness of each pavement layer. The weight for a layer depends on the material that the layer contains (see OECD, *Pavement Management Systems*, OECD, Paris, 1987, p. 52).

STAA double. A combination of a truck tractor and two 28-foot trailers. The Surface Transportation Assistance Act of 1982 (STAA) authorizes the use of these vehicles on a National Network. "Today, with over 200,000 miles of roadway, the NN [National Network] includes virtually all Interstate Highways (44,000 miles) as well as other highways" (USDOT 2000, vol. III, p. II-6).

Turnpike Double. A combination of a truck-tractor and two trailers of equal length, typically 48 feet or 53 feet.

Figure 2: Low-Speed Offtracking

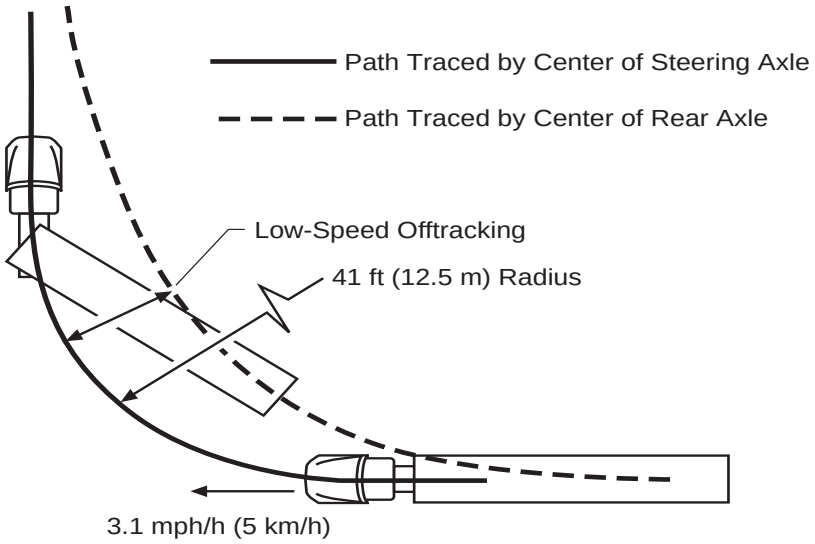
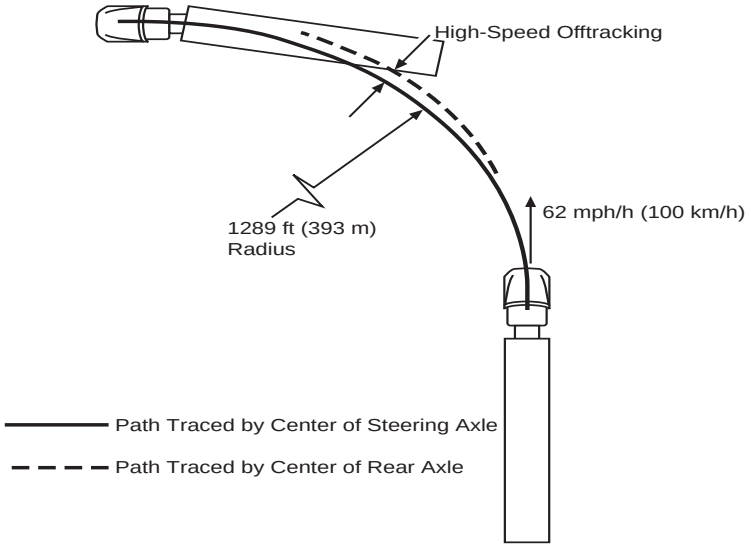


Figure 3: High-Speed Offtracking



Sources: USDOT (2000), Volume III, p. VII-2.

End of attachments to LAND

Reclamation District 501

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April 12, 2019

VIA CERTIFIED MAIL AND E-MAIL

Department of Water Resources
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Re: Partial Recirculation Draft Environmental Impact Report
Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

On behalf of Reclamation District 501 ("RD 501"), we appreciate the opportunity to comment on the Partial Recirculation of the Draft Environmental Impact Report for the Prospect Island Tidal Habitat Restoration Project ("DEIR"). As the public agency responsible for maintenance of levees on Ryer Island in Solano County, RD 501 remains concerned about several adverse impacts that are likely to result from the Prospect Island Tidal Habitat Restoration Project ("Project"), but which the DEIR continues not to adequately address. While the DEIR addresses some of the concerns that RD 501 previously raised, the DEIR again falls short in its analysis regarding the suite of impacts that will result from the Project. RD501-1

Since many of the deficiencies that RD 501 previously raised regarding the original draft environment impact report remain unaddressed in this DEIR, RD 501 hereby incorporates by reference its October 7, 2015 comments on the Project's anticipated impacts as well as the ENGEO Seepage Impact Analysis that RD 501 previously shared with DWR. RD 501 now supplements its prior concerns by providing the following comments. RD 501 again requests that a new draft environmental impact report be prepared for the Project that adequately addresses all adverse environmental impacts.

Groundwater Seepage Impacts on Ryer Island

The DEIR continues to ignore the conclusions and critical data relied upon in the ENGEO Seepage Impact Analysis. It concludes that the Project "is not expected to have any seepage effects on Ryer Island" because "there is no significant relationship between Ryer Island groundwater levels and Prospect Island stage that is not explained by Miner Slough stage and local precipitation." (DEIR 5-81.) This conclusion is wrong and the analysis is deficient because the DEIR continues to ignore substantial information about subsurface soil conditions. RD501-2 (Cont. below)

The DEIR continues to rely upon the 2014 DWR Site Characterization and Groundwater Monitoring Data Analysis Summary. (DEIR 5-79 to 5-81.) But as set forth in the ENGEO Seepage Impact Analysis provided to DWR by RD 501 on September 10, 2015, the 2014 DWR

Summary is deficient for several reasons, including its (1) assumption of homogeneous soil conditions across Prospect and Ryer Islands; (2) simplification of soil analysis by selecting only three differing soil conditions; (3) failure to trench at or near the toe of the Miner Slough levees on the Prospect Island side; (4) spacing of bore holes too far apart to be representative of soil conditions on Prospect Island; (5) ignoring of three sand lenses that were discovered during DWR's subsurface investigation; and (6) ignoring of data showing that flooding Prospect Island increases the head pressure on Prospect Island, which has a corresponding increase in ground water head elevation on Ryer Island.

RD501-2 (Cont.)

The DEIR does not address and correct this deficient analysis. Instead, the DEIR relies upon the 2018 DWR Prospect and Ryer Island Hydrologic Data Analysis, which omits any reference to the ENGEO Seepage Impact Analysis. (*See* DEIR 5-81 (describing the 2018 DWR Analysis and conclude there won't be seepage effects on Ryer Island).) Critically, the 2018 DWR Analysis—like the 2014 DWR Analysis Summary—does not appropriately incorporate sand lenses into its seepage analysis. Again, the DWR's seepage analysis perpetuates its faulty 2014 seepage modeling that ignored crucial, known data about subsurface soil conditions. As the Seepage Impact Analysis demonstrates, this omitted information would significantly affect the DWR's analyses and conclusions.

RD 501 provided its Seepage Impact Analysis as technical input to assist DWR in its CEQA review. While the DWR's environmental review need not be exhaustive, it must include sufficient analysis to allow DWR to intelligently consider the Project's environmental impacts. (Cal. Code Regs. tit. 14, § 15151.) And while DWR may not agree with the ENGEO Seepage Impact Analysis, its environmental review must nonetheless summarize and address the Analysis's main points. (*See* Cal. Code Regs. tit. 14, § 15151 ("the EIR should summarize the main points of disagreement among the experts").) Because it continues to ignore significant factual information about subsurface conditions that are discussed in the Seepage Impact Analysis, the DWR's analyses of foreseeable environmental impacts from groundwater seepage lacks substantial evidence and is ultimately flawed. Since the DEIR remains inadequately informative, RD 501 requests that DWR continue its review and draft a new environmental impact report that incorporates this missing information, addresses the ENGEO Seepage Impact Analysis, and incorporates that Analysis into the EIR as a reference.

Scour and Erosion Impacts

The DEIR acknowledges that there is the "potential for scour along the center of the channel bottom during winter conditions under both baseline and future conditions under the Proposed Project." (DEIR 5-85.) And DWR anticipates that implementing the Project will increase peak longitudinal cross-section averaged velocity by, for example, 20 percent during winter storm conditions at upstream locations and double those velocities during summer conditions at downstream locations. (DEIS 5-90, Table 3.1-3.) This, in turn, creates the increased potential for bed scour. (DEIR 5-85.) Despite this increased potential, however, the DEIR concludes that the anticipated substantial increase in velocity will neither significantly impact the Ryer Island levee nor significantly increase seepage on adjacent lands. (DEIR 5-85 to 5-91.) This assessment is arbitrary and unreasonable for multiple reasons.

RD501-3 (Cont. below)

First, the DEIR's analysis first goes awry because it does not adequately consider the Sacramento River Deep Water Ship Channel's (DWSC) connectivity with the Miner Slough. The

DEIS acknowledges their "significant hydraulic connection" but it makes the conclusory statement that potential bed scour is unlikely to occur because the seepage-prone areas "lie generally upstream of the planned breach locations." (DEIS 5-90.) Thus, the DEIS arbitrarily sets aside the foreseeable impacts that flooding Prospect Island will have on bed scour by observing Miner Slough in isolation. Further analysis is required to more accurately account for the effects that breaching the levees will have on bed scour when the DWSC's hydraulic connectivity is considered. RD501-3 (Cont.)

Also, because the DEIR consider the Miner Slough in isolation, its unreasonably disregards impacts that increased potential for bed scour will have on seepage. Specifically, the DEIR disregards this potentially significant impact because the seepage-prone areas lie "generally upstream of planned breach locations." (DEIR 5-90.) But as more fully set forth in the ENGEO Seepage Impact Analysis, flooding Prospect Island will greatly increase the total head elevation due, in part, to the connectivity between the DWSC and Miner Slough. (ENGEO, *Seepage Impact Analysis Report*, at 15 to 18.) The DEIR's disregard of increased bed scour's impact on seepage, therefore, is arbitrary and unreasonable because it ignores the anticipated increase in total head elevation due to the significant hydraulic connection between the DWSC and Miner Slough.

Second, the DEIR's analysis perpetuates an oversimplification of the lithologic model. This flawed methodology that skews the analysis of the anticipated seepage impacts caused by increased bed scour. As explained in the Seepage Impact Analysis, the 2014 DWR seepage modeling oversimplified the subsurface soils. (ENGEO, *Seepage Impact Analysis Report*, at 8 to 12 (March 17, 2015).) The 2014 DWR modeling incorrectly assumed a layer of impermeable soil cover both Prospect and Ryer Islands. Instead, the actual subsurface conditions lack consistency. (*See id.* at 11 ("there is no consistency to the main subsurface sand layer nor the near surface clay layer…[and]the top of the main sand layer can vary from 25 to 60 feet beneatht he water level").) The DEIR perpetuates this oversimplification by relying on the assumption that the "channel bottom lies primary within the lower permeability Upper Clay HU." (DEIR 5-90.) Thus, the DEIR again concludes that "it is unlikely this scour would significantly increase the area of hydrologic connection between Miner Slough and the Main Sand HU." (*Id.*) This conclusion contradicts the ENGEO Seepage Impact Analysis, yet provides no explanation for the disparity.

In sum, the DEIR does not consider RD 501's concerns with the underlying data and the methodology in the DWR's analyses of scouring and erosion impacts. The DEIR remains at variance with RD 501's analysis; yet, the DEIR is silent on how it considered and addressed this disparity. When an agency receives detailed concerns about incorrect data and flawed methodologies underlying its environmental review, that agency must address those concerns in detail by providing a good faith, reasoned analyses in response. (Cal. Code Regs. tit. 14, § 15088, subd. (c).) To date, the DEIR has categorically ignored RD 501's concerns and ignored vital information to the detriment of providing an adequate assessment of reasonably foreseeable impacts. RD 501, accordingly, requests that DWR issue a new draft environmental impact report that addresses all potential scour-related impacts from the Project.

Wind-Wave Erosion Impacts

RD 501 again disagrees that wind-wave erosion of the interior side levees will not significantly impact. The DEIR continues to underestimate wind speeds and high river stages in the delta during major storm events. RD501-4

As previously raised, inundating Prospect Island will create wetland habitat so that access to the Island's interior by land-based equipment will become impossible. When and how rip-rap or other measures that can mitigate the impact of high waves are dependent upon waterway conditions. Yet, the DEIR again fails to consider mitigation measures addressing wind-wave erosion are affected by these constraining access issues.

Continued and Routine Monitoring

The DEIR removes important groundwater and surface water monitoring during and after Project implementation that "would allow for assessment of conditions following restoration." (DEIR 5-81, 5-91.) It also removes routine monitoring of the Miner Slough levee. (DEIR 4-6.) Given the likelihood of impacts resulting from groundwater seepage, scour, and wind-wave erosion, continued and routine monitoring during and after Project implementation should remain a condition of Project implementation. At the very least, substantial evidence indicates uncertainty as to the extent of these impacts. So, DWR should retain this continued and routine monitoring requirements as a feasible measure to substantially lessen the Project's significant environmental effects. (*See* Cal. Code Regs. tit. 14, § 15126.4(a)(1) (an EIR should describe feasible mitigation measures that could minimize significant adverse impacts).) RD501-5

We thank you again for the opportunity to comment on the DEIR. Based on the significant deficiencies discussed herein, DWR should issue a new draft environmental impact report for the Project, develop more appropriate mitigation measures, and allow further public comment before preparing a Final EIR. We look forward to continuing to work with DWR to ensure that all significant environmental impacts resulting from the Project are adequately addressed.

Should you wish to meet and discuss these issues, please do not hesitate to contact me.

Regards,

Michael J. Van Zandt

cc: RD 501
Central Valley Flood Protection Board

Solano County — Department of Resource Management

(SOLC)

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DEPARTMENT OF RESOURCE MANAGEMENT

SOLANO COUNTY

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April 15, 2019

Department of Water Resources
Fish Restoration Program
Attention: Dan Riordan
P.O. Box 942836
Sacramento, CA 94236-0001
FRPA@water.ca.gov

Dear Mr. Riordan:

Thank you for the opportunity to comment on the Partial Recirculated Draft Environmental Impact Report (RDEIR) for the proposed Prospect Island Tidal Restoration Project (Project). Solano County has offered comments on the Project since 2010, and commented on the Draft EIR on the Project for the Project in 2016. We look forward to responses to those comments as well as the comments offered below.

It is disconcerting to note that additional analyses for the Project were used to reduce the obligation of the State relative to local agencies and landowners affected by the Project, rather than fine-tune the Project itself. We note that in Chapters 4 and 5, mitigation measures listed in the prior Draft Environmental Impact Report for the Project have been removed from the subsequent RDEIR. This includes mitigation pertaining to monitoring of groundwater and surface water levels, monitoring and repair of Prospect and Ryer Island levees along Miner Slough, and monitoring of groundwater levels on Ryer Island following completion of the Project.

SOLC-1

On page 4-5, monitoring and repair of Prospect Island levees "*have been deleted from the DEIR because the analysis has shown that these actions are not considered necessary to support the impact determinations.*" Similarly, and even more troublesome, under Impact 3.1-3, mitigation for potential groundwater seepage impacts from Prospect to adjacent areas has also been removed "*Monitoring of groundwater and surface water levels following Project completion has been removed from the DEIR".* And on page 4-6, monitoring due to wind/wave erosion has also been struck. Finally, under Impact 3.1-5, *"Routine monitoring of the Miner Slough levee along Ryer Island and funding of any necessary repairs related to the Project have been removed from the DEIR because the analysis in Section 5.2 has shown this action it is not considered necessary to support the impact determination. Previously circulated information included in the DEIR and updated information in the Partial Recirculated DEIR supports the assessment that*

SOLC-2
(Cont. below)

Impact 3.1-4 will be less than significant without need for mitigation." A similar disclaimer is written on Page 4-7 regarding a potential increase of seepage impacts from the Project to neighboring Ryer Island. Where DWR may not anticipate significant impacts associated with actions in development of the Project, we question mitigation measure removal given dredging, hydraulic head and other largely untested Project elements that may ultimately have impacts given described changes to the land and hydrology. Without monitoring, it will be difficult if not impossible to assess potential impacts of the Project over time and to effect meaningful repair. Even without the 'good neighbor' aspect of these protections, monitoring would be important and consistent with any number of other state plans and programs. SOLC-2 (Cont.)

On page 4-7, and later in the document, salinity increases are noted. Any salinity increase is problematic and the piecemealing aspect of the EcoRestore projects would require a more comprehensive, or cumulative look at water quality impacts of this Project with the number of other habitat restoration projects in various stages of planning, development and construction. See our water quality comments below in Attachment A. SOLC-3

The additional hydrodynamic analysis for 100 and 200-year flood scenarios referenced on pages 4-11, and 5-83 to 5-86 should take into account more prolonged flood high-water event scenarios that will occur with climate change. The hydrodynamic effects of prolonged high water flow to areas affected by altered flow from breached levees under these circumstances should not be discounted, but rather mitigation proposed, that could be used if necessary. There are many examples of unintended hydraulic effects from engineered changes to the landscape, rendering this sort of mitigation not only appropriate, but necessary. On page 5-49, the "experimental" aspect of breach velocity dissipation features are noted. SOLC-4

On page 4-9, the RDEIR details a new option that allows for thousands of additional truck trips hauling very heavy loads, including rock, aggregate and sediment, rather than the use of barges in the prior draft. This constitutes a significant impact and is somewhat mind-boggling, given the remote location, rural 2-lane and levee roads, not to mention existing accessibility by water. The access route information as stated is incomplete; on page 5-170, for example, Highway 680 must either connect to Hwy 80 and Hwy 12 to Hwy 84; or to Hwy 4, Hwy 160 and Hwy 12 before accessing Hwy 84 from the Bay Area through Rio Vista. It is difficult to see how <u>all</u> vehicle access to the site would occur from Sacramento via Hwy 84; some broadening of this discussion, as well as identification of impacts from increased truck traffic with heavy loads on rural roads, including State routes and/or roads not identified as haul routes should be included in mitigation measure 3.17-1.2. Impacts to agricultural operations in the region from increased use of these roads should also be detailed and mitigated. At a minimum, discussion of importation of rock and fill and other materials by truck should be struck from the document in favor of barge access as previously indicated in the prior draft document. As indicated on page 5-176, some roads in Solano County are not structurally SOLC-5 (Cont. below)

sufficient for this weight, size or amount of truck traffic. We disagree with the notion on page 5-175 that loading on many of these roads lies within tolerable limits. If hauling on local roads is necessary, then mitigation would include repair and/or replacement of all road damage from the Project. These additional impacts to the County's local roads, as well as the larger region should be addressed and mitigated. SOLC-5 (Cont.)

On page 5-52, mention is made of revegetation of bare soil areas. The County would strongly encourage a high level of ongoing and active management which includes active, dense planting, with aggressive monitoring and management, which does not include passive revegetation. The potential for non-native species of all kinds is high, as are nuisance complaints from neighbors when there is no one actively on the lands. This creates problems and additional costs for the County relative to nuisance abatement and safety, among many other things. SOLC-6

Somewhere in the RDEIR is mention of approximately 17.7 acres of land that will be taken out of agricultural land use. Is that in addition to other lands referenced in the DEIR? The document references the Solano County General Plan in several sections of the RDEIR; will there be any sort of agricultural mitigation for removal of these lands? SOLC-7

The Project and the other identified restoration projects will have cumulative effects on water quality, flood protection, agriculture and transportation, among many other items. We do not see a cumulative analysis, nor an updated version of the reasonable foreseeable projects in the region. These projects in aggregate will have effects which should have been taken into account in modeling scenarios. SOLC-8

Solano County has been corresponding with DWR for many years relative to this Project and others in the region, expressing the desire to work closely and collaboratively on projects, to little avail. We still believe that is the best approach, one evidenced recently with the collaborative model used with development of the Little Egbert Tract Feasibility Study. It would set an important precedent for neighboring impacted regions, and should it be managed well, as an example of how ecosystem projects and active agriculture can co-exist in the region. We find this may be difficult if mitigations proposed for the Project are withdrawn, and encourage DWR to reexamine this reductive approach. SOLC-9

Sincerely,

Bill Emlen

Bill Emlen,
Director
Department of Resource Management

Start of attachments to SOLC

APPENDIX A

Water Quality Comments on Prospect Island RDEIR
April 15, 2019

Under CEQA and the State's antidegradation policies (CVRWQCB 2011; Page IV-8.00), water quality of waterbodies with above-average existing conditions should not be diminished even if resulting quality would still satisfy minimum standards. This means that a Bay-Delta project should disclose and fully mitigate its adverse water quality impacts even if the quality is better than current SWRCB municipal and industrial and agricultural standards. For example, the water available to Solano County residents at Barker Slough is typically of lower salinity that the SWRCB's daily-average 250 mg/L chloride concentration standard, but the people of Solano County and local residents have historically had access to that low salinity water and have the right to have that existing high quality preserved.

On page 5-114, the project proponents have edited the section on antidegradation policy to now state that SWRCB Resolution 68-16 now requires "*existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State*."

Subsequently, on page 5-131, the project proponents attempt to dismiss the significant adverse water quality impacts of the project as "*small*" and that these small water quality increases "*are consistent with maximizing the beneficial use of water for the State based upon the additional benefits to fish and wildlife from the Proposed Project.*" This is not acceptable. Beneficial use of water for the State would be maximized if the State Water Project and Federal Central Valley Project were to operate to the enhanced Delta inflow and outflow standards recommended by the SWRCB in its 2010 Delta Flow Criteria report and Part 2 of the SWRCB's current Bay-Delta Water Quality Control Plan update. Higher Delta outflows, especially in the fall, would serve to restore and sustain the Delta ecosystem for fish and wildlife while restoring water quality (lower salinities) in the Delta and offsetting the significant adverse water quality impacts of the Prospect Island project.

The RDEIR is inadequate under CEQA because it fails to fully disclose, acknowledge and fully mitigate the significant adverse impacts of the proposed Prospect Island project on the water quality for legal users of water and fish and wildlife in the Sacramento-San Joaquin Delta.

The RDEIR must acknowledge the widely accepted water quality significance criteria of 5 mg/l chloride or 5% increase, whichever is greater. In the case of specific conductance (EC) the corresponding criterion is 20 µS/cm. These significance criteria were developed

as significance screening criteria by CCWD for the September 1993 Los Vaqueros Project Final EIR/EIS (SCH #91063072, Volume 1, page 5-9)[1]. These significance criteria were also used by EBMUD for the July 2003 Freeport Regional Water Project EIR/EIS (see Draft EIR/EIS Modeling Technical Appendix, page 4-228)[2]

The RDEIR acknowledges that the project will increase salinities in the Delta by more than 5%, e.g., on page 5-128, the RDEIR states that the maximum salinity increases under the Proposed Project by up to 7.8% during a dry-year hydrology (fall of 2009). This is in excess of the significance criterion of 5%.

Table 38 on page 82 of Appendix D: Additional Modeling Results to Support Environmental Analysis shows the computed change from Base condition monthly averaged EC (uS/cm and %) for Alternatives 26, 3 and 23, for C4 – San Joaquin River at San Andreas. Table 38 is reproduced below. Other Prospect Island alternatives increase salinities at San Andreas Landing by up to 10.4%.

[1] http://www.calwater.ca.gov/Admin_Record/C-033044.pdf
[2] http://www.freeportproject.org/nodes/project/draft_eir_eis_v3/section04-4-7.pdf

		Alt 26	Alt 3	Alt 23		Alt 26	Alt 3	Alt 23
Feb 2009	**384**	**5**	**4**	**6**		**1.3**	**1.0**	**1.5**
Mar 2009	**196**	**0.4**	**-0.3**	**0.3**		**0.2**	**-0.1**	**0.2**
Apr 2009	**195**	**0.4**	**0.1**	**0.4**		**0.2**	**0.1**	**0.2**
May 2009	**162**	**0.3**	**0.0**	**0.3**		**0.2**	**0.0**	**0.2**
Jun 2009	**170**	**1**	**1**	**1**		**0.7**	**0.7**	**0.8**
Jul 2009	**272**	**-0.8**	**-3**	**-0.6**		**-0.3**	**-1.1**	**-0.2**
Aug 2009	**472**	**6**	**3**	**8**		**1.3**	**0.5**	**1.7**
Sep 2009	**518**	**22**	**22**	**29**		**4.3**	**4.2**	**5.6**
Oct 2009	**377**	**30**	**33**	**39**		**7.8**	**8.8**	**10.4**
Nov 2009	**343**	**21**	**25**	**29**		**6.0**	**7.2**	**8.4**
Dec 2009	**439**	**14**	**16**	**19**		**3.2**	**3.6**	**4.4**
Jan 2010	**378**	**3**	**1**	**4**		**0.8**	**0.4**	**0.9**
Feb 2010	**218**	**0.3**	**-0.3**	**0.2**		**0.1**	**-0.1**	**0.1**
Mar 2010	**216**	**0.2**	**-0.2**	**0.1**		**0.1**	**-0.1**	**0.0**
Apr 2010	**224**	**0.2**	**-0.2**	**0.1**		**0.1**	**-0.1**	**0.1**
May 2010	**175**	**0.0**	**-0.2**	**0.0**		**0.0**	**-0.1**	**0.0**
Jun 2010	**137**	**0.1**	**0.0**	**0.1**		**0.1**	**0.0**	**0.0**
Jul 2010	**161**	**0.2**	**-0.4**	**0.3**		**0.1**	**-0.3**	**0.2**
Aug 2010	**295**	**-1**	**-3**	**-0.6**		**-0.4**	**-1.1**	**-0.2**
Sep 2010	**402**	**1**	**-2**	**2**		**0.3**	**-0.4**	**0.6**
Oct 2010	**302**	**8**	**8**	**11**		**2.6**	**2.5**	**3.6**
Nov 2010	**322**	**9**	**10**	**13**		**2.9**	**3.0**	**4.1**

The RDEIR is also inadequate because it only analyzes a dry water year type (2009) and below normal water year type (2010). The RDEIR modeling shows that water quality impacts are larger in dry years than below normal years. In critically dry years such as 2008, 2014 and 2015, the adverse water quality impacts of the proposed project will be even worse.

The RDEIR should be revised to also include analysis of the Prospect Island project during critically dry water year types when project impacts will tend to be largest. The significant adverse salinity impacts under those conditions must be fully disclosed and fully mitigated, and a new revised draft released for public review and comment.

The RDEIR fails to take into account the cumulative water quality impacts of the proposed project in conjunction with other proposed EcoRestore habitat restoration projects and the current version of DWR's WaterFix Delta conveyance project. Even if each of these projects only increased Delta salinities by the 5% criterion, the combined increase in salinity would be far greater than 5%. Piecemealing into small sub-projects for the purposes of dispersing the adverse water quality impacts is not permitted under

California Environmental Quality Act (CEQA). The RDEIR is inadequate under the CEQA because it piecemeals the actual EcoRestore and WaterFix project. (*See* 14 C.C.R. § 15378(a) (defining "project" for CEQA purposes as "the whole of the action"); *see generally Laurel Heights Improvement Assn. v. Regents of the University of California* (1988) 47 Cal.3d 376.)

The modeling for DWR's original Bay Delta Conservation Plan (BDCP) which included both new conveyance and multiple ecosystem habitat restoration projects disclosed severe adverse water quality impacts throughout the Delta. DWR at the time declared these impacts as significant and unavoidable. As discussed above, those impacts were avoidable through increased Delta outflows (to reduce seawater intrusion into the Delta and improve the Delta ecosystem) and modifications to both the habitat restoration projects and the conveyance-only tunnels project. For example, by adding new south-of-the-Delta export-area storage, more water could be captured and exported during wet months (Big Gulp) and allow less water to be exported during dry months (Little Sip) allowing for higher Delta outflows in those dry months, typically in the fall.

The RDEIR is inadequate because it fails to disclose how the chloride concentrations were calculated from the modeled EC values. On page 5-94, the RDEIR discusses the basis for the conversions between TDS and EC but not the relationship between EC and chloride. On page 5-128, the RDEIR states that "Compliance for stations with municipal and industrial beneficial use designations… … was determined by computing the mean daily value of chloride concentration from the modeled EC values..." However, no citation is given for the conversion between EC and chloride. Relationships between salinity, EC and chloride were presented in a January 1997 CCWD memorandum, titled "Conversions between EC, TDS, Chloride, Bromide and Sodium." (see SWRCB WaterFix hearing Exhibit DWR-509)[3]

Bottom Line: The RDEIR fails to disclose and fully mitigate the significant adverse impacts of the proposed Prospect Island project on salinity in the Delta under the full range of hydrologic conditions (especially critically-dry years). DWR's claim that the significant adverse water quality impacts of the BDCP were "*unavoidable*" was incorrect. It is similarly unacceptable to claim that the adverse water quality impacts of the Prospect Island project are allowable because this project somehow maximizes the beneficial use of water for the State based upon the additional benefits to fish and wildlife from the project. " (page 5-114) A holistic joint storage-conveyance project that incorporates a portfolio of ecosystem restoration, water conservation, levee strengthening, local water supply reliability and groundwater overdraft correcting actions would truly maximize the beneficial use of water for California and should be developed. The RDEIR must be

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3 https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/petitioners_exhibit/dwr/dwr_509.pdf

revised to address all of these issues and a new draft released for detailed public review and comments.

End of attachments to SOLC

Solano County Water Agency

(SCWA)

SCWA

SOLANO COUNTY WATER AGENCY

April 15, 2019

Mr. Dan Riordan
Department of Water Resources
Fish Restoration Program
3500 Industrial Blvd, 2nd Floor
West Sacramento, CA 95691

via e-mail and U.S. Mail

Subject: Comments on Partial Recirculation of Draft Prospect Island Tidal Habitat Restoration Project EIR dated February 2019

Dear Mr. Riordan:

The Solano County Water Agency (SCWA) provides water from the Federal Solano Project and the North Bay Aqueduct (NBA) of the State Water Project to cities, special districts and State agencies in Solano County. The agency boundaries include all of Solano County, portions of which are within the legal Delta. The NBA, which provides much of the municipal drinking water in Solano County, is owned and operated by the Department of Water Resources. The NBA's intake draws water directly from Barker Slough, located within the Cache Slough Complex (CSC) and approximately eight miles away from the proposed Prospect Island Tidal Habitat Restoration Project.

SCWA-1

We remain concerned that the Partial Recirculation of Draft Environmental Impact Report: Prospect Island Tidal Habitat Restoration Project, dated February, 2019 (Recirculated Prospect Island DEIR); like the preceding Draft Prospect Island Tidal Habitat Restoration Project Draft Environmental Impact Report, dated August 2016 (2016 Prospect Island DEIR) understates the potential cumulative water quality and endangered species impacts to the NBA and agricultural water diversions at SCWA's nearby Petersen Ranch, at least in part, by failing to fully evaluate the impact of the Prospect Island Tidal Restoration Project in context with existing and proposed restoration projects in and near the CSC – most notably, the Lookout Slough Restoration Project and proposed restoration activities on the Little Egbert Tract.

SCWA-2
(Cont. below)

More specifically, it remains unclear how the Prospect Island Tidal Restoration Project, in concert with existing and planned restoration projects, impact the hydrodynamics and tidal energy within the CSC. Both hydrodynamics and tidal energy are known to influence and to a certain degree dictate water quality conditions and biological productivity. In the absence of a regional hydrodynamic evaluation of existing and proposed habitat restoration projects, as opposed to the current "piece meal" approach to evaluating habitat restoration in the CSC, in remains unclear how and to what degree the Prospect Island Tidal Restoration project will, when combined with hydrodynamic impacts of the proposed Lookout Slough Restoration Project and others, ultimately impact operations at the NBA and perhaps more broadly,

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SOLANO WATER
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impact the feasibility and effectiveness of existing and proposed restoration projects in the CSC through incremental changes in hydrodynamics and tidal energy.

Not addressed, but also of concern to SCWA and many privately owned agricultural water diversions in the CSC, particularly those that rely in part on tidal energy to move water, is how the Prospect Island Tidal Restoration project may or may not incrementally reduce the amplitude of daily tidal fluctuations or otherwise alter tidal energy currently relied on to divert agricultural water at existing water diversion facilities in the CSC.

SCWA-2 (Cont.)

Additional, page specific comments are as follows:

Page 5-60: *Barker Slough is a dead-end tidal slough except during winter rain events when water that is normally impounded in Campbell Lake is released to Barker Creek and discharges to Barker Slough at the Barker Slough Pumping Plant Forebay."* Campbell Lake is relatively small and in actuality, captures and retains only a relatively small portion of the total annual runoff from the Barker Creek watershed. Accordingly, Campbell Lake typically has a significant impact on water quality conditions at the Barker Slough Pumping Plant during and shortly after the "first flush". However, as demonstrated by water quality monitoring results obtained by SCWA and others, following the first flush and for the balance of the rainy season, water quality conditions at the Barker Slough Pumping Plant are influenced to a greater degree by conditions in the Barker Creek watershed, upstream of Campbell Lake.

SCWA-3

Page 5-61: *"Both the Barker Slough Pumping Plant and the NBA are managed by the Solano County Water Agency"*. The Barker Slough Pumping Plant and the NBA are part of the State Water Project and are owned and operated by the Department of Water Resources. The Solano County Water holds a contract for water deliveries, but does not own or operate the aforementioned facilities

SCWA-4

Page 5-112: *"The NBA supplies water to Napa, Vallejo, and Benicia"*. The NBA also supplies water to the cities of Fairfield and Vallejo in Solano County, and American Canyon and Calistoga in Napa County. Collectively, the NBA provides drinking water to approximately 500,000 residents in Solano and Napa counties

SCWA-5

In closing, we appreciate the opportunity to comment on the Partial Recirculation of Draft Environmental Impact Report: Prospect Island Tidal Habitat Restoration Project. Please do not hesitate to contact me at 707-455-1103 or rsanford@scwa2.com if you have any questions.

Sincerely,

Roland A. Sanford
General Manager

Yocah Dehe Wintum Nation

(YDWN)

YDWN

YOCHA DEHE
CULTURAL RESOURCES

March 8, 2019

Department of Water Resources
Attn: Dan Riordan, Fish Restoration Program
3500 Industrial Boulevard
West Sacramento, CA 95691

RE: Prospect Island

Dear Mr. Riordan:

Thank you for your project notification dated, February 25, 2019, regarding cultural information on or near the proposed Prospect Island Project, Solano County. We appreciate your effort to contact us and wish to respond.

The Cultural Resources Department has reviewed the project and concluded that it is within the aboriginal territories of the Yocha Dehe Wintun Nation. Therefore, we have a cultural interest and authority in the proposed project area.

Based on the information provided, the Tribe has concerns that the project could impact unknown cultural resources. Additionally, Yocha Dehe Wintun Nation requests a site visit to the project area to evaluate our cultural concerns.

YDWN-1

Please contact the following individual to coordinate a date and time for the site visit.

Kristin Jensen, CRD Administrative Assistant
Yocha Dehe Wintun Nation
Office: (530) 796-0105
Email: kjensen@yochadehe-nsn.gov

Please refer to identification number YD – 08252016-01 in any correspondence concerning this project.

Thank you for providing us with this notice and the opportunity to comment.

Sincerely,

Burnam Lowell

Burnam Lowell, Sr.
Tribal Historic Preservation Officer

Attachment 3

September 14, 2017 Letter from DWR to LAND

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

September 14, 2017

Osha R. Meserve
Soluri Meserve
510 8th Street
Sacramento, CA 95814

Dear Ms. Meserve:

This letter follows receipt and review of LAND/RD 501's response of August 16, 2017 to DWR's Settlement Discussion Document.

In an effort to be good neighbors, DWR has gone above and beyond what is legally necessary to identify and alleviate impacts, including the following:

- Completed a multi-year groundwater and surface water study on Prospect and Ryer Islands, at the request of RD 501
- Analyzed new hydrologic data collected since the completion of the above study, at the request of LAND and RD 501
- Agreed to monitor existing wells on Prospect and Ryer Island post-restoration project, at the request of RD 501
- Hosted a half-day technical workshop to share technical information and gather input from RD 501 on groundwater and surface water conditions
- Met with LAND and RD501 on several occasions to discuss concerns about the restoration project
- Agreed to include many additional mitigation measures in the final EIR to help alleviate concerns about potential impacts
- Conducted additional modelling of velocities in the Miner Slough channel
- Analyzed wind direction, intensity, and wind-wave erosion data

These additional analyses support DWR's previous conclusions regarding impacts as identified in the Prospect Island draft EIR, and have not provided any evidence that potential impacts not identified in the EIR will occur. Irrespective of these additional analyses, efforts, and resulting data (which has been shared), it is apparent that LAND/RD 501's position on the significant issues remains unchanged, and is unlikely to change. Therefore, DWR does not see any constructive pathway to move forward with the current negotiations, and sees no reason to continue them. DWR appreciates the interest of all parties in coming to the table to attempt to reach a resolution.

LAND/RD501's position is that DWR should "pre-mitigate" speculative impacts that our analysis shows are unlikely to occur. Pre-mitigation for speculative impacts that are not supported by scientific evidence is not fiscally responsible, and not required by CEQA. However, in the unlikely event that impacts to Ryer Island occur and are

attributable to the Prospect Island restoration project, DWR is committed to mitigate the impacts at that time.

DWR stands by its prior commitments to LAND/RD 501 as provided in our “Prospect Island Restoration and Settlement Discussions” document of July 7, 2017. DWR will include these commitments in the final EIR for the Project. In addition, DWR will continue analyzing the hydrologic data from October 2013 to April 2017, will share the results with LAND/RD 501 when they are available, and will include these new results in the final EIR.

Sincerely,

Catherine Cavanaugh

Attachment 4

DWR (2018) Review of 2015 ENGEO Seepage Impact Analysis Report

State of California

California Natural Resources Agency

Memorandum

Date: February 15, 2018

To: Dennis McEwan, Chief
Environmental Program Manager I
Division of Environmental Services
Department of Water Resources

C. L. Bonds 2/15/18

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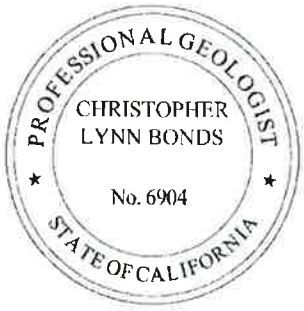

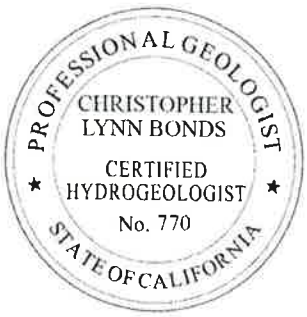

Subject: Review of ENGEO's SEEPAGE IMPACT ANALYSIS, RECLAMATION DISTRICT 501, PROSPECT AND RYER ISLANDS, SOLANO COUNTY, CALIFORNIA, JULY 14, 2015, ENGEO Incorporated.

INTRODUCTION

On September 10, 2015, a report titled *SEEPAGE IMPACT ANALYSIS, RECLAMATION DISTRICT 501, PROSPECT AND RYER ISLANDS, SOLANO COUNTY, CALIFORNIA (JULY 14, 2015)* (ENGEO Report) was submitted by ENGEO Incorporated, on behalf of Reclamation District 501, to the California Department of Water Resources (DWR) for review and consideration. This memorandum formally documents DWRs technical staff review of the ENGEO Report.

GENERAL COMMENTS

Due to concerns about reported seepage impacts to Ryer Island resulting from flooding on Prospect Island, DWR undertook a comprehensive, multi-year, multidisciplinary study of the geology and groundwater conditions in the Project Area starting in 2010. DWRs extensive efforts culminated in the publishing of two reports in 2013 and 2014 that supported the data collection and analysis of possible seepage impacts that may result from the Project.

Because of the importance of the Project to California's habitat restoration planning efforts now and in the future, DWR management and technical staff developed a rigorous scope of work for data collection and analysis. This work, as documented in DWR's 2014 report, provides a much higher level of technical analysis than previous, similarly sized projects in the delta.

Lastly, there is no perfect study and some uncertainty will always exist in the results of any study. However, the California Environmental Quality Act (CEQA) standard does

not require a perfect study, but a good and reasonable study. DWRs comprehensive study and 2014 report meet the CEQA standard.

SPECIFIC COMMENTS

Page 2, Section 2.4 – HISTORY, paragraph 1 excerpt:

The ground surfaces of both Prospect and Ryer Islands rest below sea level and below the neighboring surface water bodies; and therefore, are susceptible to flooding.

DWR Response:

Although there are locations on Prospect Island where the ground surface elevation is below sea level (about -3 feet MSL-NAVD88 at its lowest point), the average ground surface elevation on Prospect Island is about +2 feet MSL-NAVD88. On the portion of Ryer Island that is adjacent to Prospect Island, the lowest ground surface elevation is well below sea level (about -10 feet MSL-NAVD88) and the average ground surface elevation is about -3 feet MSL-NAVD88.

Therefore, land elevation survey data show that the average ground surface elevation of Prospect Island is about 5 feet higher than the average ground surface elevation of the portion of Ryer Island adjacent to Prospect Island.

Page 3, Section 2.5 - GEOLOGY, paragraph 3 excerpt:

Subsurface explorations in Qpm and Qb deposits along Miner Slough have typically encountered 15 to 20 feet of lean to fat clay and silt overlying silty sand. Levee fills appear to consist of interlayered silty sand, silt, and clays. The subsurface explorations completed to date have not focused on areas where former distributary channels (associated with sandier Ql deposits) extended from Miner slough onto Ryer Island.

DWR Response:

The Ql deposits along Miner Slough between Prospect and Ryer Islands have been explored using borings and cone penetration tests (CPTs) nine times by three independent parties (GEI, ENGEO, and DWR) between 1999 and 2012.

Former distributary channels (or paleo channels), that may be present in the upper, fine-grained soils (identified as the Upper Clay Hydrogeologic Unit (HU) in the DWR 2014 Report), are likely connected to Miner Slough since this feature is incised into and through this HU, throughout the Project area. Because of this connectivity to Miner Slough, seepage flow through these possible paleo channels will occur whether the Project is implemented or not. Therefore, this is an existing condition that is unrelated to the Project.

Page 4-5, Section 3.3 1999 GEI CONSULTANTS STUDY, paragraph 2 excerpt:

GEI concluded that the report produced by Todd Engineers contained insufficient information to conclude that the flooding of Prospect Island would have no effect on the groundwater levels beneath Ryer Island. They specifically site, among the many items requiring further investigation, the lack of: (1) aerial photo review and interpretation, (2) widely spaced drilling and sampling locations, and (3) installation and monitoring of piezometers on both Prospect and Ryer Islands.

DWR Response:

DWRs comprehensive study and 2014 report filled these data gaps.

Page 5, Section 3.4 - 2013-2014 DWR STUDY, paragraph 3 excerpt:

It should be noted that no laboratory testing was performed on soil samples recovered from the exploratory trenches to confirm the soil type descriptions recorded on the logs. Without supporting laboratory data, it is not possible to confirm the validity of the soil types described on the logs.

DWR Response:

Trench soils were described by USACE using established ASTM D2488 methods and numerous comparisons of Upper Clay HU soils were made between CPT soil behavior types and soil samples collected and described by GEI and DWR. These comparisons showed good correlations and are consistent with published research and analysis by CPT expert Dr. Peter Robertson of Gregg Drilling and Testing, Inc.

Page 6, Section 3.5 – DELTA WETLANDS PROJECT, paragraph 1 excerpt:

The Delta Wetlands project, located within the same delta system and with similar fluvial geomorphology as Prospect and Ryer Islands, involves creating two wetlands and wildlife habitats and creating two reservoir islands from existing island farmland. It has many of the same characteristics as the PI Project. Both are attempting to restore the local island habitat to pre-farming era conditions by flooding existing island farmland adjacent to other island farmland.

DWR Response:

It is true that the proposed Delta Wetlands Project (DWP) and the Prospect Island Project are in the same delta system with similar geomorphology; however, there are other significant, project- and site-specific differences between these two projects, that must be considered before any comparisons are made.

Significant differences are summarized below:

1) Project Type:

The DWP was a water storage and habitat restoration project in the Central Delta first proposed in 1987 and abandoned on July 18, 2016 by the island owners (Delta Wetlands Properties). The proposed DWP consisted of four islands; two were designated as reservoir islands (Bacon Island and Webb Tract) and two were designated as habitat islands (Bouldin Island and Holland Tract).

Prospect Island is a proposed tidal habitat restoration project.

2) Project Locations and Elevations:

Prospect Island is located about 13 miles N-NW of DWP's Webb Tract.
Prospect Island is in the North Delta portion of Solano County and DWP's Webb Tract is in the Central Delta portion of Contra Costa County.

The mean ground surface elevations of Prospect Island and DWP's Webb Tract (not including levees) are significantly different: Prospect Island = +2.4 feet MSL (NAVD88) and Webb Tract = -14.4 feet MSL (NAVD88), so on average, Prospect Island's ground surface is about 17 feet higher in elevation than DWP's Webb Tract.

3) Subsurface Geology and Hydrogeology are different:

Prospect Island HUs and representative hydraulic conductivity (K) values are:

Levee	10^{-5} centimeters per second (cm/s)
Upper Clay	10^{-6} cm/s
Main Sand	10^{-3} cm/s
Lower Clay	10^{-6} cm/s

Little to no peat has been observed in subsurface explorations within the Project area.

DWP's Webb Tract typical geology and representative K values (URS 2000) are:

Fill Materials Mixed (Levee)	10^{-5} cm/s
Peat	10^{-4} cm/s
Sand	10^{-3} cm/s
Clay	10^{-6} cm/s

Significant peat has been reported in the DWP area.

The significant upper clay unit that occurs in the Prospect Island Project area is not present in the DWP area.

4) Projects are Operationally Different:

Prospect Island is significantly different from the proposed DWP (Webb Tract) in that it is not planned as a reservoir island, but as a tidal habitat restoration area, therefore,

water levels on Prospect Island would be similar to water levels in the nearby surface water bodies, namely Miner Slough and the DWSC.

In the proposed DWP, the reservoir islands would have been filled up to a much higher stage than the nearby sloughs and islands thereby creating a significantly different hydraulic condition than what would occur due to the Prospect Island Project.

Lastly, a more appropriate comparison between the proposed DWP and the proposed Prospect Island Project would be with respect to the habitat islands; namely, DWPs Bouldin Island and Holland Tract. However, the seepage concerns of the proposed DWP were not related to the habitat islands, but with the reservoir islands.

Page 7, Section 4.1 – 1967 DWR STUDY, paragraph 1 excerpt:

The value of the study is mostly in the seepage area plates of the 1963 and 1965 high water event, which show that during the 1963 event, when Prospect Island flooded, there was a larger area of seepage than during 1965 event, when Prospect Island did not flood (Figure 1).

DWR Response:

The two high-water events can provide information about the extent of potential seepage onto Ryer Island. However, due to significant differences in the timing of these events and the collection of aerial photography, they should not be used to determine specific seepage impacts on Ryer Island from flooding on Prospect Island.

The 1963 flood event occurred on January 31 and February 1 and peak discharge in the Yolo bypass upstream from the Sacramento weir was 163,000 cfs on February 2 (USGS 1963). The 1964-65 flood occurred over an extended period and peak discharge at the Sacramento River at Delta gage was observed around December 22 (USGS 1971). It was reported that Prospect Island flooded during the 1963 flood event, but did not flood during the 1964-65 event.

Seepage Areas shown on Plate 11 (DWR 1967) were developed based on aerial photos taken on April 24, 1963 and February 10, 1965, in conjunction with field observations. The time between peak discharge in the Yolo Bypass on February 2, 1963 and the aerial photo on April 24, 1963 was 81 days. The time between peak discharge at Sacramento River @ Delta on December 22, 1964 and the aerial photo on February 10, 1965 was 48 days.

Therefore, due to the significant temporal difference between the flood events and aerial photography dates (33 days), a direct spatial comparison of the extent of seepage on Ryer Island, resulting from the 1963 and 1964-65 flood events, is not appropriate. Additionally, as ENGEO noted, the source of water is unclear based on the reported data.

For these reasons, DWR chose to use this information, in a more general sense to illustrate that during these two high-water events, seepage water encroached onto Ryer Island for at least 1,000 feet.

Page 7, Section 4.2 – 1998 TODD ENGINEER STUDY, paragraph 1 excerpt:

Though the conclusion states that they do not expect that the flooding of Prospect Island will affect the water levels beneath Ryer Island, they clearly state additional borings and groundwater wells will be helpful in developing a more detailed understanding of seepage and groundwater conditions beneath the site.

DWR Response:

DWR filled these data gaps by performing additional surface and subsurface exploration and installing more monitoring wells as documented in the 2013 and 2014 reports.

Page 8, Section 4.4 – 2013-2014 SEEPAGE STUDIES RESPONSE, paragraph 1-2:

The 2013 and 2014 reports for the PI Project contain the most thorough seepage analysis prepared to date for the area. There is substantially more data collected than the 1998 Todd Engineer report and the creation of both a lithologic model and seepage models provides a better understanding of the potential hydrogeologic activity between Prospect and Ryer Islands.

We welcome all of the additional data that DWR has collected, but our analysis of the data collected provides for a different conclusion than DWR. We believe their seepage model incorporated highly idealized soil stratigraphy that reflects neither the actual subsurface conditions under Prospect and Ryer Islands nor even their own lithologic model. DWR fails to address the uncertainty associated with the highly idealized subsurface data modeled within their seepage analyses. Our concerns about the applicability of the seepage model are as follows:

1. A lack of representative deeper subsurface soil data from explorations penetrating the upper soil layers on Prospect Island.

2. The seepage model and the lithologic model are substantially different along the seepage cross sections evaluated.

3. The absence of any model calibration results to observed historical conditions.

DWR Response:

1. All available data supports our interpretation of the nature and extent of the Upper Clay HU on Prospect Island. The comprehensive subsurface data set compiled to date allows for reasonable interpretations of the subsurface conditions in the Project area.

2. ENGEO states that DWRs models are "substantially different", but does not elaborate on what those substantial differences are; therefore, DWR reiterates that all the available data supports our interpretation and development of the geologic and seepage models.

3. DWR evaluated seepage along three distinct island transects (north, middle, and south) covering variable subsurface hydrogeologic conditions, two different Miner Slough stage conditions (high and average), and three different scenarios (past, existing, and restored). This resulted in a total of 18 separate modeling runs covering variations of the above subsurface hydrogeology and hydrologic conditions under different past, present, and future scenarios.

   Model inputs that can be measured, including Miner Slough, Prospect Island, Deep Water Ship Channel (DWSC), and Ryer Island drainage ditch stage were based on observed historical conditions obtained during the study.

   Regardless of varying the above measurable model inputs, including changing Prospect Island stage from 0 feet of water [dry conditions] to 10 feet of water [flooded conditions], the total head and flow along all three island transects as measured through the Ryer Island levee did not show significant variations thus indicating that flooding Prospect Island has no significant hydrologic effects on Ryer Island.

   DWR reiterates that there is no perfect study and some uncertainty will always exist in the results of any study. However, the CEQA standard is not a perfect study, but a good and reasonable study. DWRs comprehensive study and 2014 report meet the CEQA standard.

Page 8, 4.4.1 Lack of Representative Subsurface Soil Data, paragraph 3 excerpt:

In order to create an accurate lithologic model, it is important to take data from a representative sample of the area being modeled. This requires studying the historic records, site visits, and selecting sample locations that will cover the variety of lithologic formations in the area and that the spacing be close enough to be able to capture changes in the lithology of the site. We believe that the data which DWR used in their report is not representative of the area; as the sample locations are spaced too far apart and from deposition areas too similar to provide a meaningful model.

DWR Response:

Between 1999 and 2012, all the geomorphic and geologic units mapped within the Project area have been investigated at 69 locations by USACE, GEI, Kleinfelder, ENGEO, and DWR using multiple, complementary exploration methods, including 25 trenches, 26 borings, and 18 CPTs. As scientists, we always prefer additional data to support our investigations, but it is not possible, nor required, to collect a perfect data set for most projects, including CEQA compliance. Therefore, DWR reiterates that the 69 explorations conducted to date by five independent parties are representative of the surface and subsurface conditions within the Project area and meet the CEQA standard.

The ENGEO Report figures 25-27 attempt to show the geomorphic and geologic units mapped within the study area in relation to the extensive exploration data collected to date. However, these figures are misleading as they do not include all the available data and mislabel other known data including:

On Ryer Island:

- None of the 11 GEI 1999 exploratory borings are included,
- ENGEOs 2012 boring 1-P-1 is mislabeled as boring 1-P-2,
- ENGEOs 2012 boring 1-P-2 is not shown, and
- DWR's 2012 CPT RI-3 is missing

On Prospect Island:

- DWR's 2011 CPT PI-3 is missing on all three figures and
- DWR's 2011 CPT PI-4 is misidentified as a Ryer Island CPT location on figures 25 and 26 and is mislabeled as CPT RIS-1 on figure 27

For a complete map of the subsurface explorations conducted within the Project area between 1999 and 2012, refer to figure 3 in the ENGEO Report; please note that figure 3 is a republished version of figure 8-2 in DWRs 2014 report.

Page 9, Section 4.4.1.1 - Historic and Concealed Distributary Channels, paragraph 1 excerpt:

As previously described, published geologic mapping of Prospect Island indicates that the near-surface soils are heterogeneous in nature and include soils that have both relatively low hydraulic conductivities (former tidal wetlands and flood basin deposits) and relatively high hydraulic conductivities (levee deposits and former distributary channels). As depicted on the map of former distributary channels (Figure 26) and the former channels on Ryer Island connected to Miner slough under the existing levee location. These areas are likely to be potential seepage paths that extend well into the fine-grained deposits on Ryer Island.

DWR Response:

The potential seepage paths from Miner Slough to Ryer Island delineate an existing condition that is not affected by the Project. Furthermore, ENGEO has not described how these historic channels on Ryer Island are related to the subsurface and hydrologic conditions on Prospect Island. The Project will not affect Ryer Island seepage that may occur through these former distributary channels, if present.

Page 9, Section 4.4.1.1 - Historic and Concealed Distributary Channels, paragraph 2 excerpt:

During the deposition of the basinal deposits in the late Holocene, the distributary channel network is likely to have shifted across the area frequently as sea level rose. Given the recent depositional history of the area, it is likely that additional relatively permeable distributary channels are concealed within the fine-grained basinal

deposits on Prospect and Ryer Islands in the near subsurface. The conclusions presented in the 2013-2014 DWR reports are significantly dependent on the modeling of a relatively thick and homogeneous fine-grained surface soil layer with a relatively low hydraulic conductivity. Given the significant heterogeneity of the soil conditions, it would be difficult to accurately map the near surface soil structure to the point that a model could be developed that would conclusively prove a thick homogeneous layer of low conductivity soil covers all of Prospect and Ryer Islands.

DWR Response:

DWRs modeling is a reasonable interpretation of all the available data that meets the spirit, intent, and standard of proof in CEQA. The supposition of permeable distributary channels "concealed" by a thin cover of "basinal deposits" is speculative and not substantiated by the extensive data collected and analyzed to date.

Page 9, Section 4.4.1.2 - Highly Variable Lithology, paragraph 1:

The lithologic model that DWR created uses only 10 data points for Prospect Island that extend more than 10 feet below the surface and all of those points are on the levee perimeter of the island.

DWR Response:

Yes; however, the data support the nature and extent of the HUs developed.

Page 9, Section 4.4.1.2 - Highly Variable Lithology, paragraph 2:

The lack of deep subsurface data means that points on DWRs lithologic model are over 5,000 feet from the data point that they are interpolated from, as in the cross section shown on Figure 4. The effect of this on the lithologic model can be seen in cross section C-C' (Figure 6) where CPTs RI-3 and PI-8 (Inset 1 and 2) contain quite different subsurface soil conditions. In addition, on cross section C-C', there are soil layers that extend out westward from CPT RI-3 that terminate abruptly and others that abruptly appear. This modeling phenomenon is typically the consequence of the model trying to reconcile two largely different data points. Lastly, CPT RIS-1 shows only a 20-foot-thick upper clay layer and CPT PI-1 shows a clay layer 40 feet thick (after adjusting for the 12-foot CPT height measurement difference) despite being within about 1,000 feet of each other (Insets 3 and 4).

DWR Response:

The data supports that the Upper Clay HU thins out near CPT RI-3.

Multiple points made in this section of the ENGEO Report are misleading, including:

- The approximate ground surface elevation difference between CPTs RI-3 and PI-8 is 19 feet not 12 feet. It is inappropriate to compare these two CPT

soundings side by side, without properly adjusting for the significant elevation difference between them.

- CPT PI-8 penetrates three HUs (Levee, Upper Clay, and Main Sand) whereas, CPT RI-3 penetrates only two HUs (Upper Clay and Main Sand). Focusing only on the lithologic comparison and not acknowledging the HUs is inappropriate and misleading.

- The ground surface elevation of CPT PI-1 is about 17 feet higher than CPT RIS-1. The direct comparison of CPTs RIS-1 and PI-1 without consideration of their significant elevation differences is inappropriate and misleading.

- CPT PI-1 is located on the levee crown of Prospect Island, so CPT PI-1 penetrates three HUs; namely, the Levee, Upper Clay, and Main Sand HUs, whereas CPT RIS-1 only penetrates two HUs; Upper Clay and Main Sand on Ryer Island. Focusing solely on a lithologic comparison and not acknowledging the HUs is further misleading.

Page 10, Section 4.4.1.2 - Highly Variable Lithology, paragraph 3 excerpt:

Ryer Island contains a much larger sample of CPTs and borehole logs taken from the inland area. Most of the area where the Ryer Island CPTs were performed is in flood basin deposits. Despite being from a similar soil deposit and being spaced much closer together than the CPTs on Prospect Island, the Ryer Island CPTs also show substantial variation (Appendix B). As an example of the substantial variation, RI-2 (Inset 5) shows sand and silty sand to a depth of 5 to 15 feet and clay from 20 to 45 feet while RI-4 (Inset 6) shows clay from 5 to 12 feet and sand and silty sand from 12 feet to 55 feet.

DWR Response:

As above, it is misleading to directly compare these CPTs without acknowledging and adjusting for the significant ground surface elevation difference of about 26 feet between these two points. Additionally, CPT RI-2 is near the levee crown of Ryer Island and penetrates three HUs, namely, the Levee, Upper Clay, and Main Sand whereas CPT RI-4 penetrates only two HUs, Upper Clay and Main Sand. Focusing only on the lithologic comparison and not acknowledging the HUs further misleads.

Page 11, Section 4.4.1.3 - Limited Characterization of Prospect Island Interior, paragraph 1 excerpt:

Without laboratory testing of the soils encountered in the trenches, it is only an assumption that the soils were accurately identified and that the soils will have a similar hydraulic conductivity as those sampled from the levees.

DWR Response:

The trench soils were logged by USACE using ASTM D2488 standard methods (Visual-Manual Procedure) which compare favorably to the CPTs and collocated soil samples from our study, further supported by published research by CPT expert Dr. Peter Robertson from Gregg Drilling &Testing.

Page 12, 4.4.2.1 Overly Simplified, paragraph 1 excerpt:

The seepage model is a further simplification of an already over-simplified lithologic model. The result is a large 10- to 20-foot layer of relatively impermeable soil covering both Prospect and Ryer Islands (Figures 18 to 23). This layer does not adequately reflect the lithologic model or the various borings and CPTs upon which the model is based.

DWR Response:

The DWR lithologic model contains nine defined soil types which span the full range of soils encountered in the 69 exploration sites evaluated throughout the Project area, including 18 CPTs, 26 borings, and 25 trenches. Simplification of subsurface geologic conditions is commonly done to create models for various purposes and is considered an industry standard practice. In general, we followed the principle of parsimony by building the simplest models that honor all relevant available data and knowledge.

Page 12, 4.4.2.1 Overly Simplified, paragraph 1 excerpt:

As described earlier, on Ryer Island, the set of boreholes commissioned by the DRW [*sic*] (Borings RI 1 to 5, see Figure 24) demonstrates that there is no consistency to the main subsurface sand layer nor the near-surface clay layer. The CPT data from Borings PI 1 to 10 show that the top of the main sand layer can vary from 25 to 60 feet beneath the water level (Appendix B). CPT PI 2, 9, and 10 all show lenses of higher conductivity soil intermixed with the near-surface clay layer.

DWR Response:

Please note that ENGEOs Figure 24 is a republished version of Figure 9-1 in DWRs 2014 report. The intent of Figure 9-1 was only to illustrate the good correlation between CPT-derived soil behavior types and soil samples collected from the collocated Ryer Island well borings and CPTs. ENGEOs use of Figure 24 to demonstrate layer consistency between these CPTs is inappropriate and misleading for the following reasons:

- The CPT datums are not corrected for differences in ground surface elevation. For example, CPT RI-2 has a ground surface elevation of about 26 feet above MSL and CPT RI-3 has a ground surface elevation of about -3 feet MSL; a difference of about 29 feet.

- The CPTs are not directly adjacent to each other as depicted on Figure 24, but range from about 1,300 feet to 4,500 feet apart.

- ENGEO performed a direct lithologic comparison without acknowledging the multiple HUs delineated by DWR at these locations, namely the Levee, Upper Clay, and Main Sand HUs.

CPT PI-2, -9, and -10 do contain lenses of higher conductivity soil at shallow depths between about 5 and 10 feet; however, DWR accounts for the hydrogeologic properties of these lenses within the Levee HU which is recognized as having mixed soil types. The ENGEO Report overlooks the incorporation of mixed soil types in the Levee HU. Additionally, CPT PI-10 contains one lens of higher-conductivity soil within the Upper Clay HU at a depth of about 24-28 feet and this lens intersects the Miner Slough channel.

Page 12, Section 4.4.2.2 - Assumed Hydraulic Conductivity, paragraph 1:

The hydraulic conductivity of the layers comes from soil samples taken to the lab and tested. Though this provides an excellent estimate of the sample's hydraulic conductivity and even a good estimate with that soil type, it is unlikely that the actual subsurface soils are that homogenous.

DWR Response:

Incorrect; the estimated hydraulic conductivity values used in DWR's seepage models were based on extensive independent testing completed for the DWR 2014 report, including CPT-based estimates and pneumatic slug tests. These estimates compared favorably to other hydraulic conductivity values obtained for similar geologic materials in other parts of the delta.

Page 12, 4.4.3 Seepage Model Shows Flooding Prospect Island Changes The Subsurface Water Flow, paragraph 1 excerpt:

Should there be locations where the hydraulic conductivity is higher in the near surface, then there will be a greater quantity of water flowing from Prospect and Ryer Island. This is what our seepage analysis in Section 5.0 attempts to illustrate.

DWR Response:

Since Miner Slough incises into and through the Upper Clay HU within the Project area, these hypothesized hydraulically conductive layers within the Upper Clay HU that ENGEO suggests would likely intersect Miner Slough. Therefore, groundwater levels and flows would be fully attenuated through the connection with Miner Slough and their possible presence in the shallow subsurface of Prospect Island would not have a seepage effect on Ryer island.

Page 13-14, Section 5.2.1 - Model Specifications, paragraphs 1-2 excerpt:

We followed DWR seepage model as closely as we could, creating a steady state model, with specific head boundaries on the side and river interfaces and a no flow boundary at the bottom interface...

We chose a no flow boundary along Miner Slough to isolate the variability associated with a fluctuating water surface with the slough and, therefore, better capture the transmissivity relationship potential between the two Islands.

DWR Response:

The modeling approach taken by ENGEO mischaracterizes the hydrology of the study area by isolating Minor Slough. ENGEO did not follow the DWR seepage model closely.

Above it is stated that river interfaces are modeled with specified head boundaries (constant head), so it is unclear why ENGEO chose a no-flow boundary along Miner Slough (a river interface) considering that its channel bottom is clearly a boundary across which flow occurs. The characterization of Miner Slough as a no-flow boundary is in direct conflict with the extensive hydrologic data reported by DWRs and others in past studies.

Modeling the most significant source of surface water between Prospect and Ryer Islands (Miner Slough) with a no-flow boundary is unreasonable and misleading as it disregards the known flow that occurs across the Miner Slough channel bottom.

Page 14, Section 5.2.1 - Model Specifications, paragraph 4 excerpt:

To keep consistent with the work that DWR performed, we used the derived values for the hydraulic conductivity of the soils located below the levee foundation from the DWR study. We felt that the assumption DWR made for the levee soils did not accurately represent the CPT derived hydraulic conductivities, thus we modeled the levee soils as having the same hydraulic conductivity as the DWR defined clay soil values.

DWR Response:

Figure 10-1 in DWRs 2014 report indicates that the Levee HU is significantly more hydraulically conductive than the Upper Clay HU by at least an order of magnitude as evidenced by the overall K geometric means of these HUs. Therefore, DWR identified the levees as a separate HU for subsurface characterization and seepage modeling purposes.

In **Section 2.5 – GEOLOGY,** ENGEO states that "Levee fills appear to consist of interlayered silty sand, silt, and clays.", so it is evident that the levee fills are a mixture of soils with a range of hydraulic properties.

ENGEO questions DWRs subdivision of HUs and asserts that our models are overly simplified, yet for their modeling analysis, they chose to combine the Levee and Upper Clay HUs (a simplification), since these units appeared to have similar hydraulic properties.

DWRs interpretation of units for this project is similar to the proposed DWP, where individual soil units, including fill material (levee), peat, clay, and sand units were identified from representative exploration sites and used to develop typical soil profiles with representative hydraulic conductivity values (URS 2000).

Page 14, Section 5.2.2 - Sensitivity Scenarios, paragraph 1 excerpt:

We modeled three different scenarios at the location of cross section D-D'. Each of the scenarios represented a possible variation in the subsurface lithology. The goal of the sensitivity analysis is not to demonstrate the most likely scenario; but instead, to illustrate how reasonable changes in the subsurface lithology can have substantial changes in the groundwater elevation and the seepage condition on Ryer Island.

DWR Response:

Based on the extensive data collected and analyzed, the hypothetical subsurface lithology scenarios ENGEO chose as examples are not supported by the CPT data along cross section D-D'. In fact, some of their scenarios are implausible in nature based on sound geologic principles.

Page 15, Section 5.2.2.1 - Scenario 1, paragraph 1 excerpt:

This scenario is our analysis of the lithology presented in the DWR seepage analysis. We choose to include the levees as part of the clay layer as described above.

DWR Response:

ENGEO indicates that they used cross section D-D' as the representative base model for their scenarios, yet the shallow sand layer as seen in cross section D-D' is not modeled, but rather another sandy layer is placed in various hypothetical, implausible configurations, none of which are supported by the extensive subsurface data collected for this Project.

Page 15, Section 5.2.2.2 - Scenario 2, paragraph 1 excerpt:

This scenario is a possible lithology based on the CPT data used in the cross section for D-D'. We created a sand layer that extends from the slough into Prospect Island.

DWR Response:

In scenario 2, ENGEO included a hypothetical layer into the model that is implausible. The CPT data does not support their hypothetical layering configuration.

Page 15, Section 5.2.2.3 - Scenario 3, paragraph 1 excerpt:

In this scenario, we created a larger sand layer that extends from Prospect Island into Ryer Island and has extensive proximity to the surface of Prospect Island and Ryer Island.

DWR Response:

ENGEOs scenario 3 is even more implausible than scenario 2. Again, the extensive data collected does not support hypothetical layering such as this.

Page 16, Section 5.3 - SEEPAGE MODEL RESULTS, paragraph 1 excerpt:

The results of the three scenarios are summarized in Table 5.3-1. Changing the subsurface lithology changed the head elevation and seepage flow rate on Ryer Island. In every scenario, flooding Prospect Island increased the total head on Ryer Island compared to the condition of no flooding on Prospect Island.

DWR Response:

It is important to note in ENGEOs results that the only sources of water available are from the DWSC and from Prospect Island (when flooded) since they have modeled Miner Slough as having a no-flow boundary even though Miner Slough is the closest and most significant source of water between the islands. Additionally, they are not modeling flow, but rather estimating total head and head changes at selected points in their model scenarios.

ENGEOs modeling results are not valid since they exclude Miner Slough as a source of water in the Project area. Additionally, they used hypothetical layering scenarios that are not supported by the extensive subsurface data collected for this Project and are implausible in nature based on sound geologic principles.

Page 16, Section 5.3.1 - Scenario 1 excerpt:

Scenario 1 - Prospect Island Not Flooded

DWR Response:

It is important to note in this section that the height of water in the DWSC (higher) versus Miner Slough (lower) and recall the no-flow boundary underlying Miner Slough, which in effect, makes it invisible and unable to contribute any flow of water into the model.

In these scenarios, water flows from the DWSC to the east due to the head differences. There is nowhere else for the water to come from. The ENGEO model mischaracterizes the Project area's hydrology.

Page 17, Section 5.3.1 - Scenario 1 excerpt:

Scenario 1 - Prospect Island Flooded

DWR Response:

In this scenario, the water level in the DWSC and on Prospect Island are the same and Miner Slough is shown, but not set up to allow for flow to occur, which forces water to flow from the DWSC and Prospect Island only. Again, the no-flow boundary underlying Miner Slough renders it a non-source of water and invisible to the model, thus forcing all water to flow from the only two sources available in their hypothetical modeling scenarios (DWSC and Prospect Island).

During a significant flood, it is more likely that the water level in Miner Slough would be at a similar height as DWSC and equal to or greater than the water level on a potentially flooded Prospect Island.

DWRs REVIEW CONCLUSION

Due to mischaracterization of DWRs analysis of the available data, inaccurate statements, misleading data comparisons and figures, and flawed hypothetical modeling of subsurface geology and water levels in the Project area, it is DWRs conclusion that the ENGEO Report does not provide any compelling analysis which would cause DWR to change its draft EIR finding that the Project would have no significant impact on Ryer Island seepage.

REFERENCES

ASTM D2488, Standard Practice for Description and Identification of Soils (Visual - Manual Procedure). American Society for Testing and Materials.

DWR 1967, Sacramento Valley Seepage Investigation. Bulletin 125. California Department of Water Resources. August.

DWR 2013, Site Characterization and Groundwater Monitoring Data Collection Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum Report. North Central Region. June.

DWR 2014, Site Characterization and Groundwater Monitoring Data Analysis Summary, Prospect Island Tidal Habitat Restoration Project. Solano County, California. Memorandum Report. California Department of Water Resources. North Central Region. January.

ENGEO 2015, Seepage Impact Analysis, Reclamation District 501, Prospect and Ryer Islands, Solano County, California. ENGEO Incorporated. July 14.

GEI 1999, Evaluation of Potential Impacts on Ryer Island Associated with Flooding Prospect Island, Solano County, CA. GEI Consultants. July 21.

Todd Engineers 1998, Preliminary Seepage Analysis, Prospect Island, CA, Technical Memorandum. Todd Engineers. May 26.

URS 2000, Levee Stability and Seepage Analysis Report for the Delta Wetlands Project Revised EIR/EIS. Supplemental Geotechnical Report. URS Greiner Woodward Clyde. May.

USGS 1963, Flood of January – February 1963 in California and Nevada. Open File Report. Water Resources Division. United States Geological Survey. March.

USGS 1971, Floods of December 1964 and January 1965 in the Far Western States. Part 1. Description. Water Supply Paper 1866-A. United States Geological Survey.

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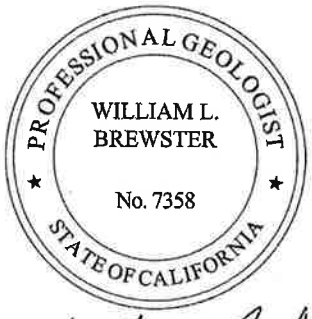


2/15/18

Attachment 5
DWR (2019) Review of 2018 ENGEO and KSN (RD 501) Letter on the 2018 DWR Hydrologic Data Analysis Report

State of California | California Natural Resources Agency

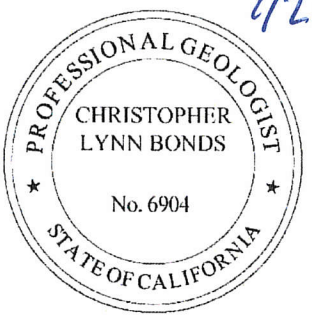
Memorandum

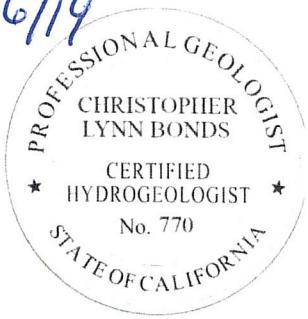
Date: July 26, 2019

To: Dan Riordan, Chief
Senior Environmental Scientist
Division of Environmental Services
Department of Water Resources

From: Christopher L. Bonds, P.G. 6904, C.Hg. 770
Senior Engineering Geologist
Division of Regional Assistance (DRA)
Department of Water Resources

C. L. Bonds
7/26/19





Subject: Response to RD 501 Comments on the February 2018 DWR Hydrologic Data Analysis Report, Prospect Island Tidal Habitat Restoration Project, Solano County, California

INTRODUCTION

On August 20, 2018, a letter commenting on the February 2018 DWR Hydrologic Data Analysis Report (DWR 2018) for the Prospect Island Tidal Habitat Restoration Project (Project) was jointly prepared by ENGEO Incorporated and Kjeldsen, Sinnock & Neudeck, Inc. on behalf of Reclamation District 501 (RD 501). The RD 501 letter was submitted to the California Department of Water Resources (DWR) for consideration during the finalization of the Environmental Impact Report (EIR).

This memorandum provides DWR technical staff review of the RD 501 letter. This memorandum has been formatted with subject headings in bold, black, and all caps. RD 501 letter headings used in the response are bold and blue for ease of reference. DWR review comments are provided on content under the headings used in the RD 501 letter, namely; **Background on RD 501 Concerns**, **Discussion of the 2018 DWR Report**, and **Conclusions**.

DWR REVIEW

Background on RD 501 Concerns

In spring 2017, DWR met with RD 501 and agreed to develop a plan for additional hydrologic data analysis, including the use of water level data from the existing monitoring network spanning periods of drying and flooding on Prospect Island. RD 501 representatives were provided an opportunity to review DWR's draft plan dated June 9, 2017 (DWR 2017) and no changes to the scope and methods were proposed. DWR embarked on a significant effort to compile and analyze the new hydrologic data and prepare a report of findings. This information was shared with RD 501 and was later made available to interested parties during the public review of the 2019 Partial Recirculated DEIR.

SURNAME DWR 155 (Rev 7/11)				

DWR (2018) established that Miner Slough stage exceeded Prospect Island stage 98% of the time during the 2011-2017 period of record (POR) (Figure 3). Since Miner Slough has higher water levels than Prospect Island water levels 98% of the time, and Miner Slough is deeply incised into the floodplain and subsurface hydrogeologic units between Prospect and Ryer Islands, Miner Slough is clearly the main hydrologic feature that controls water levels and flow onto the islands, including any reported seepage that might occur on Ryer Island. Other factors that influence water levels, flow, and any reported seepage on Ryer Island include precipitation and the operation of Ryer Island's drainage system.

Although recommended by RD 501, DWR determined that a statistical correlation analysis of the hydrologic data was not warranted, since by itself, correlation does not imply causation and the results of such an analysis will not change the DEIRs findings and conclusions. A correlation analysis can be used to assess the strength of association between two continuous variables, but it cannot be used to prove a causal relation between the two variables (Helsel and Hirsch, 1992). Evidence for causation cannot come from a statistical analysis, but only from knowledge of the processes involved.

This is one of the reasons why DWR used multiple, independent methods of technical analysis for the Proposed Project, namely:

- Detailed geologic site characterization;
- Hydrogeologic conceptual modeling of Prospect and Ryer Islands, including Miner Slough and the Deep Water Ship Channel;
- Hydrographs depicting continuous groundwater and surface water elevations at dozens of locations coupled with precipitation measurements;
- Groundwater contour maps; and
- Seepage modeling.

It is noted that the hydrologic data from Prospect and Ryer Islands are indeed related by the fact that they are in the same geographic area, they are influenced by the same upstream hydrologic conditions, as well as local meteorology, but this does not mean that the hydrologic conditions on Prospect Island directly or indirectly cause seepage to Ryer Island.

The comprehensive technical analysis as documented in the 2013, 2014, and 2018 DWR reports allowed for the development of multiple lines of evidence to support the findings and conclusions in the DEIR; specifically, no significant impacts to Ryer Island’s reported seepage with implementation of the Proposed Project.

Discussion of the 2018 DWR Report (RD 501)

DWR (2018) built upon and extended some of the hydrologic data analyses provided in previous reports (DWR 2013, 2014). RD 501 comments describing a simplified and limited analysis ignore the extensive data collection and comprehensive body of work previously conducted and reported on Prospect Island and Ryer Island subsurface geology and hydrology.

RD 501 disputes the interpretation of some water level time-series data on Figures 4A, 4C, 5A, and 5C, but does not dispute the interpretation of Figures 4B and 5B which present the most compelling data relevant to the reported seepage conditions of concern on Ryer Island. The significance of Figures 4B and 5B and relevance to the reported seepage conditions on Ryer Island are discussed in the following paragraphs.

DWR (2018) established that between late fall and spring of each water year during the 2011-2017 POR, groundwater levels in shallow wells on Ryer Island (MW 99-4, 99-6, and 99-8) rise to within about a foot below the ground surface and in some cases rise above the ground surface (Figures 4B and 5B). If groundwater levels in the shallow aquifer system rise to within about one foot of the ground surface, agricultural activities may be affected due to the saturation of shallow depth, clay-rich soils. Also, if groundwater levels in the shallow aquifer system rise above the ground surface, groundwater seepage occurs. Furthermore, if the shallow groundwater levels are close to, or above, the ground surface and a precipitation event occurs, there is little to no unsaturated zone available for precipitation to infiltrate into and ponding may result.

Ryer Island groundwater level rises shown on Figures 4B and 5B coincide with significant increases in Miner Slough stage, ranging from 5.2 feet NAVD88 on 3/2/14 to 13.35 feet NAVD88 on 2/12/17. These groundwater level increases also coincide with significant local precipitation events, ranging from 0.87 inches on 3/24/11 to 2.7 inches on 12/11/14. Additionally, most significant precipitation events during the 2013-2017 POR coincide with a notable increase in stage at the Ryer Island drainage ditch sites. Most importantly, in comparison to increases in Ryer Island groundwater levels during periods of Miner Slough stage increases and/or precipitation events, Prospect Island stage shows little to no increase. Therefore, it is most likely that the cause of the significant groundwater level rises of concern on Ryer Island are those related to Miner Slough hydrology as well as local meteorology events. Furthermore, it is unlikely that the unremarkable Prospect Island stage increases are the cause of the significant rises of groundwater levels on Ryer Island.

To further support the above evidence, refer to Figures 11-31, 11-36, 11-37, 11-42, and 11-43 from DWR (2014). These figures are included as Attachment A and highlight the response in all nine (9) Ryer Island wells (MW 99-1, -2, -3, -4, -5, -6, -7, -8, and -11) and Prospect Island stage to significant stage increases on Miner Slough and local precipitation events with higher frequency data (every two hours) from 11/28/12 through 12/31/12. As shown, the coincident groundwater level rises in Ryer Island wells are sharp and distinctly higher in magnitude compared to the coincident subtle and lower magnitude stage increases on Prospect Island.

To illustrate another important response characteristic observed in all nine (9) Ryer Island wells, refer to Figures 11-30, 11-34, 11-35, 11-40, and 11-41 from DWR (2014) (See Attachment B). Again, using higher frequency, two-hour data, but from a different period (August 2012), a remarkable tidal signal is observed in all wells in response to diurnal tides affecting Miner Slough. These figures clearly show Miner Slough's strong influence over groundwater level fluctuations in wells on Ryer Island.

The above examples from DWR (2014) provide further supporting evidence that the groundwater level rises of concern and fluctuations on Ryer Island are most likely caused by Miner Slough stage increases and/or precipitation events and not stage increases on Prospect Island. Contrary to the assertion by RD 501, surface water on Prospect Island does not have a significant effect on water levels on Ryer Island.

Additionally, RD 501 does not dispute the spatial data analysis shown on groundwater contour maps (Figures 7 through 10). These maps provide another line of independent supporting evidence that Miner Slough has the highest water levels in the Project and surrounding area and is the primary driver of surface water and groundwater flow on Prospect and Ryer Islands. As noted earlier, other significant factors that affect water levels and flow on Ryer Island include precipitation and operation of the Ryer Island drainage system.

Regarding the analysis of hydrographs shown on Figure 4A, RD 501 asserts that the Prospect Island elevations generally track Miner Slough stages prior to the tidal gate repair and no longer track Miner Slough following repair of the tidal gate structure. Contrary to RD 501's assertion, the stages on Miner Slough and Prospect Island still generally track each other following the tidal gate repair, but at different elevations due to the periodic island drainage response. It is important to note that the water level data shown on the 2018 report hydrographs are daily mean values and therefore, do not show the significant diurnal tidal responses on purpose to allow for simpler data analysis.

As described in DWR (2014), Prospect Island wells PI-6A and -6B were installed in two different hydrogeologic units (HU), namely, the Upper Clay HU and Main Sand HU, respectively, and therefore each respond uniquely, as documented in DWR (2018).

As described in DWR (2018), shallow Ryer Island well 99-8 was installed by GEI Consultants for RD 501 across a portion of the same HU that the collocated, deep Ryer Island well 99-7 is screened across (Main Sand HU) and as a result, these two wells have similar elevations and responses. RD 501 omits this important fact in the review to support the assertion that surface water on Prospect Island affects groundwater levels and seepage on Ryer Island. Prospect Island Well PI-6B and Ryer Island Wells MW 99-7 and 99-8 are all screened across the Main Sand HU and therefore, the similarity in groundwater level responses at these three wells is to be expected.

However, the similarity in groundwater level responses at these three wells does not imply that there is a connection between the surface water on Prospect Island and the reported seepage on Ryer Island; it only implies a connection between wells screened within the same HU. As documented in DWR (2014), directly underlying the surface of Prospect Island is the Upper Clay HU, a low hydraulically conductive unit with an average thickness of 25 feet, which provides a significant restriction to water flow into the subsurface. Additionally, the Upper Clay HU directly underlies the surface of Ryer Island, has an average thickness of 16 feet, and provides a significant barrier to water flow into and out of the subsurface.

DWR concurs with RD 501 that the operation of the drainage system on Ryer Island has a significant effect on groundwater levels in Ryer Island wells and is one of the drivers of water levels and flow on Ryer Island.

Conclusions (RD 501)

RD 501 states that “Miner Slough’s water surface elevations are the highest, Prospect’s elevations are the second and lower, and Ryer Island’s elevations are lower still.” DWR concurs and this sets that stage for how water flow occurs in the area, namely, that Miner Slough is a water divide between the two islands, which allows water to flow downward into the subsurface, as well as flow laterally west toward Prospect Island, and flow laterally east toward Ryer Island.

In RD 501’s review of Figure 4A, the following is stated: “The hydraulic head and gradient does not need to move from Miner Slough to Ryer Island. Instead, these data clearly support that the movement is from Miner Slough to Prospect Island to Miner Slough as shown in the relative elevations.” This last sentence is illogical and contrary to well-established scientific literature (DWR 2014, Appendix A) that states that water flows via gravity from areas of high levels, potential, or energy, to areas of low levels, potential, or energy, as dictated by hydraulic gradients and hydraulic conductivities. Since Miner Slough is located between the two islands and has the highest water levels, it is a water divide which allows water to flow downward into the subsurface, as well as flow west toward Prospect Island, and flow east toward Ryer Island.

Lastly, as an element of the Good Neighbor Policy, DWR plans to continue data collection from the existing monitoring network pre- and post-Proposed Project for future review and analysis.

DWR REVIEW CONCLUSION

Upon review and consideration of the RD 501 letter, we conclude that it does not provide any compelling new data or analysis which would cause DWR to change its DEIR findings and conclusions regarding potential seepage impacts on Ryer Island. DWRs comprehensive technical study and reports (2013, 2014, and 2018) provide multiple lines of evidence to support the findings and conclusions that Prospect Island surface water levels do not significantly impact Ryer Island and that the Proposed Project would have no significant impacts on Ryer Island seepage.

REFERENCES

DWR 2013, Site Characterization and Groundwater Monitoring Data Collection Summary, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum Report. North Central Region. June.

DWR 2014, Site Characterization and Groundwater Monitoring Data Analysis Summary, Prospect Island Tidal Habitat Restoration Project. Solano County, California. Memorandum Report. California Department of Water Resources. North Central Region. January.

DWR 2017, Hydrologic Data Analysis Plan, Prospect Island Tidal Habitat Restoration Project. Solano County, California. Draft June 9, 2017.

DWR 2018, Prospect and Ryer Island Hydrologic Data Analysis, October 1, 2013 to April 1, 2017, Prospect Island Tidal Habitat Restoration Project, Solano County, California. Memorandum Report. North Central Region. February.

Helsel, D.R., and Hirsch, R.M., 1992, Statistical methods in water resources: Amsterdam, Elsevier Publishers, 529 p.

FIGURES

Figure 3
Figure 4B
Figure 5B
Figure 7
Figure 8
Figure 9
Figure 10

ATTACHMENTS

Attachment A – DWR (2014) Report Figures

Figure 11-31
Figure 11-36
Figure 11-37
Figure 11-42
Figure 11-43

Attachment B – DWR (2014) Report Figures

Figure 11-30
Figure 11-34
Figure 11-35
Figure 11-40
Figure 11-41

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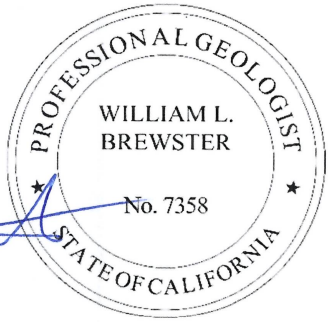

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FIGURES

Figure 3
Figure 4B
Figure 5B
Figure 7
Figure 8
Figure 9
Figure 10

Figure 3

Hydrograph of Miner Slough Stage minus Prospect Island Stage

Daily Mean Water Levels - January 1, 2011 to April 1, 2017

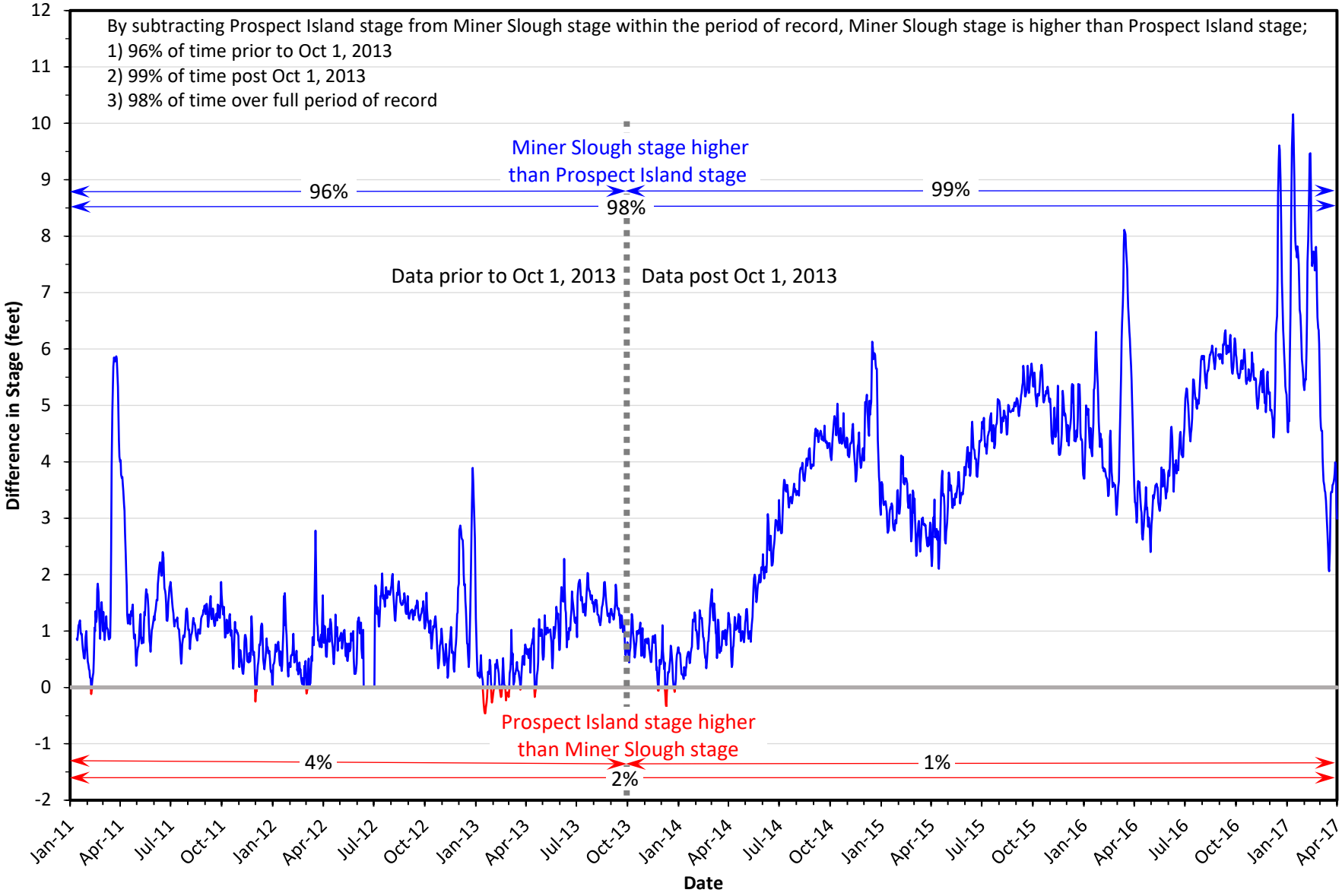


Figure 4B

Select Hydrographs of Stage and Groundwater Elevations along North Transect with Precipitation at Hastings Tract East

Daily Mean Water Levels, Daily Precipitation - January 1, 2011 to April 1, 2017

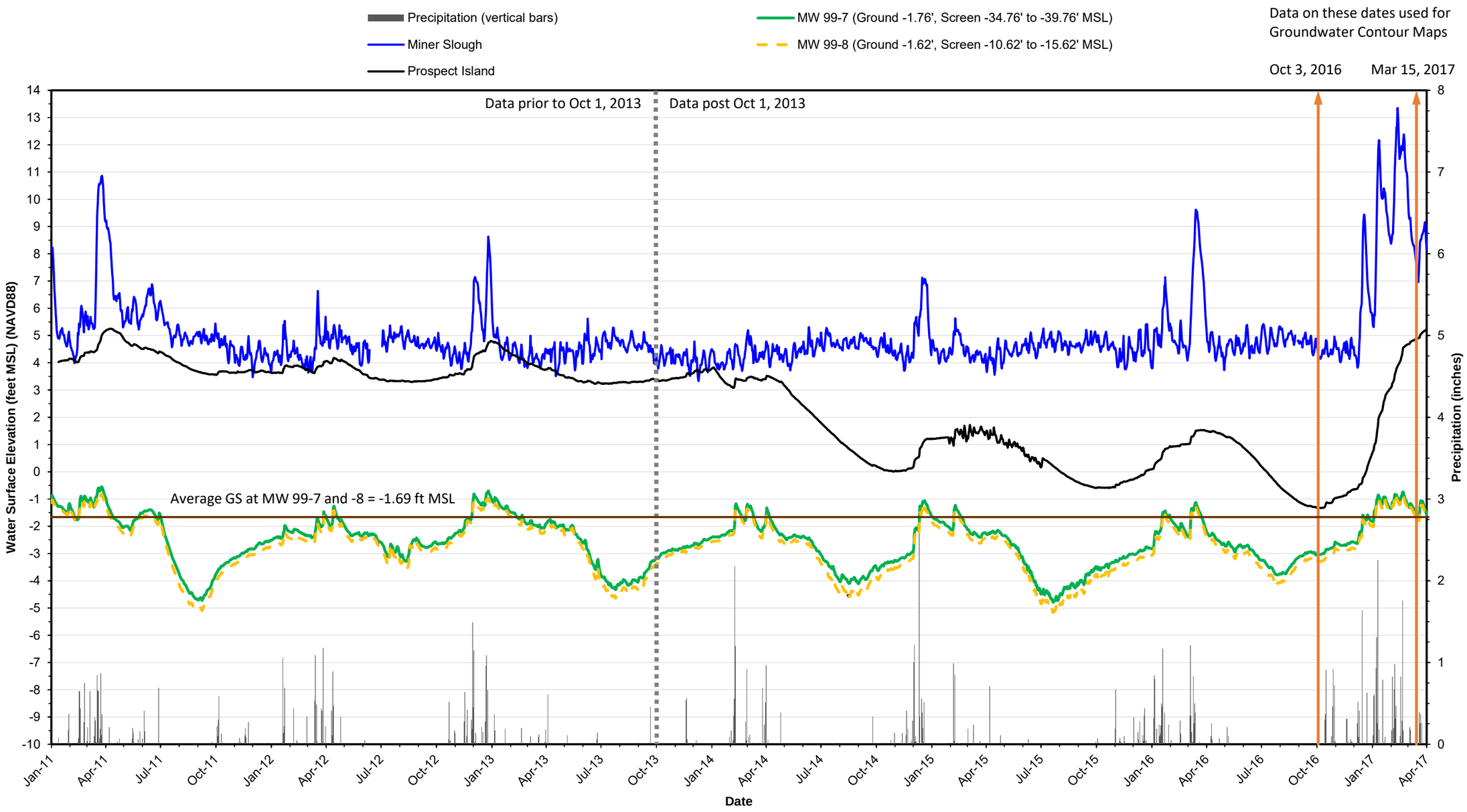
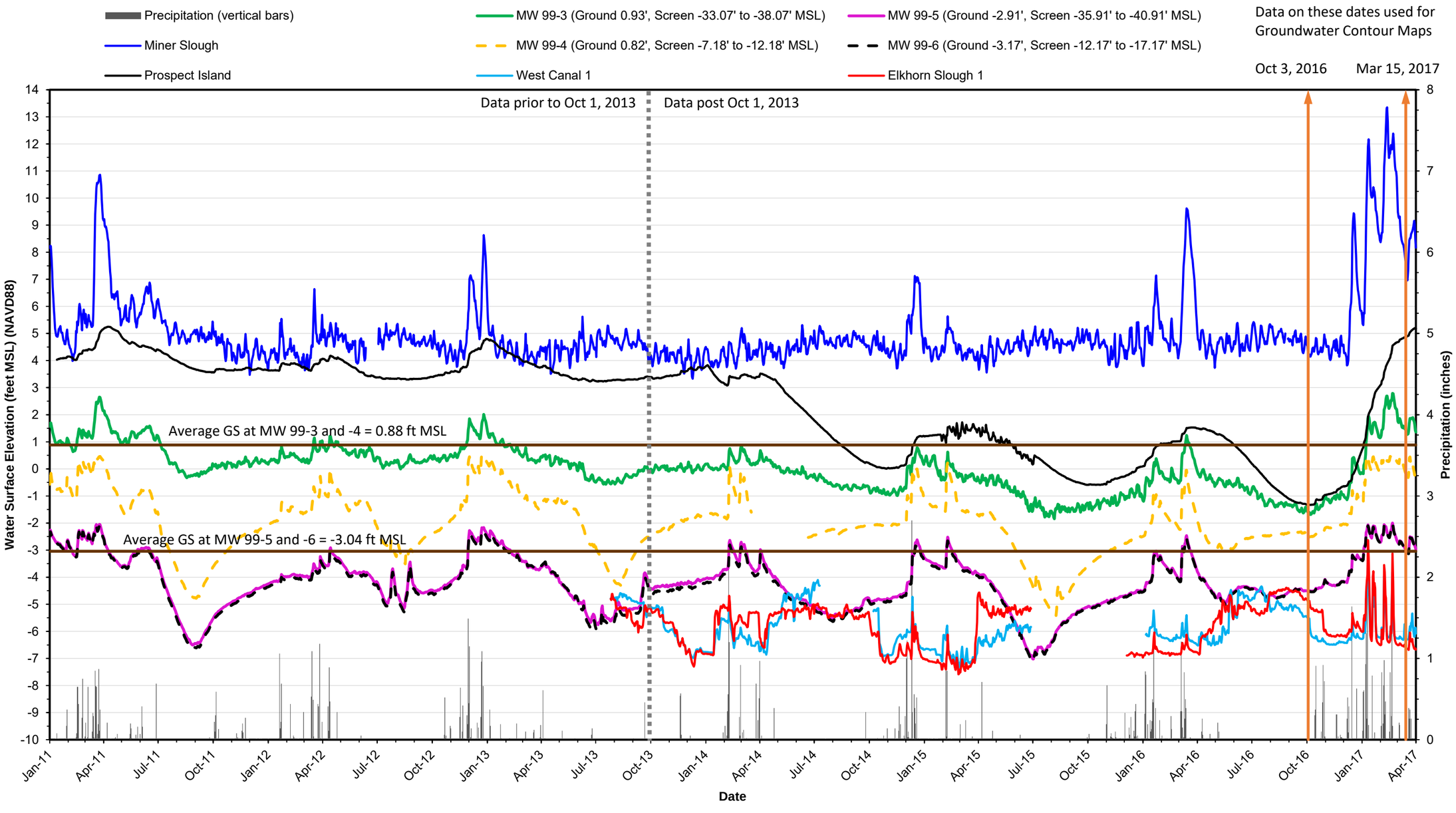
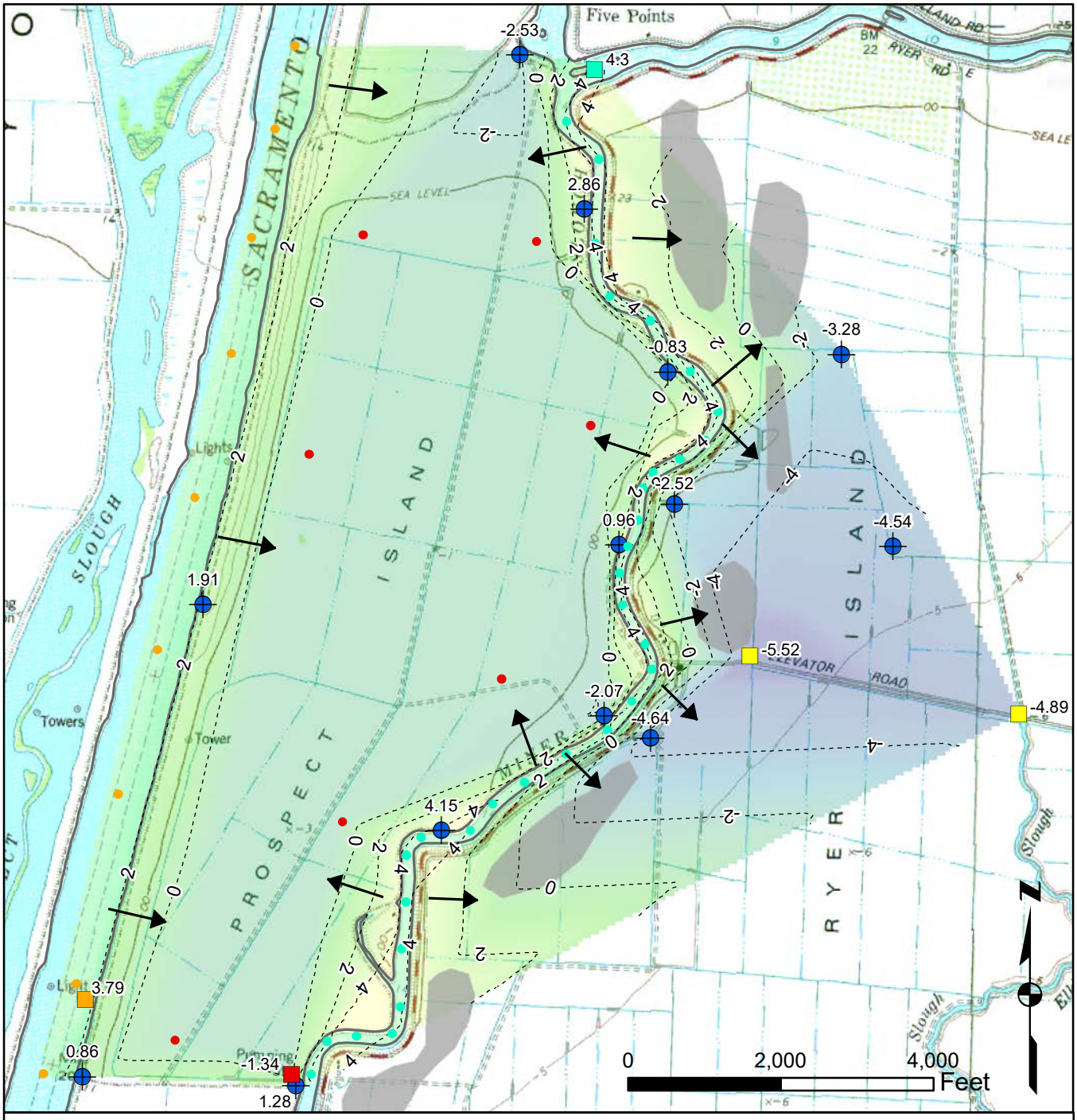


Figure 5B

Select Hydrographs of Stage and Groundwater Elevations along Middle Transect with Precipitation at Hastings Tract East

Daily Mean Water Levels, Daily Precipitation - January 1, 2011 to April 1, 2017





Groundwater Elevation from Well

Prospect Island Stage ● inferred stage from gage

DWSC Stage ● inferred stage from gage

Miner Slough Stage ● inferred stage from gage

Ryer Island Ditch Stage

RD 501 Reported Seepage Areas

Groundwater Flow Direction (Not Magnitude)

---2--- Potentiometric surface contour - Shows elevation of potentiometric surface on October 3, 2016 in the SHALLOW aquifer, in feet NAVD88. Contour interval is 2 feet.

Potentiometric surface (ft, NAVD88)

High : 4.3

0.0

Low : -5.5

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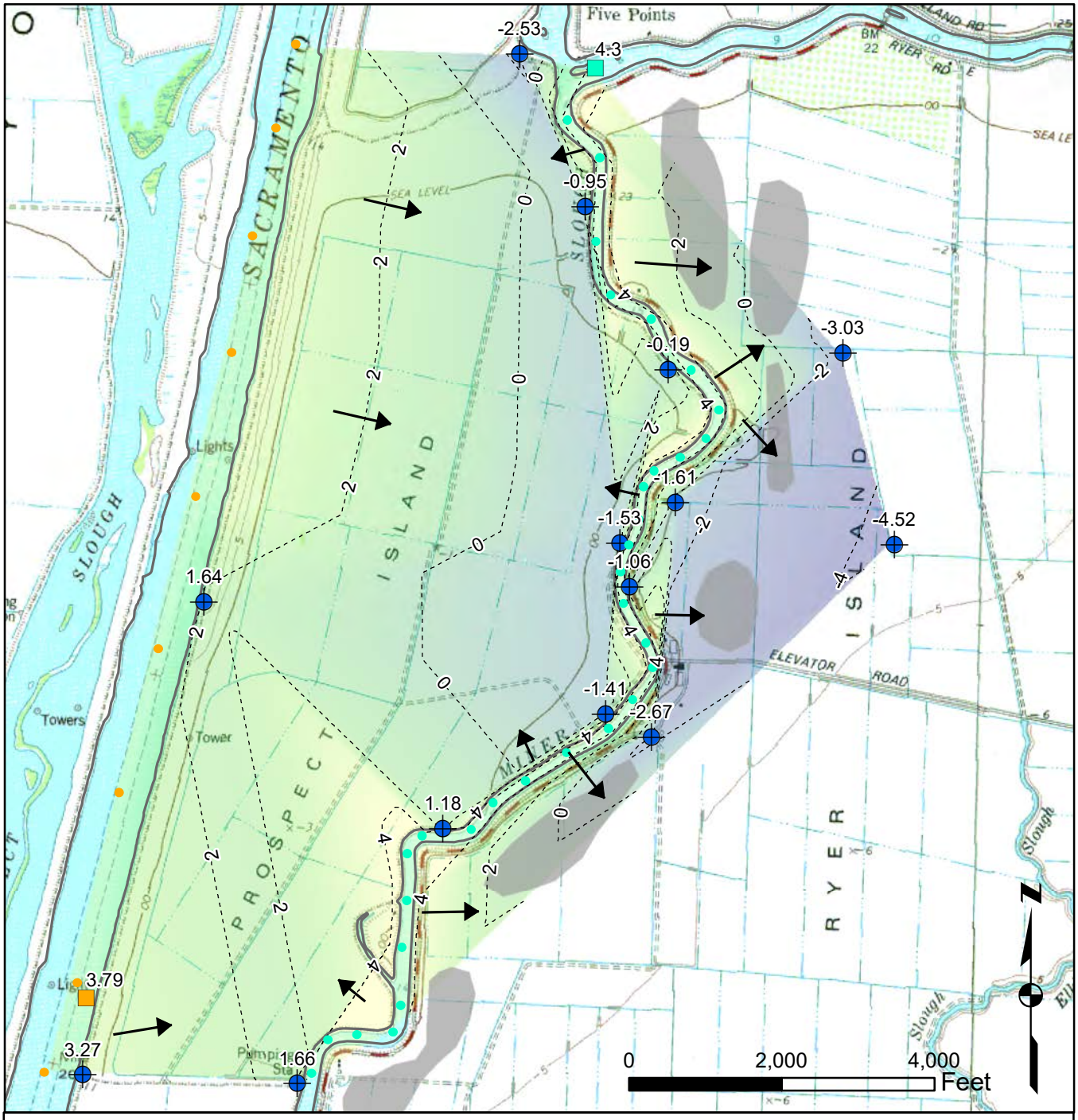
Division of Integrated Regional Water Management
NORTH CENTRAL REGION OFFICE
Geology and Groundwater Investigations Section

Groundwater Contour Map Shallow Aquifer (Upper Clay HU) October 3, 2016

Figure 7



Groundwater Elevation from Well

DWSC Stage ● inferred stage from gage

Miner Slough Stage ● inferred stage from gage

RD 501 Reported Seepage Areas

Groundwater Flow Direction (Not Magnitude)

---2--- Potentiometric surface contour - Shows elevation of potentiometric surface on October 3, 2016 in the MAIN SAND aquifer, in feet NAVD88. Contour interval is 2 feet.

Potentiometric surface (ft, NAVD88)

High : 4.3

0.0

Low : -4.5

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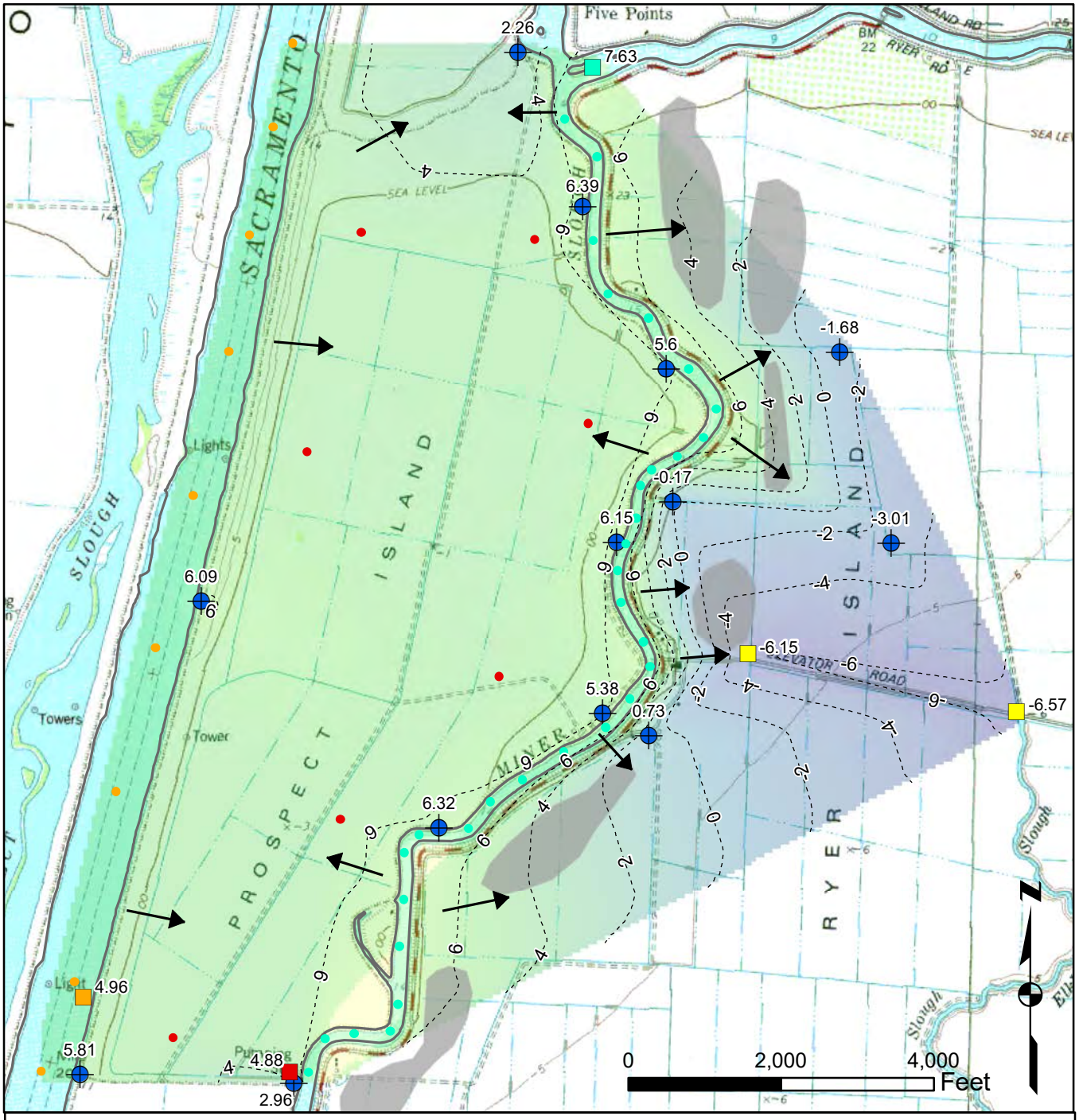
NORTH CENTRAL REGION OFFICE
Geology and Groundwater Investigations Section

Groundwater Contour Map
Main Sand Aquifer (Main Sand HU)
October 3, 2016

Figure 8



Groundwater Elevation from Well

Prospect Island Stage • inferred stage from gage

DWSC Stage • inferred stage from gage

Miner Slough Stage • inferred stage from gage

Ryer Island Ditch Stage

RD 501 Reported Seepage Areas

Groundwater Flow Direction (Not Magnitude)

----2---- Potentiometric surface contour - Shows elevation of potentiometric surface on March 15, 2017 in the SHALLOW aquifer, in feet NAVD88. Contour interval is 2 feet.

Potentiometric surface (ft, NAVD88)

High : 7.6

0.0

Low : -6.5

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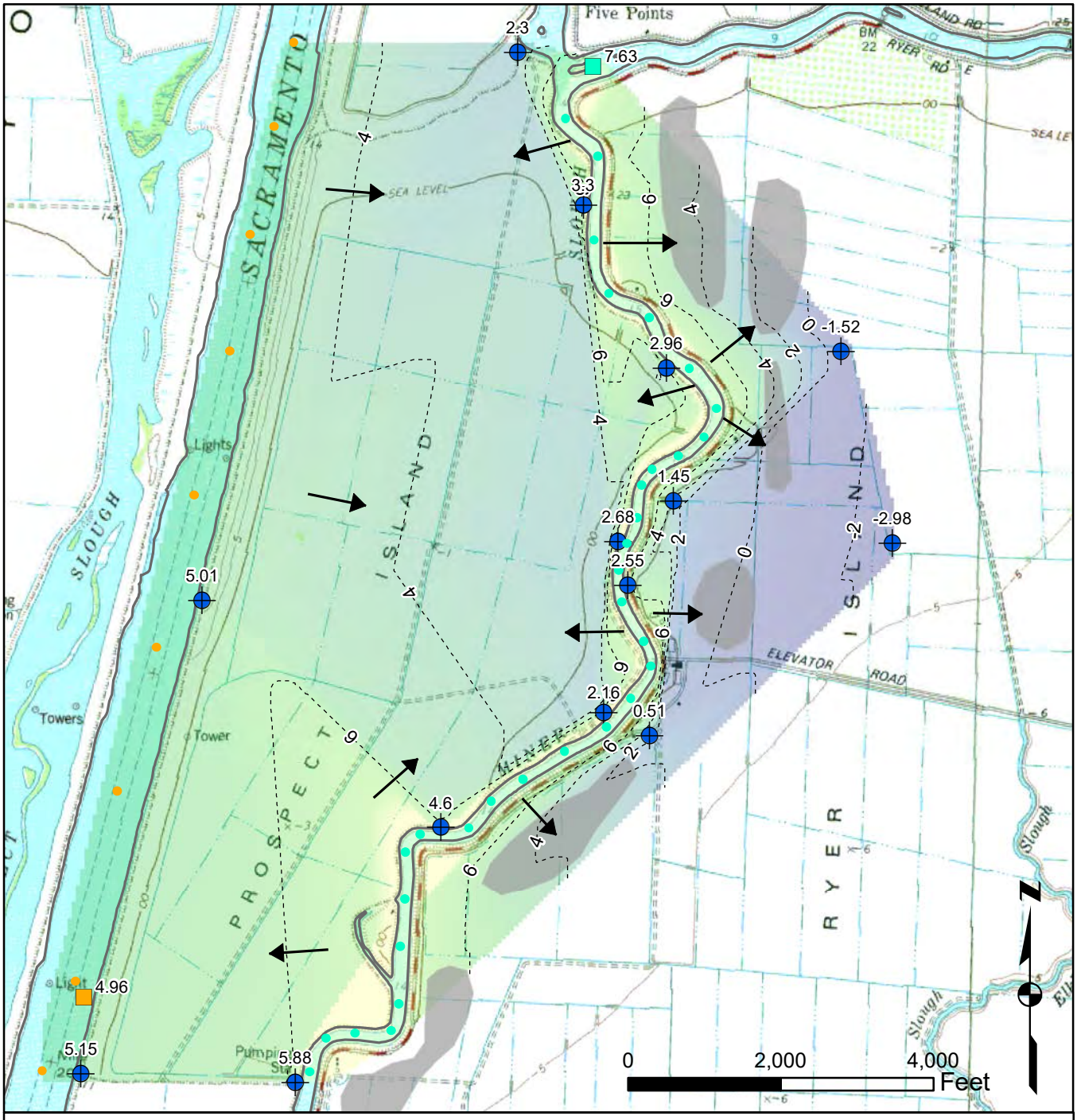
NORTH CENTRAL REGION OFFICE
Geology and Groundwater Investigations Section

Groundwater Contour Map Shallow Aquifer (Upper Clay HU) March 15, 2017

Figure 9



Groundwater Elevation from Well

DWSC Stage ● inferred stage from gage

Miner Slough Stage ● inferred stage from gage

RD 501 Reported Seepage Areas

Groundwater Flow Direction (Not Magnitude)

----2---- Potentiometric surface contour - Shows elevation of potentiometric surface on March 15, 2017 in the MAIN SAND aquifer, in feet NAVD88. Contour interval is 2 feet.

Potentiometric surface (ft, NAVD88)

High : 7.6

0.0

Low : -2.9

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Geology and Groundwater Investigations Section

Groundwater Contour Map
Main Sand Aquifer (Main Sand HU)
March 15, 2017

Figure 10

ATTACHMENTS

Attachment A – DWR (2014) Report Figures

Figure 11-31
Figure 11-36
Figure 11-37
Figure 11-42
Figure 11-43

Figure 11-31

Hydrographs of Miner Slough Stage and Prospect Island Stage, Ryer Island MW 99-1 and -2 Groundwater Levels with Precipitation at Georgiana Slough

Two Hour Water Levels, Daily Precipitation - November 28 through December 31, 2012

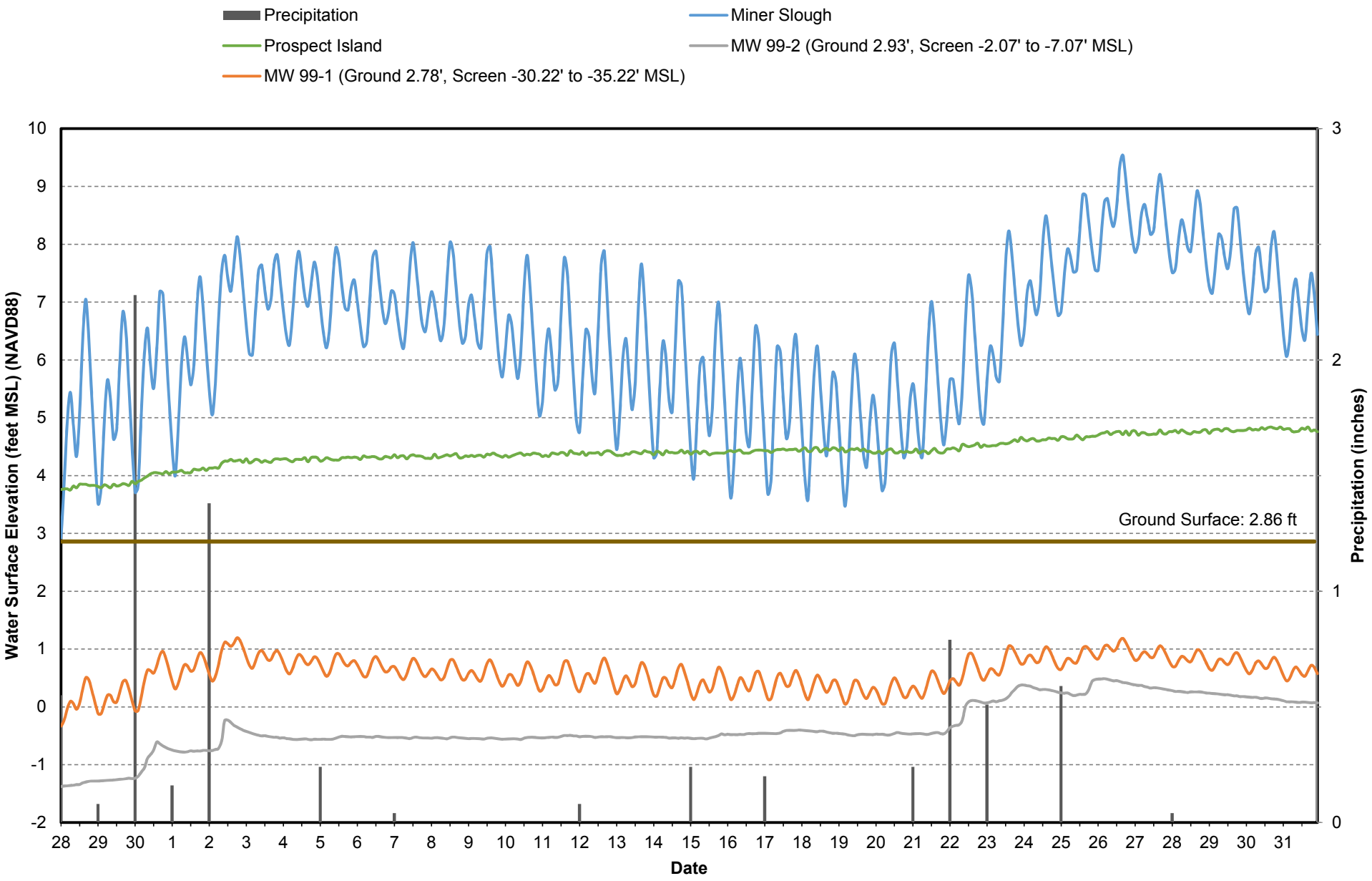


Figure 11-36

Hydrographs of Miner Slough Stage and Prospect Island Stage, Ryer Island MW 99-3 and -4 Groundwater Levels with Precipitation at Georgiana Slough

Two Hour Water Levels, Daily Precipitation - November 28 through December 31, 2012

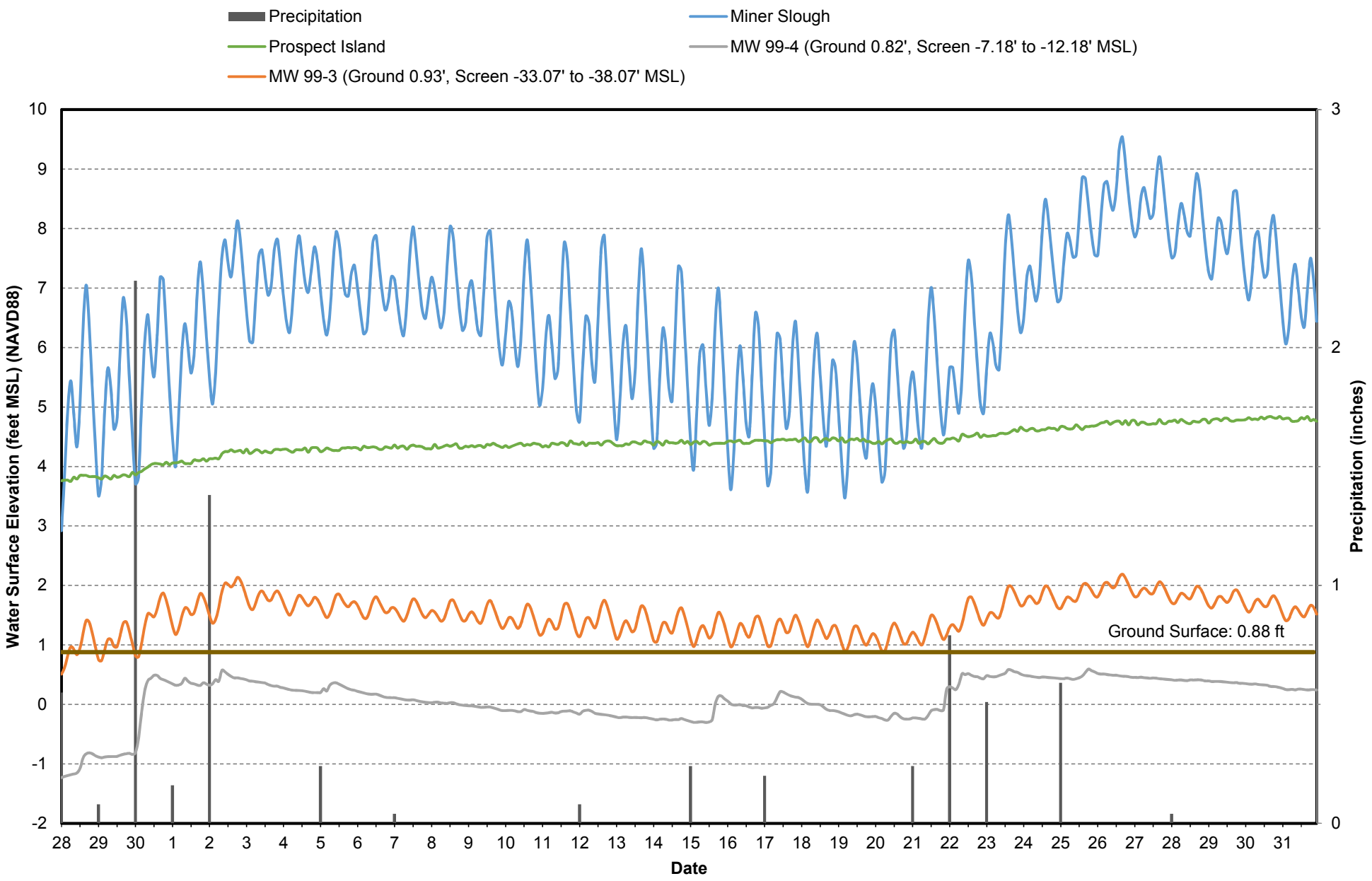


Figure 11-37

Hydrographs of Miner Slough Stage and Prospect Island Stage, Ryer Island MW 99-11 Groundwater Level with Precipitation at Georgiana Slough

Two Hour Water Levels, Daily Precipitation - November 28 through December 31, 2012

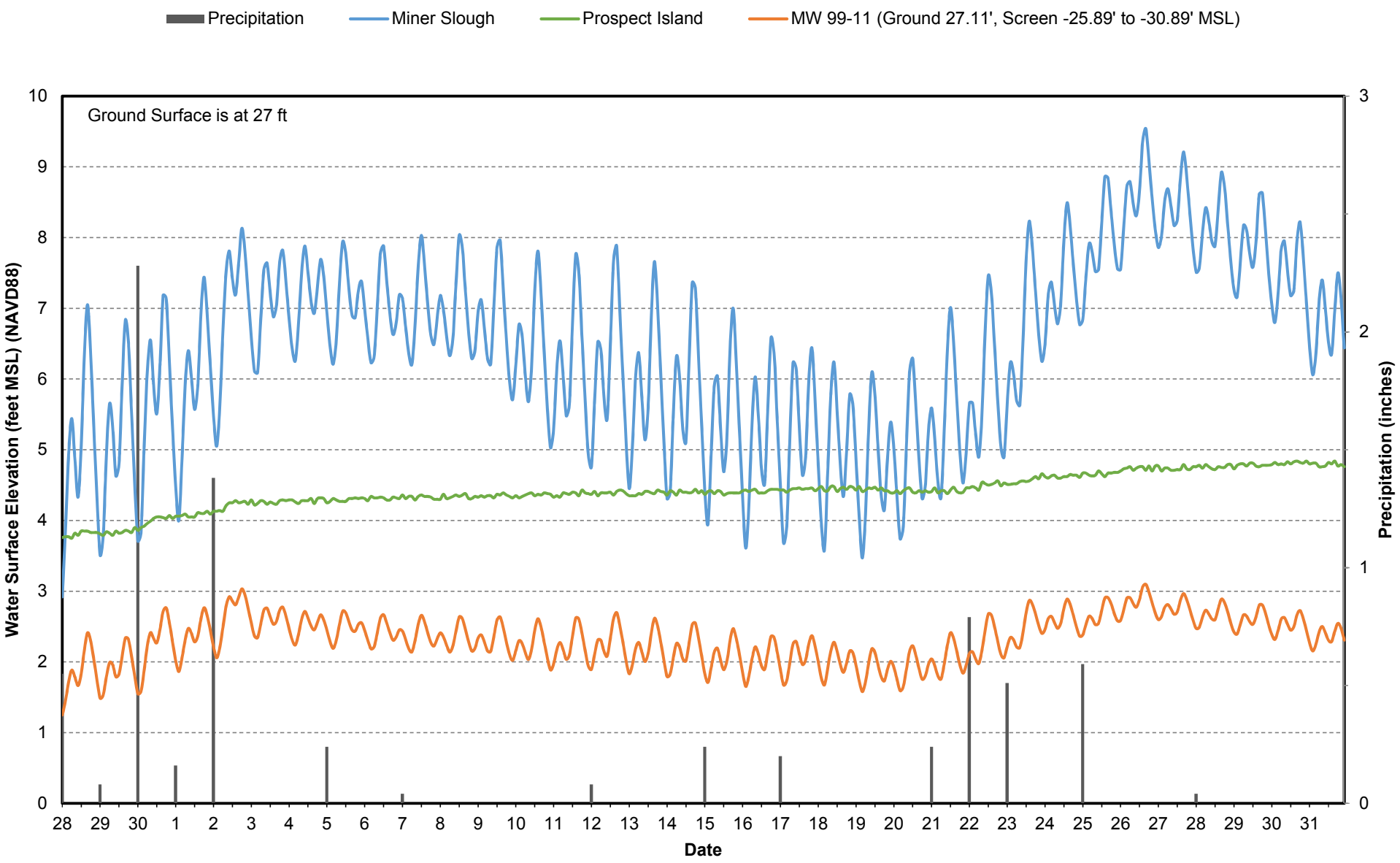


Figure 11-42

Hydrographs of Miner Slough Stage and Prospect Island Stage, Ryer Island MW 99-5 and -6 Groundwater Levels with Precipitation at Georgiana Slough

Two Hour Water Levels, Daily Precipitation - November 28 through December 31, 2012

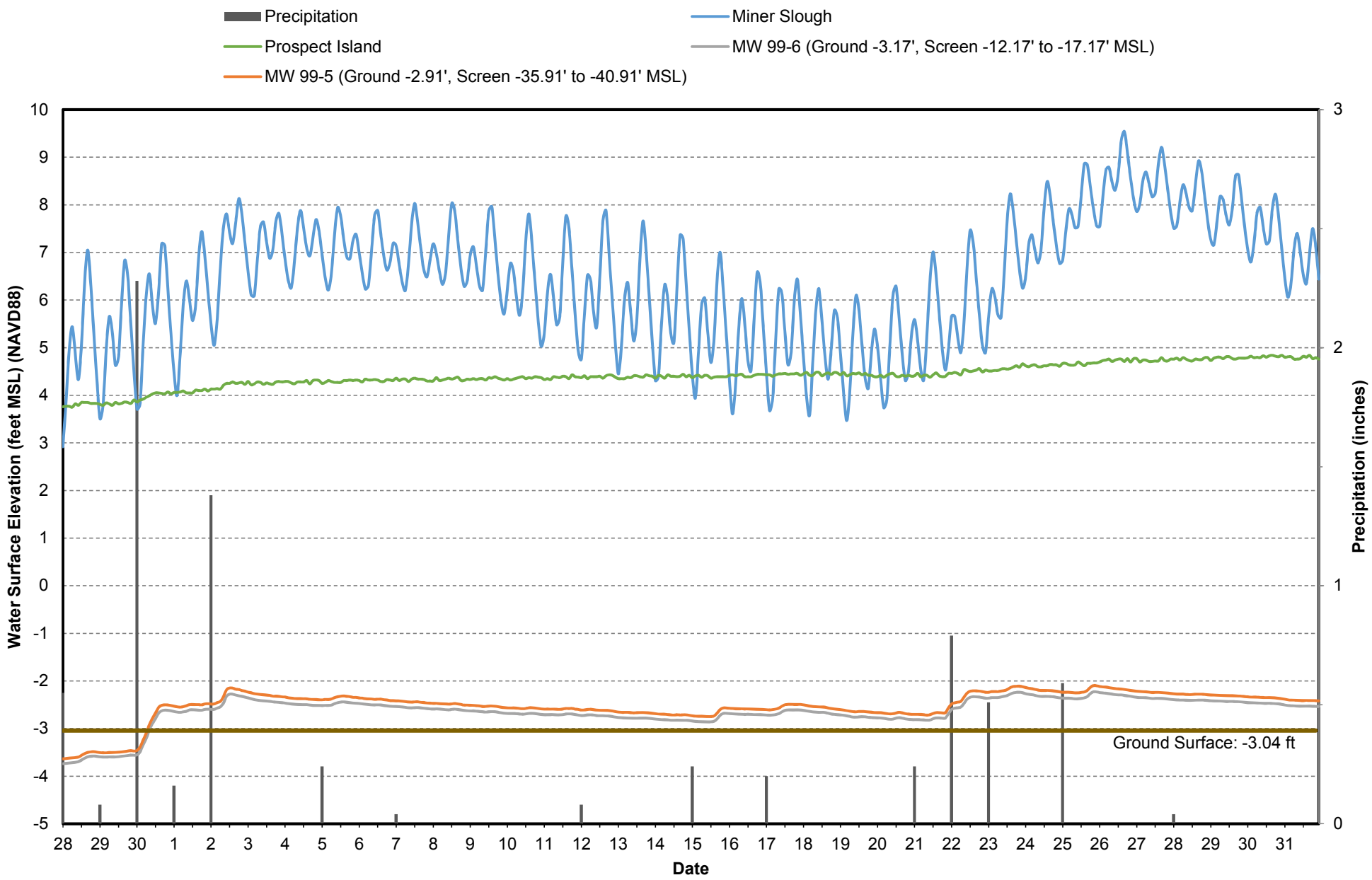
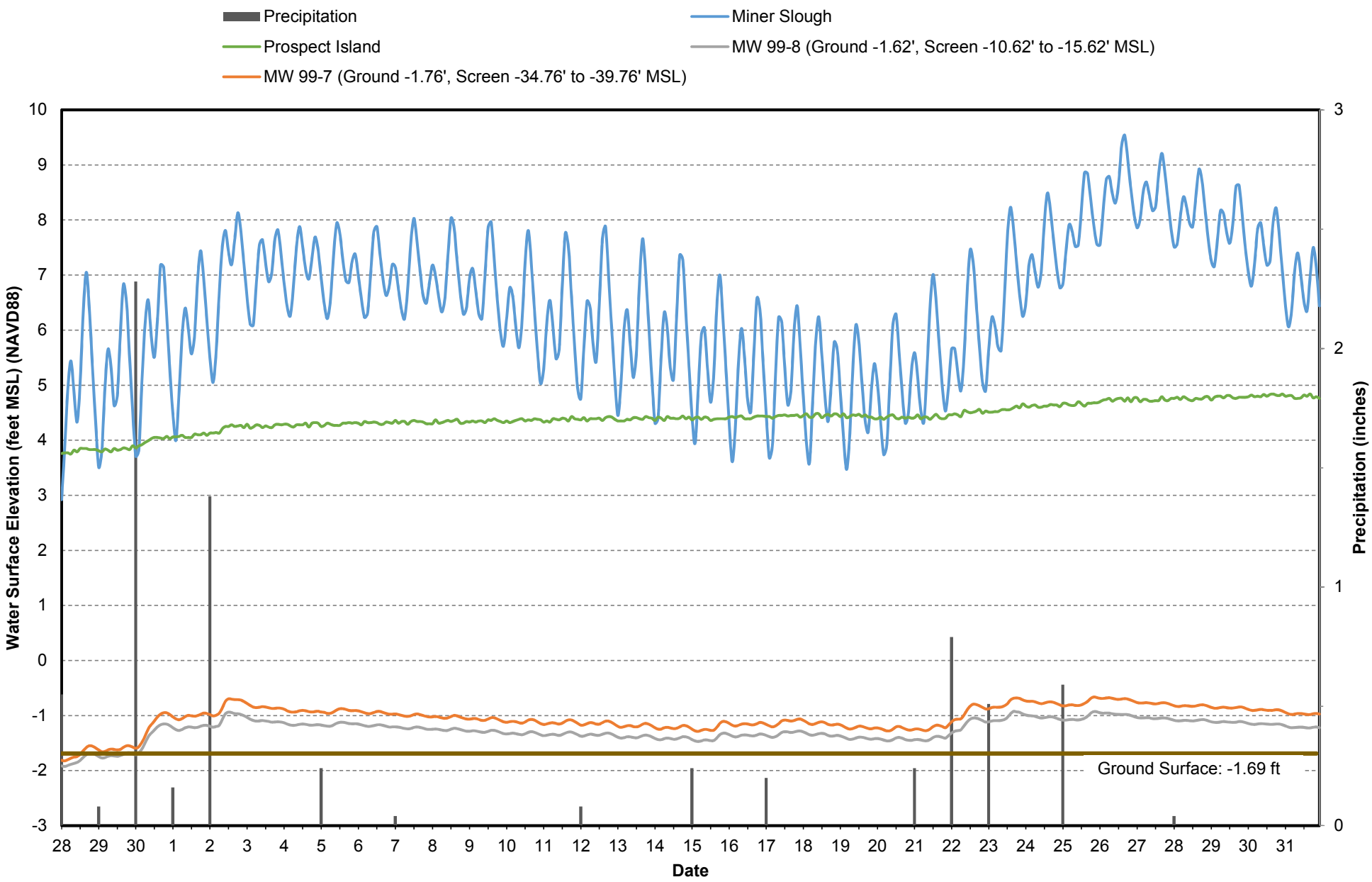


Figure 11-43

Hydrographs of Miner Slough Stage and Prospect Island Stage, Ryer Island MW 99-7 and -8 Groundwater Levels with Precipitation at Georgiana Slough

Two Hour Water Levels, Daily Precipitation - November 28 through December 31, 2012



Attachment B – DWR (2014) Report Figures

Figure 11-30
Figure 11-34
Figure 11-35
Figure 11-40
Figure 11-41

Figure 11-30

Hydrographs of Miner Slough Stage and Prospect Island Stage, Ryer Island MW 99-1 and -2 Groundwater Levels

Two Hour Water Levels - August 2012

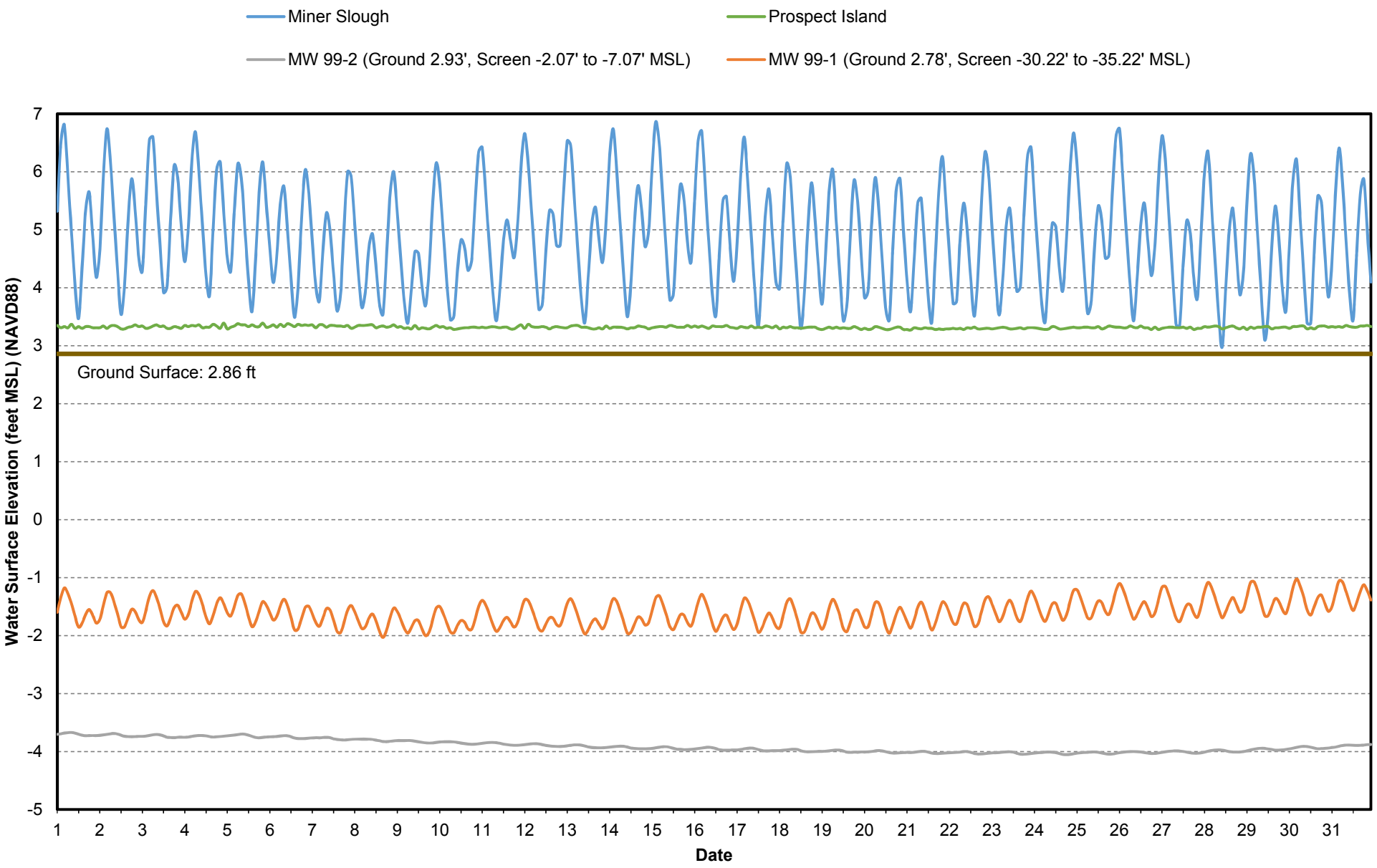


Figure 11-34

Hydrographs of Miner Slough Stage and Prospect Island Stage, Ryer Island MW 99-3 and -4 Groundwater Levels

Two Hour Water Levels - August 2012

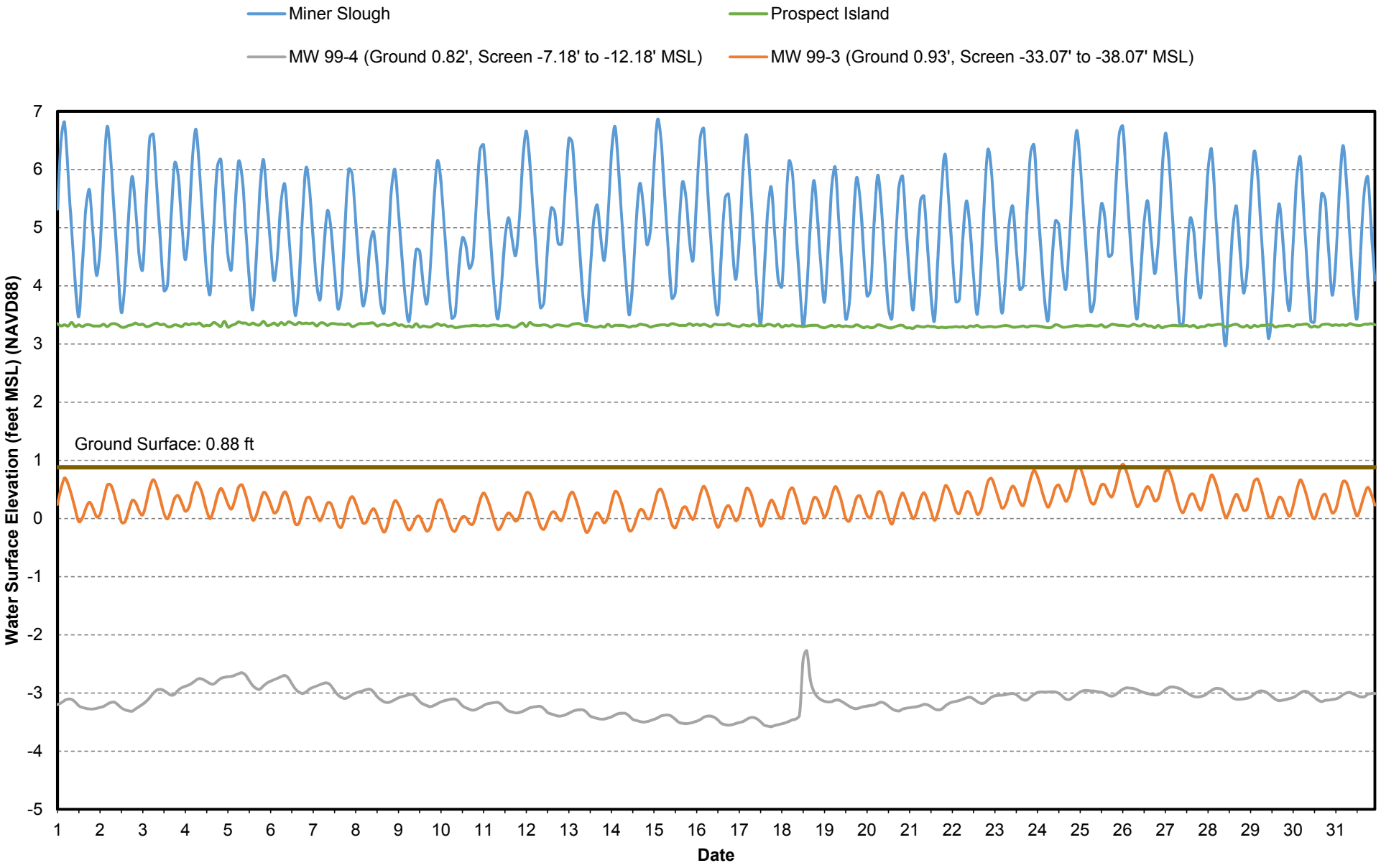


Figure 11-35

Hydrographs of Miner Slough Stage and Prospect Island Stage, Ryer Island MW 99-11 Groundwater Level

Two Hour Water Levels - August 2012

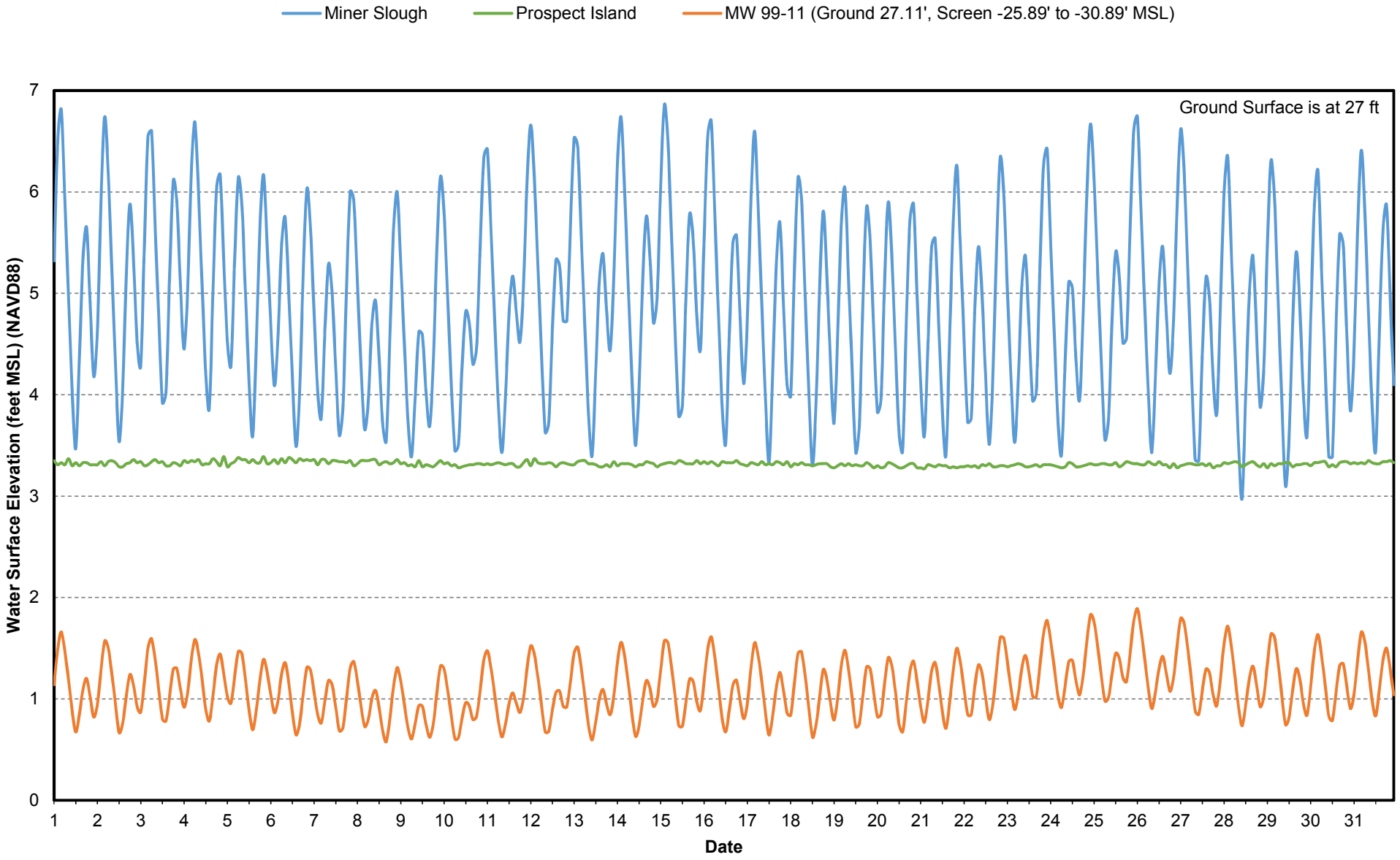


Figure 11-40

Hydrographs of Miner Slough Stage and Prospect Island Stage, Ryer Island MW 99-5 and -6 Groundwater Levels

Two Hour Water Levels - August 2012

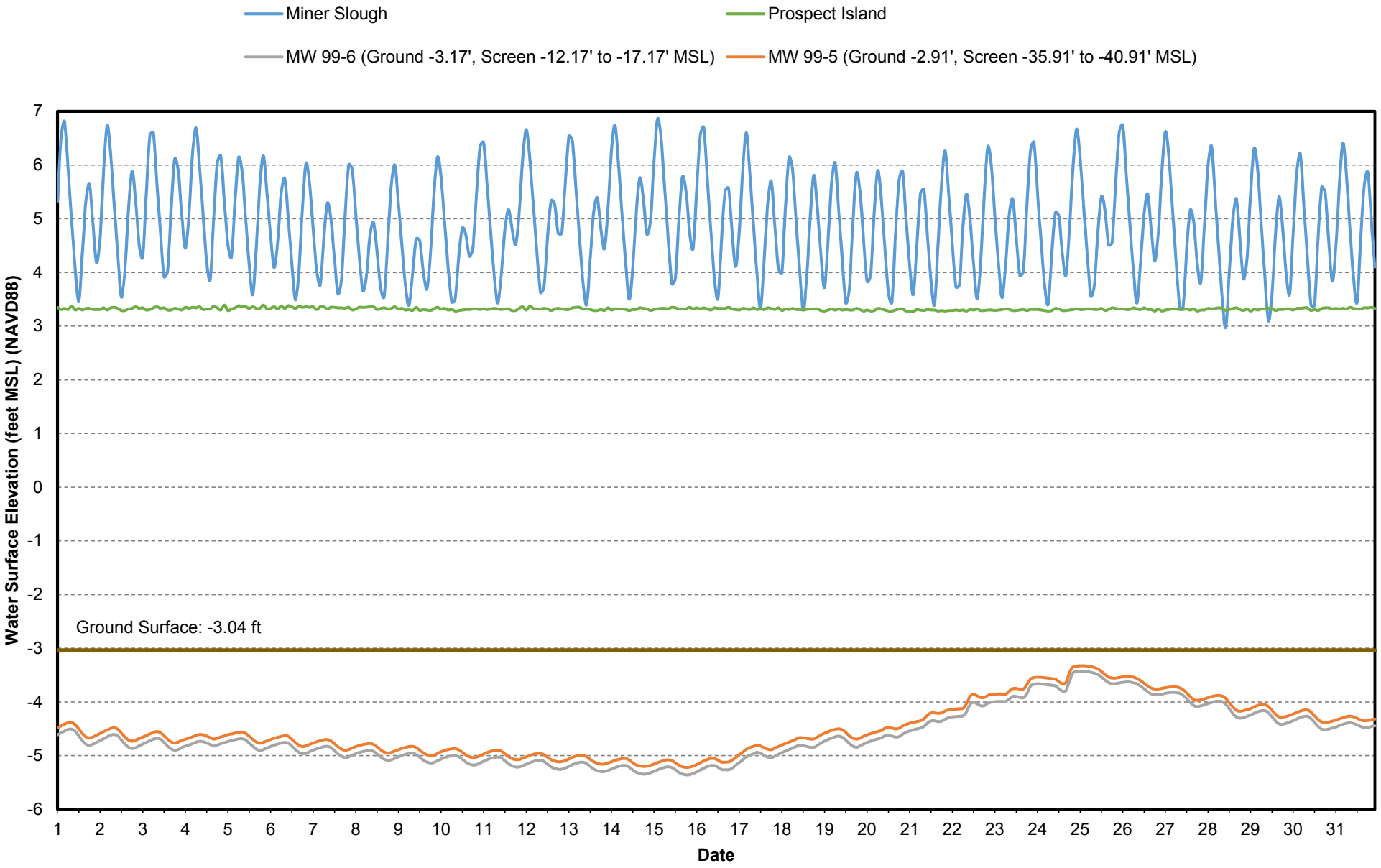
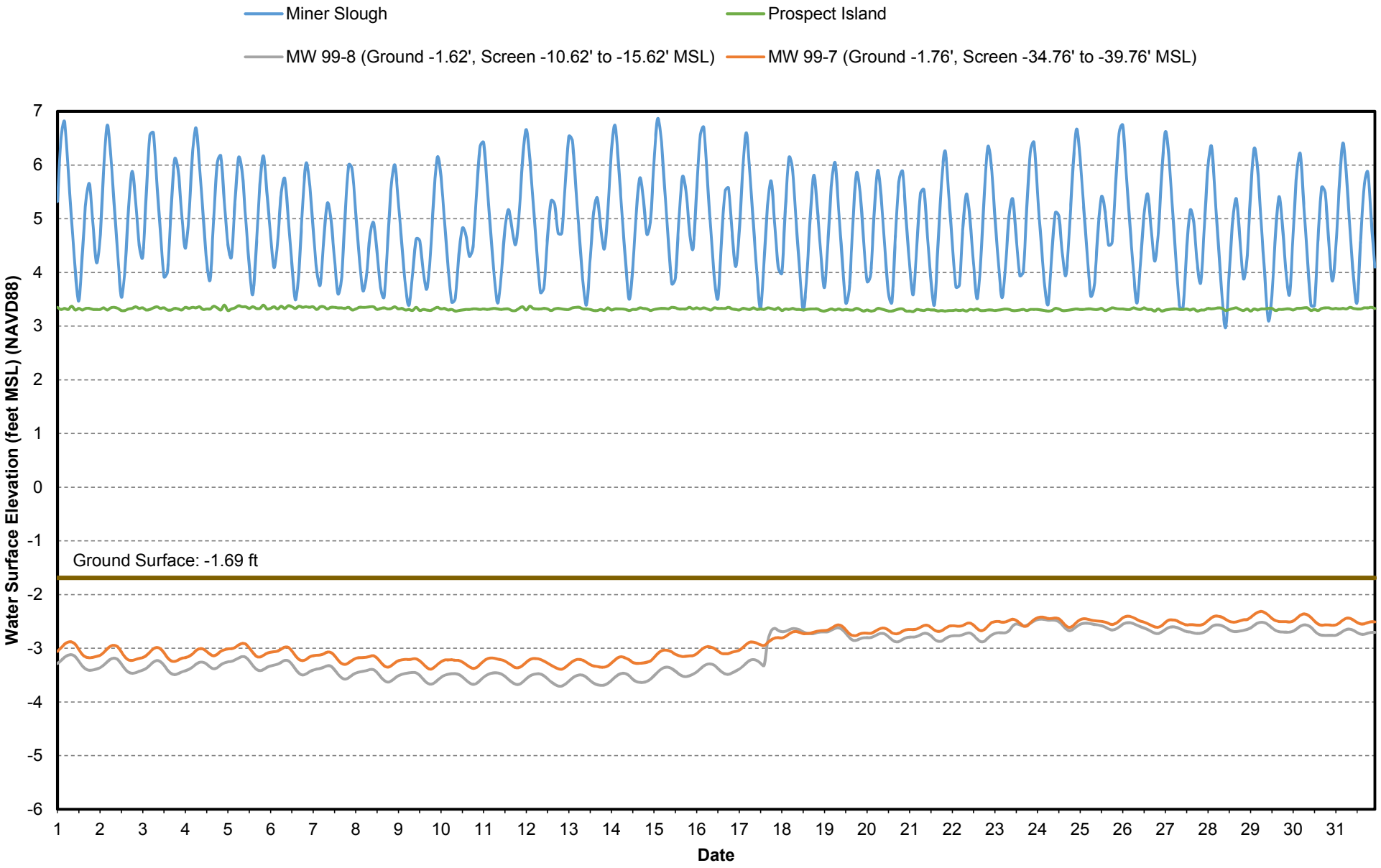


Figure 11-41

Hydrographs of Miner Slough Stage and Prospect Island Stage, Ryer Island MW 99-7 and -8 Groundwater Levels

Two Hour Water Levels - August 2012



Appendix F

Response to Supplemental Comments on the 2016 DEIR and 2019 Partial Recirculated DEIR

Table of Contents

1 INTRODUCTION 2
2 RESPONSE TO LAND SUPPLEMENTAL COMMENTS 2
3 REFERENCES 17

List of Attachments

Attachment 1. 2019 Supplemental Comment Letter

1 INTRODUCTION

On June 28, 2019 Soluri Meserve (a law corporation) submitted a letter to the California Department of Water Resources (DWR) titled "Supplemental Comments on the Partial Recirculation of the Draft EIR for the Prospect island Tidal Habitat Restoration Project" on behalf of Local Agencies of the North Delta (LAND) (**Attachment 1**). LAND is stated to include Reclamation District 501 (RD 501), International Farming Corporation, and Fahn Family Farming. The public comment period for 2019 Partial Recirculation of Draft Environmental Impact Report: Prospect Island Tidal Habitat Restoration Project (2019 Partial Recirculated DEIR) was March 1, 2019 to April 15, 2019. Therefore, this supplemental comment letter was received over two months post close of the public comment period. CEQA Guidelines Sections 15088.5(f) and 15088(a) gives DWR discretion to decide if it wishes to respond to late comments. Given the extensive consultation with LAND to date (see General Response D in 2019 FEIR **Appendix D**), DWR has decided that it would be helpful to decision-makers and the public to review and respond to the late supplemental comments.

Many of the supplemental comments received from LAND repeat concerns raised by LAND or other commenters on the 2016 Draft Environmental Impact Report (DEIR) and 2019 Partial Recirculated DEIR. In these cases, the relevant existing response(s) in 2019 FEIR **Appendix D** and **Appendix E** are referred to.

2 RESPONSE TO LAND SUPPLEMENTAL COMMENTS

S-LAND-1: EIR Completeness

Commenter states that the 2019 Partial Recirculated DEIR is an incomplete work product by DWR and generally disagrees with the impact significance determinations.

DWR Response

DWR does not agree with the view expressed by the commenter that the 2019 Partial Recirculated DEIR is an incomplete work product. All relevant impacts were analyzed, and DWR considers the EIR to be based on the best available science and rigorous technical analyses. The numerous technical reports for the Prospect Island Tidal Habitat Restoration Project were made available online at the weblinks provided in Section 4.1 *Access to Technical Reports* of the 2019 Partial Recirculated DEIR and are available on request. Except for the ENGEO Report discussed in General Response F of 2019 FEIR **Appendix E**, the commenter has not undertaken any independent technical sampling or data analysis that it thinks DWR should have considered.

DWR has considered mitigation in developing the CEQA EIR, and EIR mitigation measures are summarized in Table ES-1 *[Executive Summary]* and discussed in EIR Section 3 *Environmental Setting, Impacts, and Mitigation Measures*. DWR and commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *beneficial*, *no impact*, or *less than significant* are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA.

Additionally, good neighbor monitoring measures are discussed in General Response I in 2019 FEIR **Appendix E** and in General Response D in 2019 FEIR **Appendix D**. While DWR did not agree to all of the measures requested by commenter, DWR did agree to carry out some of the actions requested.

S-LAND-2: Monitoring and Mitigation

Commenter states that DWR avoids reasonable mitigation for Proposed Project impacts. Commenter states that the 2019 Partial Recirculated DEIR concludes that monitoring is not required for levee seepage and erosion, proliferation of weeds, and facilitation of harmful algal blooms, and without monitoring there is no means for DWR to detect or mitigate these impacts.

DWR Response

Please refer to the response to S-LAND-1. The EIR did not identify significant adverse impacts for the subjects identified in the comment. Please refer to General Response E in 2019 FEIR **Appendix E** regarding erosion, General Response F in 2019 FEIR **Appendix E** regarding seepage, General Response F in 2019 FEIR **Appendix D** regarding weeds, and to the responses to LAND-6 in 2019 FEIR **Appendix D** and LAND-31 in 2019 FEIR **Appendix E** regarding algal blooms. Mitigation is not required under CEQA when impacts are not significant. The Agricultural and Land Stewardship Framework and Strategies identified in Commenter's Exhibit A are not CEQA mitigation measures, but provide an approach that project proponents can consider. Please refer to General Response H in **Appendix D** in relation to proposed monitoring plans. As stated in the response to S-LAND-1 above, good neighbor monitoring measures are discussed in General Response I in 2019 FEIR **Appendix E** and in General Response D in 2019 FEIR **Appendix D**. While DWR did not agree to all of the measures requested by commenter, DWR did agree to carry out some of the actions requested.

S-LAND-3: Good Neighbor Policies and Monitoring

Commenter states that if the *less than significant* findings are retained, monitoring programs should be incorporated as part of the Good Neighbor Policies or as environmental commitments. Commenter states that DWR must be prepared for the Project not meeting its goals and objectives. Commenter states that there is no monitoring for probable environmental consequences of the Proposed Project, including:

- sediment trapping harming the critical refugia of Delta smelt;
- methylmercury harming wildlife and disadvantaged communities;
- invasive aquatic and terrestrial weeds, and other invasive organisms;
- algal blooms harming wildlife; and
- seepage harming crops and the threat to life and property from levee damage.

Commenter has attached proposed measures in Exhibit B of the comment letter.

DWR Response

Please refer to the responses to S-LAND-1 and S-LAND-2 above. If the EIR had identified potential significant adverse environmental impacts, the measures described in the commenter's Appendix B could be measures to consider for mitigation. However, as stated in S-LAND-2, the impacts identified in the comment were found to be *less than significant* without mitigation. For further information on the specified topics, please also refer to the following:

- For sediment trapping, please refer to the response to CSLC-7 in 2019 FEIR **Appendix D** and to LAND-39 in 2019 FEIR **Appendix E**.
- For methylmercury, please refer to the response to LAND-34 in 2019 FEIR **Appendix E**.
- For invasive aquatic and terrestrial weeds, please refer to General Response F in **Appendix D**.
- Please refer to EIR Impacts 3.3-9 and 3.3-11 for discussions relating to nonnative aquatic species. For invasive clams and mussels, please refer to the response to LAND-7 in 2019 FEIR **Appendix D** and LAND-37 in 2019 FEIR **Appendix E**.
- For algal blooms, please refer to responses to LAND-6 in 2019 FEIR **Appendix D** and LAND-31 in 2019 FEIR **Appendix E**.
- For seepage, please refer to General Response F in 2019 FEIR **Appendix E**.

S-LAND-4: Good Neighbor Policies and Agriculture

Commenter states that CDFW's 2017 Delta Conservation Framework 2018-2050 (Exhibit C) recognizes the constructive value of good neighbor policies. Additionally, commenter states that the Delta Protection Commission's Strategic Plan 2030 (Exhibit D) also calls for "supporting wildlife-friendly farming and agriculture-friendly habitat restoration" through policy A.3.

DWR Response

DWR is familiar with the two items mentioned. Good neighbor policies have been considered. Please refer to General Responses D and E in 2019 FEIR **Appendix D**.

S-LAND-5: Habitat Change and Invasive Species

Commenter states that the EIR implies that the nominal aquatic wildlife benefit from the restoration supersedes the losses of wetland and terrestrial habitat provided by current conditions, and that any risk to adjacent functional habitat and farms from its actions should be ignored. The commenter states that DWR must monitor and treat terrestrial and aquatic invasive species and set specific thresholds for action triggers.

DWR Response

DWR does not agree that the restoration project provides only a nominal aquatic wildlife benefit. The Proposed Project is functionally superior for fish, and, in the long-term, would have *beneficial* effects on water temperature, aquatic species and habitat, western pond turtle, foraging and migratory birds, and subsidence within Prospect Island due to sediment deposition, and would also remove existing hazards. Page 3-191, nor any other part of the EIR, does not state that risk to adjacent functional habitat and farms from its actions should be ignored. This is a gross misstatement by the commenter. As specified in General Response D of **Appendix D** and in General Response C of **Appendix E**, DWR has reviewed and considered the concerns raised by neighbors. Potential impacts to agriculture are discussed in Section 3.12 *Agricultural Resources* of the EIR, and all relevant agricultural impacts are assessed as *less than significant* or *no impact*. Additional information on concerns raised by neighbors of agricultural land is provided in General Responses E and F of 2019 FEIR **Appendix D** and General Response F of 2019 FEIR **Appendix E**. For methylmercury, please refer to the response to LAND-34 in 2019 FEIR **Appendix E**. For algal blooms, please refer to responses to LAND-6 in 2019 FEIR **Appendix D** and LAND-31 in 2019 FEIR **Appendix E**.

As discussed in General Response I in 2019 FEIR **Appendix E**, text relating to ongoing biological resources monitoring was removed from the EIR. The measures were discussed in EIR Section 2 *Proposed Project Description*, but were not identified as CEQA mitigation measures. Monitoring measures are also discussed in General Responses D and H in 2019 FEIR **Appendix D**. While DWR did not agree to all the measures the commenter requested as mitigation, DWR did carry out, and did agree to carry out, some of the actions requested as a good neighbor.

Regarding invasive weed concerns specifically, please refer to General Response F in 2019 FEIR **Appendix D**. As discussed in that General Response, the Proposed Project will result in fewer invasive species than currently exist on the property and, although not proposed as mitigation, some post-project monitoring will take place. Import materials are limited to quarry materials and mineral fill, and will not include topsoil with the potential for weed importation.

S-LAND-6: Invasive Species

Commenter states there is no meaningful analysis that substantiates the removal of post-implementation treatment of invasive species with “obvious project impacts” from the 2019 Partial Recirculated DEIR in support of the conclusion that the project will no longer have these impacts. Potential problems could result from invasive aquatic weeds, invasive wetland and aquatic plants, invasive fish, levee instability/erosion, and harmful algal blooms.

DWR Response

Please refer to the responses to S-LAND-2, S-LAND-3, and S-LAND-5 above, including the reference to General Response I in 2019 FEIR **Appendix E**.

S-LAND-7: Salinity

Commenter is concerned that DWR’s salinity modeling and analysis focuses on compliance with D-1641, which it says does not have any bearing on local salinity increases.

DWR Response

Please refer to EIR Impact 3.2.5: *Long-term effects on salinity in waterbodies near Prospect Island* and to General Responses G and H of 2019 FEIR **Appendix E**, which explain that *agricultural* beneficial uses would not be adversely affected. DWR did not recirculate EIR Section 3.19 *Cumulative Impacts* as part of the 2019 Partial

Recirculated DEIR, as the commenter claims. Regardless of the results of regional studies already conducted or that might be implemented, the conclusion of the EIR is that the impacts of the Proposed Project are not cumulatively significant.

S-LAND-8: 1981 NDWA Contract

Commenter states that the 1981 Contract between the DWR and North Delta Water Agency ("NDWA") for the Assurance of Dependable Water Supply of Suitable Quality serves as a good template for DWR to maintain and monitor water quality, and make reasonable efforts to avoid levee failure. In a subsequent letter to the 1981 Contract, DWR committed to "prevent or correct erosion or seepage problems" from North Delta projects and that if "operational experience of completed works reveal unforeseen impacts … they would be corrected". The 1981 Contract led to the development of claims procedures for resolving disputes over water quality exceedances that cause damage during droughts, which the commenter suggests could be a template for resolving impacts and damage caused by restoration projects. The commenter would prefer such a claims procedure over the California Tort Claims Act procedures, including for seepage or erosion. Commenter includes Exhibits E, F, and G related to this comment.

DWR Response

The 1981 NDWA Contract does not apply to the Proposed Project.

DWR and commenter disagree on the impact of the Proposed Project regarding water quality, seepage, and erosion. It is DWR's opinion that the conclusions of the EIR regarding these impacts that are considered *no impact* or *less than significant* are supported by substantial evidence, and the best available science, and that they, therefore, do not require mitigation under CEQA. Please refer to **General Response F** regarding seepage and **General Response E** regarding erosion.

S-LAND-9: Seepage Measures

Commenter states that detailed measures to address seepage were developed in the context of the Delta Wetlands Project (Exhibit H), which also included flooding of an island, and should be considered as a template for adequate monitoring and mitigation measures.

DWR Response

Please refer to General Response F of 2019 FEIR **Appendix E**. DWR and commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *less than significant* are supported by substantial evidence and best available science and that they, therefore, do not require mitigation under CEQA. Please also refer to the response to S-LAND-1 above.

S-LAND-10: Cumulative Impacts List Approach

Commenter states the 2019 Partial Recirculated DEIR's cumulative impact analysis is incomplete as it does not provide the specified "list approach". The commenter states that there are currently 128 projects listed on the Sacramento County website, not 62. The commenter also states that there is no analysis of the Solano CEQA projects, list of reviewed projects, or links to more information, and the Yolo County link is broken.

DWR Response

Please refer to Table 3.19-1 in EIR Section 3.19.2 *[Cumulative Impacts] Cumulative projects considered in this EIR* for the list of projects considered.

At the time the 2016 DEIR was prepared, 62 private projects were listed on the Sacramento County planning projects website (http://www.planningdocuments.saccounty.net/). When reviewed in August 2019, there are 131 "Delta" private projects listed on the same website (note that Prospect Island is directly west of the Sacramento "Delta" boundary identified on the project viewer and is in southeastern Solano County). EIR Section 3.19.2 *[Cumulative Impacts] Cumulative projects considered in this EIR* has been updated to reflect the additional projects now listed. Projects in Solano County (http://www.solanocounty.com/depts/rm/documents/default.asp) are also considered in EIR Section 3.19.2 *[Cumulative Impacts] Cumulative projects considered in this EIR*. The link to the Yolo County webpage (https://www.yolocounty.org/community-services/planning-public-works/planning-division/current-projects) has been updated in the same section. However, none of these private projects would result in an overlapping contribution with any of the Proposed Project's impacts.

Please also refer to General Response G of 2019 FEIR **Appendix D.**

S-LAND-11: Sacramento County Projects

Commenter disagrees with the EIR's statement that none of the private projects analyzed in the cumulative impacts would have overlapping contributions to those of the

Proposed Project. The commenter states that they have encountered eight projects that would overlap with the Proposed Project on the Sacramento County website and the EIR's analysis is incomplete.

DWR Response

DWR recognizes that there are private projects in Solano County and neighboring counties that will disturb land, move earth, use vehicles creating particulates and greenhouse gases ("GHG"), and build or remove structures, and the analysis in the EIR considered these aspects in determining that there was no overlap that would cause a cumulatively significant impact. Commenter states that it considers that there are eight overlapping projects in Sacramento County, but did not specify the projects with which it is concerned. DWR has re-reviewed the projects on the Sacramento County website and does not consider that there are any projects that would overlap in space and time with the Proposed Project, such that there could be a significant combined impact on the resources in question.

S-LAND-12: Projects in Neighboring Counties

Commenter states that a list of public projects in Yolo, Solano, Sacramento, Contra Costa, and San Joaquin counties should be provided in the cumulative impacts section of the EIR.

DWR Response

Prospect Island is situated in the southeastern portion of Solano County, neighboring Sacramento County. Yolo County is to the north of Solano County, which is the direction from which traffic will likely access the site. Sacramento County wraps around the bottom of Solano County, such that Contra Costa and San Joaquin counties are a considerable distance south of the Proposed Project and beyond where tangible overlapping impacts could be realized, given the Proposed Project location, description, and relevant resources. Accordingly, projects that may overlap in space and time to generate a potential cumulative impact are considered for Sacramento, Solano, and Yolo counties. Information on the relevant projects in the Sacramento, Solano, and Yolo counties are available at the weblinks provided in the response to S-LAND-10 above.

S-LAND-13: Past Projects

Commenter states that a cumulative impact analysis must include past projects. Commenter states that Mound Farms, Peter's Pocket, Prospect West, and the Ryer

wetland projects are identified on EIR Figure 2.1-4, but are not discussed in the cumulative impact analysis.

DWR Response

This cumulative impact analysis focuses on projects that are not already considered in the analysis of potential impacts on environmental resources (see EIR Section 3 *Environmental Setting, Impacts, and Mitigation Measures*) due to actions and elements included in the Proposed Project (see EIR Section 2 *Proposed Project Description*). Past environmental conditions, including significant projects implemented before NOP issuance (2013) and DEIR preparation (2015), are captured by the assessment of existing conditions in the *Environmental Setting* section of each resource area analysis. This includes projects identified on Figure 2.4-1, including Mound Farms, Peter's Pocket, Prospect West, and Ryer wetland.

S-LAND-14: EcoRestore Program and Projects

Commenter states that the EIR identifies programs, but does not discuss specific projects under those programs. For example, the EIR identifies EcoRestore as a cumulative project, but the analysis fails to say which EcoRestore projects DWR included in the cumulative impact analysis.

DWR Response

Please refer to General Response G in 2019 FEIR **Appendix D**. EIR Table 3.19-1 lists relevant projects, including EcoRestore projects. Further information is available on the EcoRestore website: http://resources.ca.gov/ecorestore/.

S-LAND-15: Additional Projects for Analysis

Commenter states that the 2018 Lookout Slough, 2018 Yolo Flyway Farms, Little Egbert Tract, and other projects in the immediate area of Prospect Island should be included as part of the EIR's cumulative impact analysis.

DWR Response

Although initiated later than the Prospect Island Proposed Project baseline, these projects have been added to Table 3.19-1 in the FEIR and considered in the cumulative impact analysis.

S-LAND-16: WaterFix and Delta Conveyance

Commenter states the largest project that was identified in the EIR (the "California WaterFix/Delta Tunnels scheme") was not included in any cumulative analysis of impacts from flow reversals, residence time, or water quality and should be included.

DWR Response

Table 3.19-1 has been updated to reflect the withdrawal of WaterFix and the proposed 'Delta Conveyance' single tunnel configuration (https://water.ca.gov/deltaconveyance). The Delta Conveyance project has been considered in EIR Section 3.19 *Cumulative Impacts* analysis. Salinity modeling conducted in support of the BDCP / California Water Fix Final EIR/EIS has additionally been considered in General Response H in 2019 FEIR **Appendix E**. Please also refer to General Response G in 2019 FEIR **Appendix D** for information on the cumulative impact analysis.

S-LAND-17: Tidal Range

Commenter states that a tidal restoration project such as Prospect Island relies on the tidal range for much of its ecological value and the EIR's conclusion that "less tidal range is better belies logic". Commenter states that the change of tide ranges would be a significant impact, rather than a beneficial effect. The commenter also states that an "increase to the heights of low tides" is a threat to agricultural water supply and drainage and remains unanalyzed as a threat to levees.

DWR Response

The predicted cumulative reduction of tidal range would be regionally beneficial because it would counter flood risks associated with projected increases in regional mean sea level rise, as described in Section 3.19.3 *[Summary of cumulative impacts] Hydrology*.

With regard to increasing the heights of low tides, this would be beneficial to agricultural pumping, because the higher water levels at low tide represent a lower pump lift during irrigation operations. Since most drainage pumps are free discharges, there would be no impact to drainage operations from changes of tidal range. With regard to potential tidal range effects upon levee integrity, because existing conditions represent a wider tidal range than that for the Proposed Project, any impact of increased low tides would be within the same area of the levee slope as under existing conditions.

Please also refer to the response to LAND-16 in 2019 FEIR **Appendix E**.

S-LAND-18: Cumulative Traffic Impacts

Commenter states that the cumulative impact analysis in the EIR was not updated to reflect the change in the proposed truck traffic impact severity and scale across multiple counties for traffic or air quality.

DWR Response

The more detailed consideration of truck transport that was included in the 2019 Partial Recirculated DEIR has been considered regarding cumulative impacts. No cumulatively considerable impacts have been identified.

S-LAND-19: Adequacy of Cumulative Impact Analysis

Commenter states that the cumulative impact analysis is inadequate for failing to address all related projects, analyze project changes and changes in conditions, and acknowledge the cumulatively considerable impacts to tidal habitat.

DWR Response

DWR and commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered not cumulatively considerable, including aquatic biological resources impacts, are supported by substantial evidence and best available science and that they, therefore, do not require mitigation under CEQA.

S-LAND-20: Tidal Range Impacts on Delta Smelt

Commenter states that the assessment of cumulative impacts for tidal range is defective. Commenter considers that the reduction in tidal range is not beneficial, but a new significant impact on the existing tidal habitat, which is critically important for Delta Smelt survival adjacent to Cache Slough.

DWR Response

Please refer to the response to S-LAND-17 above, which also relates to tidal range impacts. Future tidal restoration projects are likely to slightly reduce tidal range with regional increases to tidal prism (i.e., the volume of tidal exchange). The commenter provides no evidence in its comment, nor in Exhibits I and J, linking these changes to Delta Smelt life history effects. The predicted cumulative regional reduction of tidal range would not have a significant adverse impact on the availability of low salinity habitat for Delta Smelt. Furthermore, EIR Impacts 3.3-2 *Long-term conversion and*

enhancement of aquatic habitat and 3.3-10 *Long-term impacts to fish in Prospect Island and adjacent water bodies from changes in water temperature* are both assessed as *beneficial*.

S-LAND-21: Tidal Range and Flow Changes

Commenter states that the Proposed Project has poorly designed flow and tidal range impacts, which could reduce any of its purported benefits and may never achieve positive biological benefits. Flow through the levee breaks would result in dramatically increased residence times long enough to result in harmful algal blooms. The Proposed Project would increase the Highway 84 Bridge flow by 3,000 cfs, which is a massive increase in flow directed at Arrowhead Harbor Marina. Commenter states that under CEQA, this would be a significant threat to health and safety, and that if the marina and its vessels are damaged and leak petroleum and blackwater, the environmental impacts would be significant.

DWR Response

Please refer to S-LAND-20 above.

Regarding potential for harmful algal blooms, please refer to the response to S-LAND-2 above.

Regarding the potential for damage to Arrowhead Harbor Marina, recognizing flow increases are observed upstream of the project site during 100 year and 200 year flood events, hydrodynamic modeling shows no velocity changes within the Marina (RMA 2016). Therefore, no impacts from damage to Marina infrastructure or vessels is expected.

DWR and commenter disagree on the impact of the Proposed Project. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *no impact* or *less than significant*, including aquatic biological resources impacts, are supported by substantial evidence and best available science and that they, therefore, do not require mitigation under CEQA.

S-LAND-22: Mallard Farms Conservation Bank

Commenter states that DWR sought to block the Mallard Farms Conservation Bank Project over concerns of impacts to levee integrity, and impacts related to hydrology and salinity, citing to two DWR comment letters (Exhibits K and L). Commenter considers that DWR is "willfully ignoring" those same impacts from its own project.

DWR Response

Commenter raises an issue that is not related to the adequacy of the environmental impact analysis in the EIR. Commenter is mistaken in saying that DWR sought to block the Mallard Farms Conservation Bank Project in its comments. DWR recognizes that impacts relating to levee integrity, hydrology, and salinity are important, and has considered these impacts in depth in the EIR and comment responses (see 2019 FEIR Appendices D and E).

S-LAND-23: Delta Protection Commission's 2010 Land Use and Resource Management Plan

Commenter states that the EIR fails to fully analyze the Delta Protection Commission's 2010 Land Use and Resource Management Plan for the Primary Zone of the Delta. The commenter states that Land Use Policies 3 and 14 are applicable and should be analyzed in the EIR.

DWR Response

Land Use Policy 3 and 14 were not identified because their focus is on the conversion of agricultural land. The Proposed Project is not inconsistent with these policies. With regard to Land Use Policy 14 of the Delta Protection Commission's 2010 Land Use and Resource Management Plan, no existing agricultural land would be converted for water impoundment or wetland development. Please refer to Section 3.12.1 *[Agricultural Resources] Environmental Setting* and Impact 3.12-1 in Section 3.12.3 *[Agricultural Resources] Impacts and mitigation* of the EIR. No portion of Prospect Island is designated as Prime, Unique, or Important Agricultural Land, and the only land viable for agriculture is north of the northern cross-levee. During construction activities, up to 17.7 ac of land north of the northern cross-levee (comprising of 10.9 of adjacent Fahn land currently used for agriculture, and 6.8 ac of Prospect Island land that is not currently used for agriculture) would potentially be converted to a temporary staging area (see EIR Table 2.2-2 and Figure 2.2-3). Following construction activities, the 6.8 ac of viable agricultural land that is not currently used for agriculture would be planted with a riparian mix containing both canopy and understory trees and shrubs, creating complex, high value riparian area; the other 10.9 ac would remain in agriculture. For the reasons described in Impact 3.12-1, the 6.8 ac loss of viable agricultural land is not considered significant and no mitigation is necessary.

With regard to Land Use Policy 3, as stated, the policy is designed to prevent conflicts between any proposed use and existing adjacent agricultural parcels. Except for one property, the Proposed Project is not adjacent to other agricultural parcels. As described

in the Proposed Project description, portions of the site bordering agricultural land uses to the north will be planted with riparian species to provide a buffer between agricultural and restoration site land uses. Other agricultural areas are buffered by waterways. Prospect Island is buffered by Miner Slough to the east, the DWSC to the west, and Miner Slough Wildlife Area to the south. Proposed Project actions which will convert the property from the existing flooded condition to an ecosystem with improved functions, including levee repair prior to dewatering and invasive species control, are expected to improve existing conditions and reduce potential for land use conflicts with neighbors.

Please also refer to General Responses E and F in 2019 FEIR **Appendix E** regarding erosion and seepage, as well as to General Response D in 2019 FEIR **Appendix D**.

S-LAND-24: 1981 NDWA Contract

Commenter states the EIR fails to address the 1981 NDWA Contract between the DWR and North Delta Water Agency (NDWA). Commenter refers to Article 6 of the 1981 NDWA Contract, which relates to flow impacts. The commenter considers that the Proposed Project poses a significant risk of causing levee seepage and erosion. Should such impacts occur without mitigation, the commenter considers that DWR would be in violation of the 1981 NDWA Contract.

DWR Response

The 1981 NDWA Contract does not apply to the Proposed Project.

Furthermore, DWR and commenter disagree on the impact of the Proposed Project regarding seepage and erosion. It is DWR's opinion that the conclusions of the EIR regarding seepage and erosion impacts that are considered *less than significant* are supported by substantial evidence, and the best available science, and that they, therefore, do not require mitigation under CEQA. Please refer to **General Response F** regarding seepage and **General Response E** regarding erosion.

S-LAND-25: Transportation Impacts

Commenter states that DWR has apparently abandoned efforts to obtain easements across private property on Little Holland Tract and will rely on public access routes. Commenter states that the single public access point should be analyzed, and it would have significant air quality and health risks to Arrowhead Harbor Marina. The commenter also considers that the traffic mitigation measures in the Partial Recirculated DEIR are "impermissibly vague" and what constitutes deteriorated road conditions or

necessary repairs should be defined. The commenter queries why SR-84 is excluded from the mitigation measure.

DWR Response

DWR has not made any changes to access routes at this time. With regards to traffic mitigation, please refer to the response to LAND-48 in 2019 FEIR **Appendix E**. With regards to SR-84, please refer to the response to LAND-51 in 2019 FEIR **Appendix E**.

S-LAND-26: Significance of Impacts and Good Neighbor Policies

Commenter concludes that the Proposed Project would have significant impacts on the environment, surrounding levees, and adjacent land uses. The commenter states that DWR omits discussion of these impacts, and impacts could likely be avoided or reduced through imposition of feasible mitigation or through incorporation of good neighbor policies into the Proposed Project.

DWR Response

DWR and commenter disagree on the impact of the Proposed Project on a number of resource areas. It is DWR's opinion that the conclusions of the EIR regarding impacts that are considered *no impact*, *less than significant*, or not cumulatively considerable are supported by substantial evidence and the best available science and that they, therefore, do not require mitigation under CEQA. Mitigation Measure 3.17-1.2 is a reasonable approach to mitigate for potential road surface impacts. Regarding good neighbor actions, please refer to General Response D in 2019 FEIR **Appendix D**.

3 REFERENCES

California EcoRestore. 2019. California EcoRestore: A Stronger Delta Ecosystem. Website. http://resources.ca.gov/ecorestore/ (Accessed: June 15, 2019).

DWR (Department of Water Resources). 2019. Delta Conveyance. Website. https://water.ca.gov/deltaconveyance (Accessed: June 15, 2019).

Sacramento County. 2019. Planning Projects Viewer: Delta. Website application. https://planningdocuments.saccounty.net/ (Accessed: August 2019).

Solano County. 2019. Resource Management Documents. Website. http://www.solanocounty.com/depts/rm/documents/default.asp (Accessed: July 2019).

Yolo County. 2019. Current Projects. Website. https://www.yolocounty.org/community-services/planning-public-works/planning-division/current-projects (Accessed: July 2019).

Attachment 1

2019 Supplemental Comment Letter

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S-LAND

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June 28, 2019

SENT VIA EMAIL AND U.S. MAIL (Dan.Riordan@water.ca.gov)

Dan Riordan
California Department of Water Resources
P.O. Box 942836
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RE: Supplemental Comments on the Partial Recirculation of the Draft EIR for the Prospect Island Tidal Habitat Restoration Project

Dear Mr. Riordan:

These supplemental comments on the February 2019 Revised Draft Environmental Impact Report ("RDEIR") and 2016 Draft Environmental Impact Report ("DEIR")[1] for the Prospect Island Tidal Habitat Restoration Project ("project") prepared by the California Department of Water Resources ("DWR") are submitted on behalf of Local Agencies of the North Delta, Reclamation District 501 ("RD 501"), International Farming Corporation, and Fahn Family Farming[2] (collectively, "LAND"). This comment

S-LAND-1
(Cont. below)

[1] The DEIR is not, but should be, readily publicly available since it comprises part of the environmental review for the project. The original link to the DEIR (and found in most DWR reference documents was https://water.ca.gov/environmentalservices/frpa_prospect_restoration.cfm; a version is found at: https://water.ca.gov/LegacyFiles/environmentalservices/docs/frpa/Prospect_DEIR_08_09_2016_Web.pdf; and now the only link to the other project files is found here, but without the DEIR: https://water.ca.gov/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects.
The RDEIR is even more difficult to find: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects/Files/partial-recirculation-of-draft-enfiornmental-impact-report-02-2019.pdf

[2] LAND member agencies cover an approximately 118,000-acre area of the Delta. Some of these agencies provide both water delivery and drainage services, while others only provide drainage services. These districts also assist in the maintenance of the levees that provide flood protection to homes and farms. The International Farming Corporation ("IFC") recently purchased over 6,200 acres of land previously owned by Islands Inc.

letter supplements LAND's April 15, 2019 comment letter ("2019 LAND Comments"), which previously raised concerns with the project's potential significant impacts on the environment, public health, and infrastructure.

The RDEIR is an incomplete work product by DWR. Despite entirely new impacts arising from project changes, the RDEIR concludes impacts would be insignificant and not require mitigation. Other significant impacts are ignored and omitted entirely, despite being implicated by the project's changes. The project could, however, be an opportunity for DWR to meet the requirements of CEQA and demonstrate how coordination with local agencies and communities can lead to mutual success on restoration projects. S-LAND-1 (Cont.)

I. DWR FAILS TO IMPLEMENT BASIC GOOD NEIGHBOR MEASURES NECESSARY FOR PROJECT SUCCESS

The conclusions in the RDEIR reveal DWR's desire to avoid any reasonable mitigation for project impacts. (See 2019 LAND Comments, pp. 3, 4, 7, 8.) For instance, the RDEIR concludes that for obvious project impacts, such as levee seepage and erosion, proliferation of weeds, and facilitation of harmful algal blooms ("HABs"), monitoring is not required since the impacts are no longer considered significant impacts. Yet without monitoring, there is no means by which DWR would ever detect or mitigate these impacts. Thus, without monitoring, DWR cannot adaptively manage the project's impacts. S-LAND-2

If DWR wishes to maintain certain CEQA less than significant findings in the RDEIR, subsequent monitoring programs could be incorporated as part of Good Neighbor Policies or as environmental commitments. DWR's own Agriculture and Land Stewardship Framework and Strategies, attached as Exhibit A,[3] provides most of the measures that could be adopted for the project. Experimental restoration projects such as this one cannot be successful if they rely on vague and unenforceable assurances. DWR S-LAND-3 (Cont. below)

(Tom Hester). (See https://www.internationalfarming.com/.) IFC has a strong interest in protecting its Ryer Island lands from damage from inadequately mitigated neighboring projects, such as the Prospect Island restoration project. The Fahn Family owns land on Ryer Island as well as land directly north of the project site that would receive negative offsite impacts from the project if not properly mitigated.

[3] Also available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Materials/ALS/ALS---Framework-and-Strategies-Updated.pdf?la=en&hash=6E0ED25D3D1906CF2AD1786DB520D3B0EF2E6539

must be prepared for the project not meeting its goals and objectives; there is a limited history of successful DWR restoration projects in the Delta.

LAND's draft proposed Good Neighbor Policies (or similar measures), attached as Exhibit B, should be incorporated into the project in some fashion.[4] Currently, there are no monitoring (or no scientific methods and metrics) for probable environmental consequences of the Prospect restoration project, including:

- sediment trapping harming the critical refugia of the listed Delta smelt in the Cache Slough complex;
- the promotion of the persistent bioaccummulative toxin, methylmercury, harming wildlife and disadvantaged communities;
- the promotion of invasive aquatic and terrestrial weeds, and other invasive organisms;
- HABs harming wildlife; and
- seepage harming crops and the threat to life and property from levee damage.

S-LAND-3 (Cont.)

The California Department of Fish and Wildlife ("DFW") recognized the constructive value of measures like LAND's Good Neighbor Polices for restoration actions in the Delta in its 2017 Delta Conservation Framework 2018-2050, attached as Exhibit C. "Potential conflicts between conservation projects and local community goals could be resolved by . . . [u]sing good-neighbor practices when managing conservation lands over the long term." (Exhibit C, p. II-13, see also II-31, 32.) The Delta Protection Commission's ("DPC") Strategic Plan 2030 also calls for "[s]upport[ing] wildlife-friendly farming and agriculture-friendly habitat restoration" through policy A.3, promoting and disseminating "good neighbor policies to Delta farms and environmental entities." (Exhibit D, DPC Strategic Plan 2030, p. 11.)

S-LAND-4

A. Good Neighbor Policies Would Mitigate Weed Proliferation

The DEIR implies that the nominal aquatic wildlife benefit from the restoration supersedes the losses of wetland and terrestrial habitat provided by current conditions, and that any risk to adjacent functional habitat and farms from its actions (such as seepage, methylmercury and HABs) should be ignored. (DEIR, p. 3-191.) The RDEIR then removed post-construction monitoring of invasive species. (RDEIR, p. 5-56.)

S-LAND-5 (Cont. below)

[4] These (or similar) measures could also be adapted on a programmatic level for all restoration projects being carried out by DWR in compliance with the 2008 and 2009 Biological Opinions.

Invasive weeds and other organisms, such as clams, pose chronic problems and inhibit the success of aquatic and wetland projects such as this. The project fails to even use the most rudimentary measures for invasive species mitigation, such as:

- that imported fill is weed free;
- that trucks and equipment are pressure washed to remove seeds from offsite (note that there is not mention of this BMP in the text or the equipment inventory in the appendices); and/or
- post-construction weed management.

The RDEIR mentions weed treatment for some of the many invasive plants it has already promoted through mismanagement of the site. (RDEIR, p. 5-34.) However, DWR ignores the new weeds the project could bring on the site both during and after construction.

S-LAND-5 (Cont.)

DWR must monitor and treat terrestrial and aquatic weeds and set specific thresholds for action triggers. The project's current invasive and noxious conditions are a perfect illustration of the chronic failure to manage weeds to the detriment of the environment and project neighbors. DWR itself must realize the threat posed by invasive species, as it has already engaged in weed management for the levees at the project site.

The RDEIR identifies existing management, or lack thereof, has allowed Prospect Island be host to several ecologically disruptive, invasive plant species. (RDEIR, p. 5-34.) The RDEIR then described that it would mechanically disk to clear the project site and use a variety of chemical treatments to manage invasive plants. (RDEIR, pp. 5-34 to 5-38.)

Inexplicably, the RDEIR deletes the post-implementation treatment of weeds and a host of previously analyzed and accepted as factual invasive plants, animal and microorganisms. (RDEIR, p. 5-56.) Originally, the DEIR included the following:

> In addition, post-construction monitoring of the Project site would be necessary to identify potential problems and formulate corrective measures for addressing them. Potential problems that could occur at the Project site include:
> • Colonization and establishment of invasive aquatic weeds
> • Colonization and establishment of invasive wetland and upland plants
> • Colonization by invasive fish
> • Levee instability/erosion
> • Harmful algal blooms

S-LAND-6 (Cont. below)

(*Ibid.*) There is no meaningful analysis that substantiates the removal of these obvious project impacts from the RDEIR, and certainly no scientific basis, let alone best available science ("BAS"), in support of the conclusion that the project will no longer have these impacts. (See Code of Regs., tit. 23, § 5002, subd (b)(3), Appen. 1A.)

S-LAND-6
(Cont.)

B. Good Neighbor Policies Would Reduce Salinity

DWR acknowledges that there is a need to systematically analyze changes in salinity due to its restoration projects in this area. LAND has previously identified that the RDEIR cumulative impact analysis is defective and it appears that DWR agrees, providing in its 2017 Project Update:

> Regional Salinity Modeling-
> To ensure consistency with other restoration goals within the Bay-Delta, FRP has funded a modeling effort to assess cumulative salinity effects in the Delta and Suisun Marsh attributable to impacts from planned restoration projects. DWR seeks to better understand how collective restoration efforts are impacting salinity on a system-wide scale, and initial work on model calibration and scenario development is ongoing with a study report expected in 2018.[5]

S-LAND-7
(Cont. below)

The RDEIR's reanalysis of this issue focuses on 'compliance' with D-1641, which does not have any bearing on local salinity increases. The monitoring for D-1641uses a rolling 14-day average that obfuscates any localized project-created salinity spikes. Such localized impacts would be pumped into local irrigation systems, particularly during droughts. The State Water Resources Control Board ("SWRCB") has an extensive history of allowing exceedances[6] and routinely providing for Temporary Urgency Change Petitions ("TUCPs") and thus cannot be reasonably relied upon to ensure that the acute

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[5] DWR's update is no longer available online, yet another instance of DWR not providing the public access to project related documents. The text of the update can be found at: https://mavensnotebook.com/2017/05/22/fish-restoration-program-update-prospect-island-tidal-habitat-restoration-project-real-estate-acquisition-regional-salinity-monitoring-and-restoration-rfp/.

[6] See California Sportfishing Protection Alliance's complaint against SWRCB alleging exceedances. Available at: http://calsport.org/news/wp-content/uploads/CSPA-Complaint-Bay-Delta-2.pdf. See also North Delta Water Agency's Drought Issues webpage, available at: http://www.northdeltawater.net/drought-issues-and-resources.html.

and cumulative impacts of the project on salinity would not have significant impacts on wildlife and surrounding water users. S-LAND-7 (Cont.)

C. Good Neighbor Policies Would Promote Efficient Dispute Resolution

The 1981 Contract between the DWR and North Delta Water Agency ("NDWA") for the Assurance of Dependable Water Supply of Suitable Quality ("1981 NDWA Contract"), attached as Exhibit E, makes DWR responsible for maintaining and monitoring water quality, and making reasonable efforts to avoid levee failure. (See Exhibit E, 1981 NDWA Contract, pp. 1-2.) There, DWR affirmed the purpose of this provision of the 1981 NDWA Contract in a subsequent letter to NDWA, attached as Exhibit F. DWR committed to "prevent or correct erosion or seepage problems" from its projects in the North Delta. (See Exhibit F, 1984 NDWA Letter, p. 1.) DWR also promised that if "operational experience of completed works reveal unforeseen impacts . . . they would be corrected." (*Ibid.*) Establishment of good neighbor policies is consistent with DWR's own interpretation of its obligations under the existing 1981 NDWA Contract. S-LAND-8

The 1981 Contract between DWR and NDWA has also led to the development of claims procedures for resolving disputes over water quality exceedances that cause damage during droughts. (See Exhibit G, 2015 NDWA Contract Claims Procedure.) This approach could be a template for resolving impacts and damage caused by restoration projects, if they occur. A claims procedure provides a more efficient process for impacted neighbors and for DWR, and would avoid the need to resolve disputes using the inefficient California Tort Claims Act procedures. (Gov. Code, §§ 810 et seq.) Should the project result in offsite impacts such as seepage or erosion, use of specified procedures, such as those already used by DWR for the 1981 NDWA Contract, would facilitate equitable resolution of disputes.

Detailed measures to address seepage were also developed in the context of the Delta Wetlands Project, which also included flooding of an island. (See Exhibit H, 2013 Delta Wetlands Settlement Agreement [Attachment C, Delta Wetlands Seepage Control Plan].) While that project proponent intended to manage the project to control groundwater in the vicinity of its reservoir islands so there would be no offsite seepage impacts, the Settlement Agreement included a detailed process to address seepage if it did occur. (*Ibid*.) This included installation of a monitoring network, establishment of a baseline, and actions to address seepage if it occurred. The Settlement Agreement is both evidence of the likelihood of seepage impacts from flooding an island as well as an example of the feasible means to address such offsite impacts. S-LAND-9

II. THE RDEIR FAILS TO ADEQUATELY ANALYZE CUMULATIVE IMPACTS

An EIR must evaluate a project's cumulative impacts if the project's incremental effects "are significant when viewed in connection with the effects of past . . . current . . . and . . . probable future projects." (CEQA Guidelines, §15065, subd. (a)(3); *Banning Ranch Conservancy v. City of Newport Beach* (2012) 211 Cal.App.4th 1209, 1228.) The purpose of cumulative impact analysis is to ensure a project is not considered in a vacuum. (*Whitman v. Board of Supervisors* (1979) 88 Cal.App.3d 397, 408.)

The RDEIR includes a woefully incomplete analysis of cumulative impacts. The DEIR identifies that it uses the "list" approach for review of cumulatively considerable projects. (DEIR, p. 3-353.) Yet the DEIR does not provide an actual list of related projects. Instead the DEIR provides a narrative that fails to identify which projects were included in cumulative analysis or what specific criteria DWR used to evaluate those projects. The DEIR states that there are "sixty-two private projects listed . . . ." (DEIR, p. 3-354.) As of June 17, 2019, however, there are 128 projects identified on the Sacramento County website for the Delta. It impossible to tell which projects were analyzed in the DEIR. Furthermore, there is no analysis of the Solano CEQA projects, list of reviewed projects, or links to more information, and the provided Yolo County link is broken. S-LAND-10

The DEIR states that: "none of these private projects would result in an overlapping contribution with any of the Proposed Project's impacts." (DEIR, p. 3-354.) This categorical statement explicitly states that none of the projects could have any overlapping contribution, even though private projects that disturb land, move earth, use vehicles creating particulates and greenhouse gases ("GHG"), and build or remove structures, would overlap with the project here. Over eight projects from the Sacramento County website for private projects in the Delta had these characteristics. However, no projects from Contra Costa or San Joaquin County were included in the DEIR. S-LAND-11

The incomplete approach to private projects creates a significant blind-spot in the DEIR's analysis, and leaves its conclusions unsubstantiated. Without a list or more developed analysis of the potential cumulatively considerable private projects, the DEIR and RDEIR fail as informational documents.

The DEIR does include a list for public projects in Yolo, Solano, Sacramento, Contra Costa, and San Joaquin County. (DEIR, pp. 3-355 to 3-359.) The footnote on p. 3-359 states: S-LAND-12 (Cont. below)

> This table originated in the Lower Yolo Tidal Restoration Project Final EIR (July 2013). All projects in the source document were reviewed for current status. Projects were removed from the list if they have been implemented or if they have no potential cumulative impacts. This table includes public agency and private projects that may require public agency approvals.

S-LAND-12 (Cont.)

A cumulative impact analysis must include past projects. (See CEQA Guidelines, § 15130, subd. (b)(1)(A).) The DEIR explicitly removed past projects from consideration, and failed to even identify projects that had been removed. Although Figure 2.1-4 does identify some other public projects, but DWR did not include all of them in the cumulative project list. (Compare DEIR, p. 2-10 and pp. 3-355 to 3-559.) For example, nearby projects such as Mound Farms, Peter's Pocket, Prospect West, and the Ryer wetland are identified on the figure but are not discussed in any cumulative impact analysis.

S-LAND-13

The DEIR identifies programs, but does not discuss specific projects under those programs. For example, the DEIR identifies EcoRestore as a cumulative project (DEIR, p. 3-358), but the analysis fails to say which EcoRestore projects DWR included in the cumulative analysis. The analysis in the DEIR is perfunctory at best, and, given the considerable time passed, now inapplicable.

S-LAND-14

Also missing from the DEIR list is the 2018 Lookout Slough, 2018 Yolo Flyway Farms, Little Egbert Tract, and other projects in the immediate area of Prospect Island.[7] These projects would have the same or similar impacts on water quality, GHG, invasive weeds, tidal range, and retention time as the project, and their cumulative impacts must be considered. Updating the cumulative impact analysis to reflect the present reality (three years after publication of the DEIR) in the Delta is necessary to provide adequate cumulative impacts analysis.

S-LAND-15

Furthermore, the largest project that was identified in the DEIR, the California WaterFix/Delta Tunnels scheme, was apparently not included in any cumulative analysis of impacts from flow reversals, residence time, or water quality.

S-LAND-16

Failing as an informational document, the DEIR identifies that total tidal range would decrease with the project and the few restoration projects that were considered. The DEIR then identifies a significant impact, which and then claims is a project benefit:

S-LAND-17 (Cont. below)

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[7] See DWR's Delta Projects, available at: https://water.ca.gov/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects.

> On a regional scale, future tidal habitat restoration projects, including the Proposed Project, would cumulatively dampen tide ranges (i.e., decrease the heights of high tides and increase the heights of low tides) in the Delta.
>
> Future tidal habitat restoration projects that may be planned for California WaterFix and in nearby EcoRestore project areas could increase the tidal prism and further reduce the tidal range in the Proposed Project vicinity. Thus, overall, the Proposed Project and other tidal habitat restoration projects in the Delta have the potential to reduce flood risks associated with projected increases in regional mean sea level by decreasing water surface elevations during high tides. This would be a beneficial effect.

(DEIR, p. 3-361.) A tidal restoration project such as Prospect literally relies on the tidal range for much of its ecological value. (DEIR, p.1-2.) The conclusion that less tidal range is better belies logic.

Moreover, an "increase to the heights of low tides" is not only a threat to agricultural water supply and drainage (DEIR, p. 3-22), but also an unanalyzed threat to levees. By raising the base elevation, the Project increases the risk to the adjacent levees under the base condition. This means that under 'blue sky' levee failure scenarios, there is more hydraulic head for flooding than there would be otherwise. Furthermore, if one were to accept DWR's premise that river stage levels are the determinant of Ryer seepage, then DWR would be creating or amplifying the hydraulic conditions to worsen that effect.

S-LAND-17 (Cont.)

Finally, despite the massive increase in proposed truck traffic disclosed in the RDEIR, the Cumulative Impact analysis in the DEIR was not updated to reflect this change in impact severity and scale across multiple counties for traffic or for air quality. (DEIR, p. 3-370.)

S-LAND-18

The DEIR and RDEIR's cumulative impacts analysis is inadequate for failing to address all related projects, to analyze project changes and changes in conditions, and to acknowledge the cumulatively considerable impacts to tidal habitat.

S-LAND-19

III. THE RDEIR DOES NOT PROVIDE FULL DISCLOSURE OF PROJECT IMPACTS

A. The Project Would Result in Potentially Significant Flow Impacts

As identified above, the assessment of cumulative impacts for tidal range are defective for multiple reasons. A tidal restoration project is at its foundation an attempt to restore habitat across the range of tides creating a tidally influenced zone that has biological benefits over deep water habitat. Reducing tidal range is not a benefit; it is a new significant impact on the existing tidal habitat, which is critically important for Delta smelt survival adjacent to Cache Slough. (See Exhibit I, On Extinction's Edge.) S-LAND-20

The project's poorly designed flow and tidal range impacts could reduce any of its purported benefits, and as a result, the project may never achieve any positive biological benefits. (See Exhibit J, Role of Tidal Marsh Restoration.) As discussed in prior LAND comments, the flow through the levee breaks would result in dramatically increased residence times; residence times would be more than long enough to result in HABs formation according to the project's technical appendices. (See 2019 LAND Comments, pp. 12-14.) During floods, the project would increase the flow at the Miner Slough Highway 84 Bridge by over 3,000 cubic feet per second, which is an 18 percent increase in flow in a modeled 100 year event. (Hydrodynamic Modeling Analysis for 100-year and 200-year Flood Events, p. 25.)[8] This is a massive increase in flow directed right at the Arrowhead Marina. The modeled velocity is 25 percent greater at the Marina as well. (*Id*. at p. 35, Figure 25.) S-LAND-21

From a CEQA perspective, massive increases in flow and velocity at a marina during a 100 (and 200) year modeled event would be a significant threat to human health and safety. If the marina and its vessels are damaged and leak petroleum and blackwater, the environmental impacts would be significant. The very possibility of such dire consequences should give rise to reconsideration of the entire project design. However, there is simply no analysis on this project effect and its consequences. The project's impacts from increased flow and velocity must be disclosed and evaluated.

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[8] Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Environmental-Services/Restoration-Mitigation-Compliance/Delta-Projects/Files/Prospect-Island-Hydrodynamic-Modeling-Analysis-for-100-year-and-200-year-Flood-Events-2016.pdf

Notably, when restoration projects carried out by others would result in potential flow and seepage impacts on DWR managed lands, DWR has sought to block those projects. (See Exhibit K, July 15, 2014 DWR Comment Letter on Mallard Farms Conservation Bank Project Initial Study ("Mallard Farms IS Comments"); Exhibit L, July 12, 2016 DWR Technical Comment Letter on Mallard Farms Conservation Bank Project ("Mallard Farms Technical Comments").) For these projects, DWR has shown concern over impact to levee integrity, hydrology, and salinity. (Exhibit K, Mallard Farms IS Comments, pp. 1-3; Exhibit L, Mallard Farm Technical Comments, p. 2.) Now, DWR is willfully ignoring those same impacts from its own project. S-LAND-22

B. The Project Would Result in Potentially Significant Land Use Impacts

The DEIR failed to analyze the project's consistency with the DPC 2010 Land Use and Resource Management Plan for the Primary Zone of the Delta ("2010 RMP").[9] An EIR should analyze whether a project would cause significant impacts due to conflicts with "any land use plan, policy or regulation adopted for the purpose of avoiding or mitigating an environmental effect[.]" (CEQA Guidelines, Appen. G, § XI.) Here, the DEIR merely lists the 2010 RMP in the land use setting, but does not address the project's consistency with the policies. (DEIR, pp. 3-319 to 3-324.) Instead, the DEIR merely assumes compliance with the 2010 RMP. (See DEIR, p. 3-319.) The RDEIR does not provide any updates to land use impact analysis. The failure to analyze consistency with applicable 2010 RMP policies renders the DEIR and RDEIR deficient as informational documents.

The DEIR only lists three policies as applying to the project: Land Use Policy P-2, Land Use Recommendation R-2, and Land Use Recommendation R-3. (*Ibid.*) Beyond the failure to analyze the project's consistency with those policies, the DEIR's list of applicable policies and recommendations is incomplete, as numerous other policies directly apply to restoration projects. (See Exhibit M, Policies in 2010 LURMP Relating to Restoration Projects.) For example, the 2010 RMP specifically addresses the issue of offsite impacts from restoration projects. Land Use Policy 14 provides: S-LAND-23 (Cont. below)

> The conversion of an agricultural parcel, parcels, and/or an agricultural island for water impoundment, including reservoirs, water conveyance or wetland development may not result in the seepage of water onto or under the adjacent parcel, parcels, and/or island. These conversions shall mitigate the risks and adverse effects associated with seepage, levee stability,

[9] Available at: http://delta.ca.gov/wp-content/uploads/2016/10/Land-Use-and-Resource-Management-Plan-2.25.10_.pdf.

> subsidence, and levee erosion, and shall be consistent with the goals of this Plan.

(2010 RMP, p. 10.) In addition, Land Use Policy 3 states:

> New non-agriculturally oriented residential, recreational, commercial, habitat, restoration, or industrial development shall ensure that appropriate buffer areas are provided by those proposing new development to prevent conflicts between any proposed use and existing adjacent agricultural parcels. Buffers shall adequately protect integrity of land for existing and future agricultural uses and shall not include uses that conflict with agricultural operations on adjacent agricultural lands. Appropriate buffer setbacks shall be determined in consultation with local Agricultural Commissioners, and shall be based on applicable general plan policies and criteria included in Right-to-Farm Ordinances adopted by local jurisdictions.

S-LAND-23
(Cont.)

(2010 RMP, p. 8.) Each of these policies expressly apply to restoration projects, and yet the DEIR and RDEIR completely ignore them. As previously discussed, the project poses a risk of seepage and erosion which would impair productive agricultural land uses in the vicinity of the project. This conflicts with 2010 RMP Land Use Policies 3 and 14. DWR must analyze consistency with all applicable 2010 RMP policies in order to disclose the project's land use impacts.

C. The Project Would Potentially Cause Violations of the 1981 NDWA Contract

The DEIR and the RDEIR both failed to address the 1981 NDWA Contract, or analyze whether the project would lead to violations. The 1981 NDWA Contract addresses DWR's responsibility with respect to flow impacts in Article 6:

> Flow Impact. The State shall not convey SWP water so as to cause a decrease or increase in the natural flow, or reversal of the natural flow direction, or to cause the water surface elevation in Delta channels to be altered, to the detriment of Delta channels or water users within the Agency. If lands, levees, embankments, or revetments adjacent to Delta channels within the Agency incur seepage or erosion damage or if diversion facilities must be modified as a result of altered water surface elevations as a result of the conveyance of water from the SWP to lands outside the Agency after the date of this contract, the State shall repair or alleviate the

S-LAND-24
(Cont. below)

> damage, shall improve the channels as necessary, and shall be responsible for all diversion facility modifications required.

As discussed in prior comments, the project poses a significant risk of causing levee seepage and erosion. (See 2019 LAND Comments, pp. 8-11.) Should such impacts occur without mitigation, DWR would be in violation of the 1981 NDWA Contract. However, despite the project's potentially significant flow impacts, the DEIR and RDEIR fail to include any discussion of the 1981 NDWA Contract. Exacerbating this critical omission is DWR's refusal to implement good neighbor policies or procedures to alleviate harm to surrounding levees. (See, e.g., Exhibit B, Proposed Good Neighbor Policies.) DWR's must analyze whether the project would violate the 1981 NDWA Contract, and if so, include appropriate mitigation. S-LAND-24 (Cont.)

D. New Traffic and Air Quality Analysis Is Necessary Given the Change in Access Routes

The RDEIR assumed that trucks would access the project site via easements across private property on Little Holland Tract. (See RDEIR, Figure 2.1-2, p. 5-175.) However, DWR has apparently abandoned efforts to obtain such easements and will now have to rely on public access routes. (See Exhibit N, DWR Email Communications.) Given that all construction traffic would come through one access point now, DWR must reassess and reanalyze impacts from the project's truck traffic. The Arrowhead Harbor Marina would receive the brunt of the new traffic impacts from the project's truck traffic and create significant air quality and health risks. (See 2019 LAND Comments, pp. 17-21.) With all of construction traffic funneling through one route, these new impacts to sensitive receptors must be disclosed and analyzed. S-LAND-25

In addition, the traffic mitigation measures included in the RDEIR are impermissibly vague. What constitutes "deteriorate[d]" road conditions, or "necessary repairs" is not defined. (See RDEIR, p. 5-176.) Clear performance standards are needed in order for mitigation measures to be effective. Further, there is no justification for excluding State Route 84 from this mitigation measure.

IV. CONCLUSION

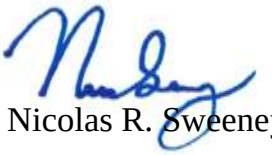
Substantial evidence demonstrates that the project would have significant impacts to the environment, surrounding levees and adjacent land uses. The DEIR and RDEIR omit discussion of these impacts, deny their significance, and fail to require even the most basic mitigation measures. Full disclosure and environmental review of project impacts must be completed to ensure project impacts are adequately addressed. The S-LAND-26 (Cont. below)

project's significant impacts on the environment could likely be avoided or reduced through imposition of feasible mitigation or through incorporation of good neighbor policies into the project. We again request that DWR undertake these actions prior to moving forward with this project. Please feel free to contact us with questions about these comments or to recommence a collaborative process to address the issues we have raised. S-LAND-26 (Cont.)

Very truly yours,

SOLURI MESERVE
A Law Corporation

By: 
Osha R. Meserve

By: 
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Attachments (available at this Dropbox link:
https://www.dropbox.com/sh/xrfujyihp0vlbgn/AAChr5nYkEt6bRiWohjojDHFa?dl=0)

Exhibit A DWR's 2018 Agriculture and Land Stewardship Framework and Strategies

Exhibit B LAND's Draft Proposed Good Neighbor Actions for Prospect Island Restoration Project

Exhibit C Sloop, Christina, Brooke Jacobs, Randi Logsdon, and Carl Wilcox. 2018. *Delta Conservation Framework – A Delta in Common*, California Department of Fish and Wildlife, Sacramento, CA

Exhibit D Vision 2030, the Delta Protection Commission's 2015 Strategic Plan

Exhibit E 1981 Contract between the DWR and NDWA for the Assurance of Dependable Water Supply of Suitable Quality

Exhibit F July 19, 1984 Letter from DWR to NDWA

Exhibit G DWR's Special Contract Claims Procedure for the 1981 Contract between DWR and NDWA for the Assurance of a Dependable Water Supply of Suitable Quality during the 2015 Drought Emergency

Exhibit H 2013 Delta Wetlands Settlement Agreement

Exhibit I April 25, 2019 article by Dan Bacher, On Extinction's Edge: Fall Fish Survey Finds Zero Delta Smelt

Exhibit J Herbold, B., Baltz, D. M, Brown, L., Grossinger, R., Kimmerer, W., Lehman, P., et al. (2014). The Role of Tidal Marsh Restoration in Fish Management in the San Francisco Estuary. San Francisco Estuary and Watershed Science, 12(1). Retrieved from https://escholarship.org/uc/item/1147j4nz

Exhibit K July 15, 2014 DWR Comment Letter on Mallard Farms Conservation Bank Project Initial Study

Exhibit L July 12, 2016 DWR Technical Comment Letter on Mallard Farms Conservation Bank Project

Exhibit M Policies in 2010 LURMP Relating to Restoration Projects

Exhibit N May 1, 2019 Email regarding Prospect Island Restoration Project

AGRICULTURE AND LAND STEWARDSHIP FRAMEWORK AND STRATEGIES

2018



These materials were developed by a DWR work group and published in 2014. These materials are now available at https://water.ca.gov/programs/california-water-plan/water-resource-management-strategies/agriculture-and-land-stewardship-framework

Table of Contents

1. Framework for Agricultural and Land Stewardship Planning.....4
    a. Framework 1A: Incorporate Toolbox of ALS Strategies into planning processes
    b. Framework 1B: Develop Agricultural Land Stewardship Plans for Projects
2. Potential Strategies
    a. Group A: Strategies to Help Maintain Farming
        i. Strategy A1: Improve Flood Management.....10
            1. Strategy A1.1: Improve Flood Protection for Agriculture
            2. Strategy A1.2: Help Farmers Comply with FEMA Flood Insurance Regulations
        ii. Strategy A.2: Improve On-Farm Agricultural Productivity, Including Soil and Water Quality.....14
        iii. Strategy A.3: Control Weeds and Other Pests.....18
            1. Strategy A.3.1: Reinvigorate County Weed Management Areas
            2. Strategy A.3.2: Prioritize Weeds and Other Pests for Area-Wide Control
            3. Strategy A.3.3: Encourage Use of Weed-Free Construction Materials
        iv. Strategy A.4: Reduce Conflict Between Agriculture and Nearby Habitat Lands..25
            1. Strategy A.4.1: Establish “Good Neighbor” Policies
            2. Strategy A.4.2: Provide Take Coverage for Neighboring Lands
            3. Strategy A.4.3: Support Local Efforts to Reduce Nuisance and Illegal Activities
        v. Strategy A.5: Provide Agricultural Conservation Easements.....31
    b. Group B: Strategies that Provide Incentives for Conservation on Agricultural Land
        i. Strategy B1: Partner with Others to Maintain and Enhance Environmental Quality on Agricultural Land.....34
        ii. Strategy B2: Provide Incentives for Farmers and Landowners to Take Part in a Market Based Conservation Program.....35
    c. Group C: Strategies to Manage Land to Reverse Subsidence and Sequester Carbon
        i. Strategy C1: Provide Incentives to Stabilize or Reverse Land Subsidence on Delta Islands.....36
        ii. Strategy C2: Assist Farmers and Landowners to Produce and Sell Greenhouse Gas Offset Credits.....39
        iii. Strategy C3: Investigate Options to Designate Subsidence Reduction and Carbon Sequestration Crops as Agricultural Production for Regulatory and Incentive Purposes.....41
    d. Group D: Strategies that Support an Agricultural Economy
        i. Strategy D1: Develop Area-Wide Economic and Land Use Studies.....43

1. Strategy D.1.1: Develop an Historic and Current Land Use Study
2. Strategy D.1.2: Develop an Economic Study of Agricultural Activity and Related Infrastructure

ii. Strategy D2: Promote Economic Development.....48
iii. Strategy D3: Improve Transportation Infrastructure.....51
iv. Strategy D4: Help Farmers and Landowners Earn New Revenue from Recreation and Tourism.....53
v. Strategy D5: Assist Farmers and Landowners in Working with Government Agencies.....55

1. Strategy D5.1: Public Adviser for Government Projects
2. Strategy D5.2: Farmbudsman - Help Farmers and Landowners Navigate Regulatory Requirements for Farm Activities
3. Strategy D5.3: Work with Others to Better Align Regulatory Processes to Expedite Wildlife Friendly Agriculture

e. Group E: Strategies for Successful Planning by Project Proponents

i. Strategy E1: Project Planning.....61

1. Strategy E1.1: Early Project Planning
2. Strategy E1.2: Work with Farmers and Landowners
    a. Strategy E1.2.1: Involve Farmers and Landowners in Project Planning
    b. Strategy E1.2.2: Compensate Farmers and Landowners to Manage Agricultural Land for Project Purposes
    c. Strategy E1.2.3: Compensate Farmers and Landowners to Manage Project Habitat Lands
3. Strategy E1.3: Avoid, Minimize, and Mitigate for Impacts to Agricultural Land from Project
    a. Strategy E1.3.1: Reduce Impacts on Land
    b. Strategy E1.3.2: Reduce Impacts on Ground Water Levels
    c. Strategy E1.3.3: Mitigate for Conversion of Agricultural Land
4. Strategy E1.4: Implementation and Funding

ii. Strategy E2: Work with Local Governments.....81

1. Strategy E2.1: Coordinate with Local Planning Efforts
2. Strategy E2.2: Implement Actions Required by the Williamson Act
3. Strategy E2.3: Work with Counties to Expand Williamson Act Authorized Uses
4. Strategy E2.4: Investigate Options for In Lieu Tax Revenue for Local Governments
5. Strategy E2.5: Work with Others to Explore the Value of Reinstating State Funding of Williamson Act Subventions

3. Good Neighbor Checklist.....93
4. List of Cases - California Litigation Dealing with Agricultural Resources.....95
5. DRAFT Discussion Paper - BDCP and Delta Farmland.....98

SECTION I: FRAMEWORK FOR AGRICULTURAL and LAND STEWARDSHIP PLANNING

A. Incorporate Toolbox of ALS Strategies into planning processes

"…[t]he multiple benefits we gain from farming and ranching including crop and livestock production. In addition to valuable open space and wildlife habitat, the management decisions and conservation practices of farmers and ranchers also enhance environmental quality, provide recreational opportunities and offer social benefits." - CDFA's Environmental Farming Act Science Advisory Panel definition of ecosystem services.

"…'Agricultural land stewardship' means farm and ranch landowners—the stewards of the state's agricultural land—producing public environmental benefits in conjunction with the food and fiber they have historically provided while keeping land in private ownership." — California Water Plan Update 2005, Agricultural Land RMS.

Agricultural and Land Stewardship (ALS) Planning can provide an integrated and collaborative approach for addressing impacts associated with the use of farmland for project purposes and the conversion of farmland to different uses, especially uses that continue an open space use of the land.

Conversion of agricultural land to other uses

Projects that convert agricultural lands for urban uses (e.g., residential, commercial, industrial) can compromise an area's ability to support agriculture. Other projects may promote open-space benefits, such as flood management or wildlife habitat on agricultural land, but may limit or eliminate agricultural uses on those lands. For many years, governmental and other organizations have encouraged programs that promote the development of environmental benefits on agricultural land as a way to protect natural resources while keeping the land in agriculturally productive private ownership. More recently, attention has been focused on the social and economic impacts of taking agricultural land out of production.

One of the key questions in approaching mitigation for conversion of farmland from one use to another for project purposes is whether the impacts identified are economic, environmental, or a mixture of the two. In general, it is not legally necessary to mitigate for purely economic impacts unless they lead to reasonably foreseeable secondary environmental impacts. Because of the complex nature of farmland as a natural and economic resource, there can be different views on when an impact is economic and when it is environmental. In addition, there may be policy reasons to support and encourage farmers[1] and agriculture[2] that go beyond current legal requirements.

Agricultural and Land Stewardship Strategies Toolbox and Framework

DWR has worked with the California Department of Food and Agriculture and others to develop an Agriculture and Land Stewardship (ALS) planning document that includes a tool box of ALS Strategies and a Framework for considering them that can help inform agricultural and land stewardship activities at all levels of planning and assist with funding decisions. The ALS Framework and Strategies can provide project proponents and those affected by a proposed project with a collaborative approach to address protecting and changing uses of agricultural land, from mitigating its loss to valuing its multiple benefits. The

Framework proposes that projects that plan to convert agricultural land to other uses develop an ALS Plan that considers the different ALS Strategies in the Tool Box. The Framework explains how the different ALS Strategies can be applied in developing such a plan.

The ALS Framework and Strategies encourage the exploration of a voluntary process that engages project proponents and other interested parties in pursuing mutually beneficial solutions that consider the following fundamental premises:

- provide the environmental and habitat benefits that are part of the project
- are consistent with state and regional polices
- provide opportunities for farmers to stay on the land
- maintain agricultural and economic viability in the area where the project is located
- support the stability of local governments and special districts

Agricultural land stewardship is not a new concept. Under various names, it has been practiced by farmers and ranchers and encouraged by state and federal entities for many years. This ALS Framework and Strategies uses an intentionally broad meaning of the term "agricultural and land stewardship" because it is designed to encourage project planners to think about the effect of their projects on agricultural resources and to be good stewards of agricultural land. Some of the ALS Strategies can be used by project proponents to work with local government and landowners to avoid or minimize impacts on agriculture and to consider local and regional plans. Some of the ALS Strategies provide options to consider for environmental mitigation required under the California Environmental Quality Act. Other ALS Strategies can assist in maintaining the agricultural viability and sustainability of the area where the project is located. Finally, some of the ALS Strategies discuss opportunities to keep local landowners and farmers on the land by participating in project activities, when a project involves conversion from agriculture to other open space uses. The Toolbox is organized in way that recognizes these distinctions.

Funding of ALS Strategies

Early consideration, support, and funding of landscape and regional level ALS Strategies could help develop a culture of cooperation, collaboration, and recognition of the value of agriculture in California, especially in areas, such as the Delta, which are recognized as unique. This could aid in establishing a foundation of understanding that will assist in project planning. Funding can come from a variety of sources, including project funding, bond programs and other sources (see Strategy E1.4). Depending on the source of funding, implementation of a Strategy could be carried out with regard to one or more of three different kinds of activities – project planning, environmental mitigation and/or other assistance (see Strategy E1.4).

Planning at the landscape, regional and site-specific project level

A framework for planning and a comprehensive set of ALS strategies can help develop informed agricultural and land stewardship activities at three levels: landscape, regional and site-specific project. Some of the ALS strategies clearly apply to only one of these levels. Others may apply to two or even all of the levels. An example of how the strategies might be grouped based on these levels is attached as Attachment 1.

Landscape Level: Basic to understanding impacts of projects on agricultural resources is baseline information on crop patterns and other land uses, agricultural commodity and market trends, agriculture and transportation infrastructure, and manpower needs; as well as modeling and analysis of this data to support development of strategies to maintain a viable agricultural economy in a particular area. This information can help provide a more effective assessment of impacts that may result from ongoing and potential ecosystem restoration and flood protection actions, and can help support strategic investment decision making.

Regional Level: Regional agricultural planning, based on the analyses gained from the landscape planning describe above can be developed to prioritize and guide planning and investment of funding to preserve and enhance agriculture in a particular area. To the extent that there is regional conservation planning, it can provide a basis for informing the development of ecosystem restoration projects and ensure that best available science and adaptive management are foundational to a long term restoration program. The overlap of these planning processes can provide an element that fully considers the agricultural systems that the restoration will impact or replace. This will ensure that to the greatest extent practical, restoration efforts will avoid, minimize or mitigate impacts to agricultural operations. Additionally, incorporating better understanding of agricultural systems is likely result in more effective restoration efforts and overall cost and time savings.

Site-specific Project Level: An Agricultural and Land Stewardship Plan (ALSP) can provide an integrated and collaborative framework for addressing the use of farmland for project purposes and the conversion of farmland to different uses, especially uses that continue an open space use of the land. It goes beyond the mandatory California Environmental Policy Act requirements and considers both economic and environmental impacts of a project. Development of an ALSP should involve the local community in the planning process for the project along with local, state and federal agencies. At its core is involvement of the landowner and the county where the property is located, recognizing that local interests have unique and specialized knowledge. The Agricultural and Land Stewardship Plan is discussed in more detail in Section B below.

[1] In this paper, farmer is used as a generic term that includes farmers, ranchers, landowners, or tenants if they are currently farming the land and want to continue managing the land whether or not it is used for project purposes, The approach suggested in this paper would not prohibit farmers from selling or leasing their land for project purposes if they do not want to continue to farm the land themselves.

[2] When discussing agriculture, farmland or agricultural land in general terms, the terms can generally be used interchangeably. The term “agriculture” is also intended to include the related effects on Delta farm workers, tenant farmers, and farmland owners and the economic impacts on the companies and individuals who provide productive inputs to Delta farmers, and on those who transport, process, store, and market the output of Delta farms.

SECTION I. FRAMEWORK FOR AGRICULTURAL and LAND STEWARDSHIP PLANNING

B. Develop Agricultural Land Stewardship Plans for Projects

Normally a draft Agriculture and Land Stewardship Plan (ALSP) would be provided to the public at the same time as draft CEQA/NEPA environmental documents, but not later than construction or implementation of a project. To the extent they apply, the strategies of the Tool Box of Potential ALS Strategies should be considered in developing the ASLP. However, not all of the strategies will apply to a specific project. In fact, some of the strategies may provide different approaches that are not compatible.

The primary responsibility for preparing and implementing an ALSP lies with the program or project proponent. ALSPs can be useful at the landscape, regional or site-specific level. They may look quite different depending on the level involved. As discussed in Strategy E1.1 on Early Project Planning, local or regional entities such as the local counties, the Delta Conservancy and the Delta Protection Commission, may want to consider developing a landscape or regional ALSP which could help identify places where special attention should be given to preserving agricultural land, as well as establishing a framework within which site-specific projects can work. More site-specific projects can take advantage of information developed in regional or landscape ALSPs but will probably be more focused on the use of the property being developed. If a farmer is involved in carrying out a site-specific project, another agreement, sometimes called an ALSP, may be needed that sets forth the responsibilities of the farmer. Part of this agreement may be a requirement that the farmer carry out identified agricultural land stewardship measures.

Development of an ALSP should occur during the planning process of a project and should involve the local community along with local, state and federal agencies. Involvement of the landowner and the county where the property is located is particularly important and recognizes that local interests have unique and specialized knowledge of the region. In addition to the landowner and/or farmers affected, at a minimum, the following organizations or types of organizations should also be consulted:

Local government, SACOG and other councils of government

- Federal and state resource and regulatory agencies
- Organizations with a regional interest such as the Delta Conservancy, the Delta Protection Commission and the Delta Stewardship Council
- Resource Conservation Districts
- Local colleges and universities, including the Agricultural Extension Service
- Local labor and farm worker organizations
- Local economic development corporations
- Tribal representatives
- NGOs representing farmers
- NGOs representing entities that promote habitat protection and restoration activities.

The basic components of an ALSP could include the following:

1. Promote Agricultural Productivity of Farmland

    a. Early Planning (Strategies D1.1, D1.2, D1.3, E1.1, E.1.2, E.2.1, E.2.2, and E.2.3)

- Identify existing land uses and relation to other planning efforts
- Identify how a proposed project can be part of or complement existing land uses, including agricultural use; flood management; mitigation and enhancement of aquatic and terrestrial habitat; recreation; and tourism
- Establish a public advisor position to serve as an information source for those wanting to know more about a proposed project (Strategy D5.1)

b. Site-Related Avoidance and Mitigation (Strategies E1.3.1)

- Try to avoid impacting agricultural lands (especially those identified as prime, unique, high value or important for the viability of local agriculture)
- Give priority to appropriate public lands and existing conservation lands
- Develop measures to reduce conflict between agriculture and nearby habitat lands by implementing good neighbor policies such as managing project lands to avoid impacts, establishing buffer zones, and developing compensation funds and agreements that protect landowners from endangered species liabilities (Strategies A4.1, A4.2, and A4.3)

c. Mitigate On-site (Strategy E1.3.1)

- Design the project to optimize contiguous parcels for farming
- Plan the project so that farming can continue during and after the project as much as possible
- Provide alternate access for roads, drainage and irrigation if existing access is disturbed.
- Save and reuse soil removed for project purposes

d. Consult with farmers on the role they wish to take, if any (Strategy E1.2.1)

- Develop working landscapes where possible (Strategies E1.1 and E1.2.1)
- Keep project land in private hands where possible and make local government whole (Strategies E2.4 and A5)
- Compensate farmers to help manage project lands (Strategies E1.2.2 and E1.2.3)
- Partner with landowners and others to maintain and enhance environmental quality on farmland (Strategy B1)
- Manage land to reduce subsidence and sequester carbon (Strategy C1, C2, and C3)
- Provide incentives to take part in market based conservation programs (Strategy B2)

e. Ways to track Implementation (Strategy E1.1)

- Provide a framework for adaptive management with regard to agricultural land
- Provide a plan for reporting and monitoring to show that the actions agreed to in the ALSP are being carried out.

2. Minimize Impacts on Williamson Act Lands

a. Make sure that proper notice and findings are made (Strategy E2.2)

b. Work with counties where Williamson Act land is located to expand Williamson Act authorized uses to include open space/habitat lands in Williamson Act Preserves (Strategy E2.3)

3. Mitigation Under CEQA/NEPA for Conversion of Farmland

a. Baseline - Determine the basis for mitigation (Strategies E1.3 and A5)

- Prime agricultural land, unique farmland or farmland of statewide significance
- Farmland of local significance and grazing land
- Temporary conversion

b. Off-Site Terrestrial Resources

- Determine whether agricultural land preserved for terrestrial species preservation or mitigation can count for agricultural land preservation (Strategies E1.3 and A5)

c. Determining Mitigation for CEQA/NEPA Impacts

- Mitigate for off-site impacts such as increased (Strategy E1.3.2)
- Determine appropriate ratio for mitigation lands for agricultural conversion (Strategies E1.3 and A5)
- Decide whether to use conventional mitigation that relies entirely on purchase of easements in the path of development or use an optional approach that can use a mix of conventional mitigation and other programs that will benefit agricultural activity in the area affected. (Can include most of the Strategies), especially E1.3, A1.1, E1.3.2, E1.3.3, A2, A3.1, A3.2, A4.1, A4.2. A4.3, A5, B1, C1, and C2)

4. Mitigation for Social/Economic Impacts (Strategy E1.3 and E1.4)

a. Work with others to find funding to mitigate for social and economic impacts not mitigated through CEQA/NEPA. Possible sources include establishing a greenhouse gas offset market using credits created through the development and restoration of wetlands; using "Cap and Trade" program funds, reinstating state funding for California Land Conservation Act subventions; recommending funds to be included in any bond measure; and others. (Can include most of the Strategies, especially E1.4, E1.5, A1.1, A1.2, A1.3, A2, A3.1, A3.2, A4.3, B1, B2, C1. C2, C3, D1.1, D1.2, D1.2, D2, D3, D4, D5.2, D5.3, E2.1, and E2.5)

Samples of proposed or actual ASLPs will be posted on the ALS website, when available, at https://AgriculturalLandStewardship.water.ca.gov/

ALS Workgroup: ALS Framework and Strategies: Section IB: Develop ALSPs: 061014

SECTION II: POTENTIAL STRATEGIES

Group A: STRATEGIES TO HELP MAINTAIN FARMING

Strategy A1: Improve flood management

Strategy A1.1: Improve flood protection for agriculture

DESCRIPTION

This strategy would enhance existing programs that protect Delta agriculture from flood damage. Improvements to flood protection could include strengthening or otherwise rehabilitating levees, enhancing floodwater bypasses, arresting riverbank and levee toe erosion, removing obstructions to floodwater flow, removal of levee encroachments, and constructing floodgates. Many such projects could be designed to benefit flood-dependent ecosystems as well.

RELATED PROGRAMS AND POLICIES

DWR provides engineering assistance and funds to Delta reclamation districts to maintain and improve levees and other flood protection facilities in a way that avoids environmental damages and enhances habitat. This work is accomplished through the Delta Subventions and Special Projects efforts. DWR's Division of Flood Management is preparing Basin-Wide Feasibility Studies (including Paradise Cut bypass options) and Regional Flood Management Plans that aim for better flood protection in the Delta for areas protected by levees that are part of the State Plan of Flood Control. The Lower Sacramento River/Delta North Regional Flood Management Plan is investigating the feasibility of SPFC improvements along the Sacramento River, the Yolo Bypass, Steamboat Slough, Sutter Slough and other watercourses in the North Delta. DWR is also seeking improvements to flood emergency preparedness at all levels of government in the Delta region via multi-agency coordination, emergency planning and exercises, and increased capacity to fight floods.

The Delta Stewardship Council has recommendations in its draft Delta Plan to (1) improve emergency preparedness and response, (2) finance and implement flood management activities, (3) prioritize flood management investment, (4) improve residential flood protection, (5) protect and expand floodways, floodplains and bypasses, (6) integrate Delta levees and ecosystem functions, and (7) limit State liability.

ISSUES

Flood protection projects could be potentially controversial because of economic feasibility, environmental and social impacts, and questions about how to pay for the projects. There are also issues about how to prioritize projects.

OPPORTUNITIES AND POTENTIAL PARTNERS

In 2012, a highly diverse group of stakeholders came together as an ad hoc group, The Coalition to Support Delta Projects, whose goal, was to identify near-term Delta projects whose implementation the group could unanimously support. Numerous Delta interests took part, including several water agencies and reclamation districts, the Delta Counties Coalition, representatives from four county governments, Local Agencies of the North Delta, and Restore the Delta. Several funding and permitting agencies attended the meetings and helped the group understand potential issues, but otherwise remained neutral. The group developed a list of projects and submitted it to the Governor, the Secretary for

Natural Resources, the Secretary for Environmental Protection, and the Acting Secretary of the Business, Transportation and Housing Agency.

The published list of supported projects includes twenty-eight whose main purpose or benefit is flood protection. Several projects also have ecosystem benefits. Nearly all of the projects would improve flood protection for agricultural lands. Seven projects have already begun, four need only permits or funding in order to get started, and the remainder requires detailed engineering or design work. The ad hoc group noted that the total cost of the projects exceeds available funds by about $500 million.

This strategy could focus on supporting the projects recommended by the Coalition. DWR, as the State's principal flood management agency, would need to play a role. To the extent that any projects are within the jurisdiction of the Central Valley Flood Protection Board, it would also need to be involved.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy A1.1 Improve Flood Protection for Agriculture: 102913

SECTION II: POTENTIAL STRATEGIES

Group A: STRATEGIES TO HELP MAINTAIN FARMING

Strategy A1: Improve flood management

Strategy A1.2: Help farmers comply with FEMA flood insurance regulations

DESCRIPTION

Outside the major cities, most of the Delta is mapped into the Federal Emergency Management Agency (FEMA) 100-year floodplain (Special Flood Hazard Area). These areas must meet community-mandated National Flood Insurance Program (NFIP) standards as they apply to both residential and nonresidential structures, including barns, agricultural storage sheds and drying sheds.

New residential structures, including major additions, must have the first floor elevated above the NFIP base flood elevation (that is, the 100-year-flood water surface shown on the FEMA effective flood insurance rate map). Required elevation of first floors can well exceed eight feet above the natural grade of the adjacent ground. Nonresidential structures that are not used for agriculture must be dry-flood proofed or elevated above the base flood elevation. Agricultural structures must be elevated or dry-flood proofed unless the community grants a variance to the community floodplain management ordinance or building code. FEMA's minimum regulations allow for a variance for nonresidential agricultural structures and their contents, provided that flood damage is limited by practices such as storage of pesticides and other farm chemicals above the base flood elevation, use of flood-resistant materials for construction, and elevation of utilities that could be damaged during a flood.

This strategy would help agricultural and other rural property owners in the Delta to meet community-adopted NFIP standards, either through buyouts, relocation, structural elevation, or flood-proofing. The financial losses caused by flooding of structures and contents could also be mitigated through the purchase of federally-backed flood insurance. Potential actions include the following:

- elevating existing homes above the base flood elevation
- providing grants for new homes and agricultural structures to be built above the base flood level
- buying out or relocating residential and nonresidential structures that cannot be elevated or retrofitted
- retrofitting existing nonresidential structures to minimize potential flood damage
- helping farmers pay for flood insurance for homes or other structures
- helping pay for crop insurance against natural disasters

RELATED PROGRAMS AND POLICIES

The Department of Water Resources is the coordinating State agency that works with FEMA and the United State Army Corps of Engineers to promote wise floodplain management and on the implementation and management of the NFIP. DWR also applies for grants under the family of FEMA hazard mitigation grants referred to as the Hazard Mitigation Assistance (HMA) Program. HMA grants generally provide 75% to 80% of the funding to implement hazard mitigation projects that include home elevation and small flood control projects. Through Community Development Block Grants, the federal Department of Housing and Urban Development (HUD) can provide funding to assist low-income property owners purchase flood insurance. Regional Flood Management Plans (being prepared by local

interests) and Basin-Wide Feasibility Studies (being prepared by DWR) may expand on strategies related to flood risk reduction and compliance with the NFIP. The State Systemwide Investment Approach (SSIA) in DWR's Central Valley Flood Protection Plan (CVFPP) recommends measures to reduce flood risks in rural and agricultural areas.

ISSUES

FEMA grants under the HMA Program are competitive and most funding is dependent on post-disaster monies made available after a presidential disaster declaration. Even with a state cost-share, many communities cannot raise the funds that are required for projects. Community Development Block Grants from HUD are also competitive and may not be awarded until after the occurrence of a disaster. Due to the implementation of the NFIP Reform Act of 2012 (Biggert-Waters 2012), some properties located in FEMA 100-year floodplains are losing their historic flood insurance subsidies and flood insurance rates will be rising in each of the next five years. For a home with the first floor located four feet below the base flood elevation, NFIP flood insurance rates may rise to above $9,000 per year.

OPPORTUNITIES AND POTENTIAL PARTNERS

Purchase of flood insurance through the NFIP is a reasonable method to mitigate potential flood damages. Elevation of existing structures, elevation of new structures, and flood proofing/retrofitting agriculture and nonresidential structures are viable and proven means of reducing flood risk. Federal funds may be available under the existing FEMA HMA Program. Funds may also be available through HUD Community Development Block Grants for low income communities. Implementation of DWR's CVFPPSSIA and the related Lower Sacramento River/Delta North Regional Flood Management Plan and CVFPP Basin-Wide Feasibility Studies, which are currently under development, may provide a vehicle for implementation of measures within this strategy.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy A1.2 FEMA Flood Regulations: 102913

SECTION II: POTENTIAL STRATEGIES

Group A: STRATEGIES TO HELP MAINTAIN FARMING

Strategy A.2: Improve on-farm agricultural productivity, including soil and water quality

DESCRIPTION

Farmers in the Delta face different on-farm problems that can affect the productivity of the land. Channel sedimentation is a problem in parts of the Delta that can make irrigation pumping for some farmers more difficult or more costly or prevent it altogether. It can also restrict channel capacity and create problems for marinas. Pumping and drainage from agricultural lands can also create water quality problems for landowners and other downstream users. Other farmers may face problems from high salt levels. in the soil. Drainage and water supply canals and crossings may not be in the optimal positions. This strategy would provide farmers with technical and financial assistance for on-farm water management activities such as those listed below. This strategy is not intended to cover water quality impacts caused by operation of the SWP, CVP or the BDCP conveyance facility which are being discussed in other arenas. See discussion below on assisting farmers in meeting their own water quality regulatory requirements. Possible measures would include:

- Creating GIS-based topographic or other types of maps of their land that would help famers better understand and manage their land. For example, GIS-based topographic maps could be used to decide whether there are drainage problems and help determine appropriate solutions.
- Regional weather networks, such as CIMIS, for irrigation scheduling.
- Providing portable pumps to improve water quality by removal of soil salts through drainage.
- Facilitate changes in timing of pumping or discharging water to improve water quality and supply by
    - Providing larger pumps, deepening wells, or extending existing local agricultural diversions further into deeper water
    - Helping to build small holding ponds for drainage water so that it can be released at a time when water quality issues for downstream users are less likely to occur.
- Consolidate intakes.
- Selectively dredging small areas to improve flow conditions and operation of agricultural siphons to provide for better water quality or supply, for example in Middle River, Old River, and West Canal in the South Delta.
- Improve agricultural and wetland management crossings.
- Maintenance and improvement of drainage and water supply canals.

This strategy could also provide technical or financial assistance for the implementation of practices to protect soil from erosion and to keep soil and agricultural chemicals, including fertilizers and pesticides, from entering ground and surface water. In 2003, the Central Valley Regional Water Quality Control Board adopted a new set of regulations pertaining to discharges of waste from irrigated agricultural lands into waters of the State. The purpose of the program is to prevent agricultural discharges from impairing the waters that receive these discharges. These regulations, which are referred to as the Irrigated Lands Conditional Waiver Program provided an individual irrigator with an option to join a coalition group or to participate directly in the program as an individual. This Strategy differs from Strategy 23b which is focused on decreasing actual and perceived regulatory obstacles on agriculture-

related businesses seeking to expand, enhance, and/or maintain their operations. Some of the practices envisioned could also be used in Strategy 12 (partner with others to maintain and enhance environmental quality on farmland) and include:

- assistance in preparation of required plans such as farm evaluation plans, nitrogen management plans and sediment and erosion control plans
- installation and maintenance of riparian forest buffers
- grassed waterways
- windbreaks and hedgerows
- cover crops and mulch
- no-till, minimum till or direct seeding
- inter-cropping
- tailwater recovery ponds and sediment basins

RELATED PROGRAMS AND POLICIES

- As part of the Suisun Marsh Preservation Agreement, the Department of Water Resources and the U.S. Bureau of Reclamation currently fund a mitigation program in the Suisun Marsh that provides portable pumps to farmers, as needed, to drain high salinity water from agricultural land to increase productivity. This is used as mitigation during drought years for high salinity soil. For this program specifically, pumps provide removal of salty water through drainage. These pumps provide temporary drainage and can be moved around among farmers. This program is managed by the Suisun Marsh Resource Conservation District.
- In the past, DWR has occasionally been able to find funding to voluntarily dredge an area in the delta which provided relief for a number of years. If funding could be found for continued dredging, it would help the farmers in the area.
- Try new BMPs at no risk: The Nutrient BMP Challenge allows growers to try current BMP application rates for N, P or K without risk to income. Producers already working at BMP fertilizer application rates can experiment with below-BMP nutrient applications. Any loss of income due to lower yield will be compensated by the program. Limitation: currently limited to corn producers.
- BMPs and training: University of California Division of Agriculture and Natural Resources used to offer a Farm Water Quality
- Planning Series to provide training for irrigated crop growers who are interested in water quality protection practices.
- State bond funding to implement BMPs: Proposition 84 money has been used to help Central Valley farmers to implement agricultural water quality improvement projects. The funding, available through a bond initiative approved by California voters in 2006, was awarded to Coalition for Urban Rural Environmental Stewardship (CURES) by the State Water Resources Control Board.
- The Delta Conservancy has convened a Habitat Enhancement of Working Landscapes Coalition, to coordinate efforts to enhance the habitat value of working landscapes and benefit agriculture in the Sacramento-San Joaquin Delta. Working with partners (Delta Protection Commission (DPC), the Natural Resources Conservation Service, the five Delta county Resources

Conservation Districts (RCD), Point Blue Science Center (previously PRBO), The Nature Conservancy, Audubon

- California, Ducks Unlimited, and the Delta agricultural community) the group has developed shared objectives and a suite of innovative management practices and project activities that focus on addressing agricultural needs and providing benefits to terrestrial species, waterfowl and other avian species, aquatic species and water quality.
- The NRCS and RCDs provide technical and financial assistance for the practices named above. For example, the NRCS Conservation Stewardship Program makes annual payments for the environmental benefits produced by the practices, and scales payments to match the level of benefits. The DPC sponsors the Delta Working Landscapes Program, a group of projects which demonstrates how farmers can integrate habitat restoration into farming practices. The program established hedgerow grass plantings and other vegetative buffers along irrigation ditch banks to separate farm fields from waterway.
- These served to reduce runoff of sediment and pesticides, reduce herbicide use, enhance levee stability, and retard levee erosion, among other benefits.
- CDFA's Fertilizer Research and Education Program (FREP) facilitates and coordinates research and demonstration projects by providing funding, developing and disseminating information, and serving as a clearinghouse for information on fertilizing materials.

ISSUES

- Some farmers may not want to participate because of their reluctance in dealing with State or federal agencies.
- There may be impacts on wetlands and other natural resources habitats, water quality and hydrology that would need to be avoided or mitigated.
- Nutrients may be lost as a result of drainage.
- Permits may be needed to install or operate facilities.
- The measures may not be a permanent solution.
- Some of the measures could increase subsidence and increase GHG emissions.
- Determining what to fund, how to fund it and how to avoid other adverse impacts is a challenge.
- Whether cost-sharing should be part of the plan.

OPPORTUNITIES AND POTENTIAL PARTNERS

The Natural Resource Conservation Service (NRCS) and local resource conservation districts (RCDs) may be possible partners since these are techniques that can help farmers increase the productivity of their land. Other partners might include reclamation and irrigation districts, UC Cooperative Extension, the Delta Conservancy and the Delta Protection Commission.

The San Joaquin County & Delta Water Quality Coalition (http://www.sjdeltawatershed.org/) and the East San Joaquin Water Quality Coalition (http://www.esjcoalition.org/home.asp) for water quality issues.

Partner with CDFA and other agricultural research organizations such as the University of California Cooperative Extension to create or extend programs such as re-establishing the Farm Water Quality

Planning Series, or administering a program similar to the Nutrient BMP Challenge that includes more crop types than just corn.

The BMP Challenge is backed by a commercial service agreement provided by Agflex, an Iowa corporation.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy A2 Improve on-farm agricultural productivity: 102913

SECTION II: POTENTIAL STRATEGIES

Group A. STRATEGIES TO HELP MAINTAIN FARMING

Strategy A3: Control Weeds and Other Pests

Strategy A3.1: Reinvigorate County Weed Management Areas

DESCRIPTION

The strategy would assist Delta county Weed Management Areas (WMAs) to coordinate and implement weed management projects in the Delta with farmers and other Delta partners. Example projects are early detection, eradication, and control of terrestrial and aquatic weeds, such as perennial pepperweed, medusahead and water hyacinth, in and around agricultural and grazing land.

Controlling the spread of weeds in and around agricultural lands has the potential to reduce the spread of weeds onto any adjacent habitat reserves or protected areas in the Delta, potentially reducing management costs. Therefore, multiple benefits can be obtained from investing in weed management programs.

Aquatic weeds are a widespread problem in the Delta and have multiple adverse effects on recreation and local agriculture and businesses by impeding flow of water, increasing the cost of pumping, increasing the need for pesticides, decreasing water quality, and harboring pests like mosquitos.

WMAs are local stakeholder groups working on weed projects and are usually led by the County Agricultural Commissioner or local Resource Conservation District. Each WMA develops a strategic plan that identifies its top priorities for local management. The WMAs that overlap the Delta are Alameda-Contra Costa, Sacramento, Northern San Joaquin Valley, Solano, and Yolo.

Once identified, weed populations could be prioritized by the WMA for control or eradication. Landowners could help detect target weeds on their land, including those rated by CDFA or listed by the California Invasive Plant Council (Cal-IPC). Where weed management is needed, the work could be contracted to landowners through their local WMA. Landowners are welcome to participate in their local WMA and landowner participation in a WMA could be a condition for famers to receive WMA funds to implement weed management on their land.

This strategy would benefit farmers because weeds are expensive to manage, and some species of weeds may reduce crop yield, decrease property value, and cause illness or death when consumed by livestock. Additionally, weeds can add fuel to wildfires and impede water flow in canals and streams.

RELATED PROGRAMS AND POLICIES

The California Department of Food and Agriculture (CDFA) administered the WMA program until the funding ended (http://www.calipc.org/policy/state/wma.php). The program infrastructure still exists and many WMAs continue to meet.

ISSUES

Permits may be necessary for chemical treatment, possibly including NPDES permits for use of herbicides on or near water.

Environmental impacts from chemical treatments may need to be addressed via CEQA. Non-chemical treatments (e.g., controlled burning, hand clearing, or grazing) are generally expensive, time consuming, or hard to implement/coordinate with residents and agencies.

PARTNERS AND OPPORTUNITIES

Potential partners include:

- CDFA Plant Health and Pest Prevention Services (http://www.cdfa.ca.gov/plant/)
- California Agricultural Commissioners and Sealers Association (http://cacasa.org/)
- California Association of Resource Conservation Districts (http://www.carcd.org/)
- California Invasive Plant Council (www.cal-ipc.org)

Potential Opportunities include:

- USDA Grant and Partnership Programs for Invasive Species are available to private land owners, tribes, and farmers and encourage them to enhance or restore habitat, including invasive species management, or convert degraded agricultural land into wildlife habitat on their property (http://www.invasivespeciesinfo.gov/toolkit/grantsusda.shtml). Part of this ALS strategy could be to provide assistance to the WMAs with the grant application and the cost-share portion.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy A3.1 Reinvigorate County Weed Management Areas: 061014

SECTION II: POTENTIAL STRATEGIES

Group A. STRATEGIES TO HELP MAINTAIN FARMING

Strategy A3: Control Weeds and Other Pests

Strategy A3.2: Prioritize weeds and other pests for area-wide control

DESCRIPTION

This strategy would provide technical assistance to Delta farmers, residents, marina operators, boaters, and others affected by terrestrial and aquatic weeds to inventory, prioritize, coordinate, and implement weed management projects. This strategy could also be extended to management of other pest species.

There are 130 known CDFA-rated noxious weeds and Cal-IPC-listed invasive plant species in the Delta. Actions could be designed to perform risk assessment and subsequent prioritization of treatment areas to strategically and effectively reduce expansion of the multiple species of weeds. Actions could include creation of an early detection network and reporting system. Tools to help identify suitable candidate weeds and populations for management include CalWeedMapper (http://calweedmapper.cal-ipc.org/) and WHIPPET (Weed Heuristics: Invasive Population Prioritization for Eradication Tool) (http://whippet.cal-ipc.org/).

CalWeedMapper (http://calweedmapper.cal-ipc.org/) is an online tool that enables natural resource managers to identify management opportunities in a region of interest. WHIPPET (http://whippet.cal-ipc.org/) is a decision-making tool to help prioritize weed populations for eradication. Used together, these tools can help land managers systematically target weed infestations by putting their limited resources into populations known to cause the greatest impacts, are most likely to spread, and are most feasible to eradicate.

As proposed in Strategy A3.1, Reinvigorate County Weed Management Areas, treatments could then be done through contracts with the landowner through the local Weed Management Areas to treat on private land or contracted with the California Conservation Corps for work on public-owned land.

This ALS strategy, in concert with Strategy A3.1, would complement the efforts of the Department of Boating and Waterways on aquatic weeds by addressing additional terrestrial weeds that are problematic for agriculture, and often for native vegetation communities as well.

RELATED PROGRAMS AND POLICIES

The California Department of Fish and Wildife maintains the California Aquatic Invasive Species Management Plan (http://www.dfg.ca.gov/invasives/plan/), which proposes management actions for addressing threats focused on non-native algae, crabs, clams, fish, plants, and other species that continue to invade California's creeks, wetlands, rivers, bays, and coastal waters.

The California Department of Food and Agriculture (CDFA) designates plant species as noxious weeds and maintains a noxious weed list per the California Food and Agricultural Code and Title 3 of the California Code of Regulations. When listed as noxious, each weed receives a rating based on its statewide importance as a pest, the likelihood that eradication or control efforts would be successful, and the present distribution of the weed in the state. CDFA uses the noxious weed list to prioritize weed control and eradication throughout the state.

Under the Aquatic Weed Control Program, the Department of Parks and Recreation's Division of Boating and Waterways (DBW) (http://www.dbw.ca.gov/) is the lead state agency responsible for the control of Brazilian waterweed, water hyacinth, and South American spongeplant in the Delta, its tributaries, and Suisun Marsh. DBW is bound by permit conditions and prioritization systems that dictate when and where control activities may occur.

The Delta Conservancy in cooperation with the Department of Water Resources is testing a pilot program that will likely lead to a Delta-wide Arundo Control Program.

The Delta Plan has a policy and a recommendation related to nonnative invasive species. Ecosystem Restoration Policy ER P5 (23 CCR section 5009) states:

> *(a) The potential for new introductions of or improved habitat conditions for nonnative invasive species, striped bass, or bass must be fully considered and avoided or mitigated in a way that appropriately protects the ecosystem.*
>
> *(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that has the reasonable probability of introducing or improving habitat conditions for nonnative invasive species.*

Ecosystem Restoration Recommendation ER R7 states:

The California Department of Fish and Wildlife and other appropriate agencies should prioritize and fully implement the list of "Stage 2 Actions for Nonnative Invasive Species" and accompanying text shown in Appendix J taken from the Conservation Strategy for Restoration of the Sacramento–San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (DFG 2011). Implementation of the Stage 2 actions should include the development of performance measures and monitoring plans to support adaptive management.

The DWR Central Valley Flood System Conservation Strategy update for 2017 will include an Invasive Plant Management Plan.

DWR Operations and Maintenance Aquatic Nuisance Species Program focuses on invasive pests in State Water Project facilities, but also has done work on arundo removal on land purchased for mitigation and funds CDFA to survey for hydrilla in the Delta and to eradicate it from Clear Lake and other water bodies connected to the watershed.

Weed managers may also consider the National Park Service Exotic Plant Management Program (http://www.nature.nps.gov/biology/invasivespecies/EPMT_teams.cfm) as a model for forming strike teams to assist landowners to respond swiftly to protect their land from invasive plants.

ISSUES

Farmers may not be familiar with Cal-IPC, CalWeedMapper, and WHIPPET and how these partners and tools are beneficial.

Currently, DBW, the only entity authorized to use herbicide to treat Brazilian waterweed, water hyacinth, and South American spongeplant in the Delta, is required to operate under two Biological Opinions (USFWS and NMFS) and the Central Valley Regional Water Quality Control Board's National

Pollutant Discharge Elimination System (NPDES) permit. NPDES permits are required for all aquatic pesticide applications in California.

Securing adequate funding and resources for aquatic weed control is also an issue. The DBW program is expensive, and nonchemical treatments (e.g., mechanical harvesters) are also expensive, time-consuming, or hard to implement/coordinate with residents and agencies.

Identifying and coordinating with existing efforts to manage pest species would maximize efficiency.

PARTNERS AND OPPORTUNITIES

Resource Conservation Districts (RCDs) (http://www.carcd.org/) implement various types of conservation projects on public and private lands and educate landowners and the public about resource conservation. Project activities conducted by the RCDs include, but are not limited to, agricultural land conservation, wildlife habitat enhancement, and wetland conservation. Weed managers could consider engaging the RCDs in helping to educate farmers about invasive species and the benefits of removal as well as provide technical assistance to identify weed populations and prioritize control or eradication on agricultural land.

The Bay area has established a Bay Area Early Detection Network (BAEDN) (http://www.cal-ipc.org/WMAs/BAEDN/). BAEDN is a collaborative partnership of regional land managers, invasive species experts, and concerned citizens in the nine-county San Francisco Bay Area which selects regional priority species for eradication, including some naturalized non-native plant species that have not yet become invasive but that are deemed to be a future risk. BAEDN has become a project of Cal-IPC, joining with other regional partnerships across the state working with Cal-IPC to prioritize eradication targets. Cal-IPC is supporting continued work on Bay Area populations that have been selected for eradication. BAEDN used WHIPPET to prioritize populations of target weed species. This program could serve as a model for a similar program in the Delta.

Other potential partners include:

- USDA-Agricultural Research Service (http://www.ars.usda.gov/)
- UC Cooperative Extension Weed Research and Information Center (http://wric.ucdavis.edu/)
- California Department of Food and Agriculture (http://www.cdfa.ca.gov/plant/)
- Local Weed Management Areas (http://www.cal-ipc.org/WMAs/)
- California Invasive Plant Council (http://www.cal-ipc.org/)
- Sacramento-San Joaquin Delta Conservancy (http://www.deltaconservancy.ca.gov/)
- California Department of Fish and Wildlife (http://www.dfg.ca.gov/invasives/)
- California Conservation Corps (http://www.ccc.ca.gov/)

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy A3.2 Prioritize weeds and other pests for area-wide control: 061014

SECTION II: POTENTIAL STRATEGIES

Group A. STRATEGIES TO HELP MAINTAIN FARMING

Strategy A3: Control Weeds and Other Pests

Strategy A3.3: Encourage Use of Weed-Free Construction Materials

DESCRIPTION

Work with County Agricultural Commissioners in the Delta to certify noxious and invasive weed-free products for use in construction and erosion control projects.

Hay and straw can contain viable weed seeds if harvested from fields where weeds are allowed to develop seed. When used for erosion control wattles, these contaminated products can spread noxious and invasive weeds to new areas. The use of certified weed-free materials is one way to prevent the spread of noxious and invasive weeds.

According to a survey conducted in April 2010, the Delta counties with active weed-free certification programs include Alameda, Contra Costa, San Joaquin, Solano, and Yolo, but not Sacramento. PG&E and Caltrans use weed-free materials in construction, operation, and maintenance activities. Encouraging other users to have a policy to use local, weed-free materials for construction, operation, and maintenance project would help expand the market for these products and local growers could have more incentive to manage their fields to produce materials that can be certified as weed free.

This strategy would benefit farmers by increasing their revenue because their product would be purchased for habitat and other projects. The region would benefit because moving the product would not contribute to further noxious and invasive weed infestation.

RELATED PROGRAMS AND POLICIES

County Agricultural Commissioners and CDFA administer the weed-free certification program. Weed-free certification is a voluntary program for producers. Weed-free certification may also be applied to forage for livestock.

Information regarding certified weed-free forage and straw resources and list of available suppliers can be found on Cal-IPC's website: http://www.cal-ipc.org/ip/prevention/weedfreeforage.php.

The California Invasive Plant Council has published Prevention Best Management Practices for Land Managers and addresses using weed-free materials: http://www.cal-ipc.org/ip/prevention/PreventionBMPs_LandManager.pdf

ISSUES

Planning ahead is necessary. Growers need to know early in the year (January/February) whether there will be demand for weed-free certified product. Inspections usually take place in June/July before harvest.

Weed-free certification programs usually inspect for noxious weeds from the CDFA Noxious Weed List, so there would need to engage in discussions with the County Agricultural Commissioner regarding

expanding the weed-free certification to include invasive species listed by the California Invasive Plant Council.

PARTNERS AND OPPORTUNITIES

County Agricultural Commissioners and CDFA would be the logical agencies to implement this strategy.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy A3.3 Encourage use of weed-free construction materials: 102913

SECTION II: POTENTIAL STRATEGIES

Group A. STRATEGIES TO HELP MAINTAIN FARMING

Strategy A4: Reduce conflict between agriculture and nearby habitat lands

Strategy A4.1: Establish "Good neighbor" policies

DESCRIPTION

Many Delta farmers are concerned that habitat lands could harm nearby agriculture in various ways. Habitat areas could export weeds, diseases and pests. Prolonged flooding of constructed wetlands could cause water seepage onto nearby farmland and consequently damage crops. Neighbors of a restoration project may also have concerns about wildlife and human trespass. Farmers are also concerned that protected species could migrate from restored habitat areas onto farmland and result in liability under species protection laws. In addition, farmers want assurance that owners of project lands purchased and held pending development and approval of projects will be good stewards and continue to maintain the agricultural nature of the lands pending commencement of the project.

Farmers would like additional assurance that entities that establish and manage habitat projects nearby will consult with their neighbors and find ways to avoid such impacts and resolve problems when they arise. This could include creation of buffer zones between habitat preserves and farmland, which would help to reduce or eliminate exposure to pests and diseases on neighboring lands, prevent overspray of chemicals onto habitat lands, and assist with a successful transition between different land uses. Another option is to provide third-party liability insurance or a fund to compensate landowners for any substantiated property damage.

A third option is to develop and obtain approval of land management agreements and permits that provide landowners protections from liability under state and federal endangered species laws for their otherwise lawful operations, should expanded populations of threatened and endangered species enter their property due to nearby habitat restoration. See Strategy A4.2 for a more detailed discussion of this option.

RELATED PROGRAMS AND POLICIES

Buffer zones are in use in the North Natomas HCP in Sacramento and Sutter Counties to separate the habitat preserve from urban and potentially urban areas. In that instance, the main aim of the buffer zone is to protect native wildlife from urban threats, such as cats and dogs.

The land use and management plan adopted by the Delta Protection Commission includes a policy that calls for habitat projects to include appropriate buffer areas to prevent conflicts with neighboring agricultural parcels. It further states: "Buffers shall adequately protect integrity of land for…agricultural uses and shall not include uses that conflict with agricultural operations on adjacent…lands."

The Mitigation and Monitoring Reporting Program for the Delta Stewardship Council's Delta Plan, which summarizes the mitigation measures in the final program environmental impact report, contains three actions under Mitigation Measure 7-1 to reduce the impact of habitat projects on agriculture. These actions include reconnecting utilities or infrastructure that serve agricultural uses if these are disturbed by project construction, managing project operations to minimize the introduction of invasive species or

weeds that may affect agricultural production on adjacent agricultural land, and establishing buffer areas between projects and adjacent agricultural land that are sufficient to protect and maintain land capability and agricultural operation flexibility.

With regard to buffer areas, Delta Plan Mitigation Measure 7-1 states, in part, "Design buffers to protect the feasibility of ongoing agricultural operations and reduce the effects of construction- or operation-related activities (including the potential to introduce special-status species in the agricultural areas) on adjacent or nearby properties. The buffer shall also serve to protect ecological restoration areas from noise, dust, and the application of agricultural chemicals. The width of the buffer shall be determined on a project-by-project basis to account for variations in prevailing winds, crop types, agricultural practices, ecological restoration, or infrastructure. Buffers can function as drainage swales, trails, roads, linear parkways, or other uses compatible with ongoing agricultural operations."

ISSUES

Buffer zones may be expensive to acquire, both in dollars and land area. Because they typically do not contribute to the acreage requirements for species protected in habitat preserves, their justification lies in their ability to reduce or prevent impacts to neighbors.

Multi-purpose buffers are worth considering both because they may provide co-benefits for the landowner and others, and because some compatible uses may reduce the costs of acquiring or maintaining buffer zones. For example, trespass concerns might be reduced by planting buffers or borders along the edges of the planting that will discourage human trespass, such as rose, blackberry, and poison oak hedgerows that also have wildlife benefits, or another barrier might involve planting a dense hedgerow of trees to intercept pesticide drift from neighboring properties. Such hedgerows can also function as valuable habitat. Other examples of multi-purpose buffers could include a drainage ditch or irrigation canal, interior or exterior levee, fire road, wind break, pipeline or power line, railroad right of way or rural airstrip, flood bypass, groundwater recharge area, windmills to generate electricity for on-farm use and/or the grid, solar panels to generate electricity for on-farm use and/or the grid, CIMIS station and cell phone tower.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy B4.1 Good Neighbor: 061014

SECTION II: POTENTIAL STRATEGIES

Group A. STRATEGIES TO HELP MAINTAIN FARMING

Strategy A4: Reduce conflict between agriculture and nearby habitat land

Strategy A4.2: Provide take coverage for neighboring lands

DESCRIPTION

Farmers are concerned that protected species could migrate from restored habitat areas onto farmland and result in liability under species protection laws. Farmers would like protection from liability under state and federal endangered species laws for their otherwise lawful operations, should populations of listed threatened and endangered species enter their property as a result of habitat restoration. This type of protection is sometimes called neighboring landowner protection.

The California Endangered Species Act provides limited protection for "accidental take," which could occur in the course of an otherwise lawful, routine, and ongoing farming or ranching activity. This strategy does not include a discussion of accidental take issues.

RELATED PROGRAMS AND POLICIES

A conservation plan approved under the federal Endangered Species Act or state Natural Community Conservation Planning Act can include provisions through which landowners neighboring habitat preserves established under the plan could obtain take authorization. The San Joaquin County Multi-Species Habitat Conservation and Open Space Plan provides for "neighboring land protections" to assure neighboring landowners that their routine and ongoing agricultural activities on their lands will not be affected by protected species that become established on their land. Protections extend one-half mile out from the habitat preserve border, and provide coverage under both the federal and state endangered species acts.

Landowners who seek such protection must sign a Certificate of Inclusion. The Santa Clara Valley Habitat Plan has a similar provision, providing incidental take coverage under a voluntary program to active farmlands within a one-mile radius of the reserve area and covering three listed species: California red-legged frog, California tiger salamander, and western pond turtle.

Incidental take programs in ESA/NCCPA conservation plans typically identify eligibility requirements, including provisions for voluntary participation, timelines for applying for take coverage, the geographic scope of eligible lands, and the land uses eligible for take coverage. In addition, they require a biological survey that identifies baseline conditions (e.g., the type, number, location, and condition of species and their habitat) for the purpose of identifying changes from the baseline as a result of conservation plan implementation. The Santa Clara Valley Habitat Plan provides landowners the option of either allowing biologists with the implementing agency to survey their property and reimbursing the cost of the survey, or hiring a biologist on their own with the approval of the implementing entity.

ISSUES

Landowners would need to allow access to biologists for the purpose of gathering information regarding baseline and future conditions. This requirement, along with the cost of surveys, could affect

participation levels in a voluntary program. The incidental take coverage program also should set forth how incidental take coverage issues will be addressed when land ownership is transferred.

Efforts to increase the abundance of protected fish species in the Delta, and elsewhere, raise concerns that those fish could be unintentionally drawn into irrigation water intakes. No approved Habitat Conservation Plan provides neighboring land protection for take of fish that are drawn into water intakes. Thus, the process and rules for determination of eligibility, geographic scope, and baseline survey requirements for such coverage have not been established, and would likely prove difficult.

OPPORTUNITIES AND POTENTIAL PARTNERS

- Farm Bureaus of five Delta counties
- California Farm Bureau Federation
- Resource Conservation Districts
- Delta Protection Commission, Delta Conservancy, Delta Stewardship Council, California Department of Fish and Wildlife, California Biodiversity Council
- U.S. Fish and Wildlife Service, National Marine Fisheries Service

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy A4.2 Provide Take Coverage for Neighboring Lands: 061014

SECTION II: POTENTIAL STRATEGIES

Group A. STRATEGIES TO HELP MAINTAIN FARMING

Strategy A4: Reduce conflict between agriculture and nearby habitat lands

Strategy A4.3: Support local efforts to reduce nuisance and illegal activities

DESCRIPTION

Farmers in the Delta face problems related to trespassing, vandalism, dumping, poaching, and crime on or near their farmland. Some Delta farmers are concerned that BDCP construction activities, as well as the development and operation of new habitat lands, could increase problems related to illegal activities. Farmers would like assurances that these unwanted situations won't harm them or interfere with their farming operations. A partial solution for this potential problem would be to increase law enforcement presence in areas where illegal activities occur. There are a variety of ways to help provide for increased law enforcement. They include providing funding for:

- Department of Fish and Wildlife to hire additional game wardens. These wardens would patrol areas deemed necessary to reduce crime on and near habitat lands. One of the BDCP measures would increase game warden staffing to enforce regulations regarding the illegal harvest of adult salmon, steelhead, and sturgeon. If this measure is funded, the mere presence of additional game could act as a deterrent to the types of crimes noted above. These game wardens may also arrest individuals engaged in a wide variety of illegal activities, in addition to poaching.
- local police and sheriff departments to hire additional staff, including law enforcement personnel
- hire private security guards.

In addition, project proponents of restoration projects should consider the potential for illegal activities and work with neighboring farmers and land managers to provide adequate patrolling of the land by project personnel or others. Regular patrolling and a visible presence on the land, as part of the job of managing the project can deter vandals and trespassers, and reduce potential opposition to the project from neighboring landowners. If problems are observed, law enforcement can be brought in to help deal with the problems.

Potential solutions not involving law enforcement also exist:

- Road, trail, public/private signs that clearly demarcate public/project land from private land.
- Trespass Signs: Landowners have a responsibility to either fence or sign their lands, but funding or signage could be provided to landowners to make it more feasible.
- Protocol for farmers/residents to follow when issues arise: Pamphlet/flyer/web site directing farmers and residents on what to do when there is a conflict.

RELATED PROGRAMS AND POLICIES

The Delta Conservancy prepared a paper on "Law Enforcement in the Sacramento-San Joaquin Delta Region" which has a number of recommendations included here. The Conservancy and the Delta Protection Commission are currently drafting a follow-up to this report that identifies how to address

some of these issues. The PPIC also issued a report called "Costs of Ecosystem Management Actions for the Sacramento-San Joaquin Delta" which discusses enforcement issues.

The Western Riverside County Multiple Species HCP includes funding for Reserve Managers to carry out management activities. These management activities include addressing disturbances, such as illegal trespass that affect the habitat land. Examples of illegal trespass are dumping, vandalism, and off-road vehicle use.

A State program to aid local law enforcement was implemented during the construction of Oroville Dam.

ISSUES

Funding for these types of positions may be difficult to obtain, especially year after year. These positions would need to be funded for the life of the habitat land, which is usually in perpetuity.

According to the PPIC report (above), one game warden would cost about $200,000 per year (including benefits, salary, and operational support).

Funding would also be needed for appropriate signage.

OPPORTUNITIES AND POTENTIAL PARTNERS

- Resource Conservation Districts
- California Department of Fish and Wildlife
- Sheriff Departments and County Prosecutors' Offices for the six Delta Counties
- CHP

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy A4.3: Support local efforts to reduce nuisance and illegal activities 061014

SECTION II: POTENTIAL STRATEGIES

Group A. POTENTIAL STRATEGIES TO HELP MAINTAIN FARMING

Strategy A5: Provide agricultural conservation easements

DESCRIPTION

An agricultural conservation easement (ACE) is a voluntary, legally recorded deed restriction that is placed on a specific property used for agricultural production. ACEs are created specifically to ensure agriculture remains viable over a long period of time and to prevent incompatible development on the subject parcels. While other benefits may accrue because the land is not developed (scenic and habitat values, for example), normally the primary use of the land is agriculture. Strategies E1.2.2 and E1.2.3 17 may make use of easements in addition to other tools such as direct payments.

Normally, ACEs are held in perpetuity, which demands careful contemplation of future potential agricultural uses, as well as current customary uses. Historically, the goal of an ACE has been to maintain agricultural land in active production by removing the development pressures from the land. Such an ACE generally prohibits practices which would damage or interfere with the agricultural use of the land, although multipurpose easements may impose restrictions on agriculture needed to preserve other, nonagricultural land values that are also within the scope of the ACE's purposes.

Because the ACE is a restriction on the deed of the property, the ACE runs with the land; that is, as long as it exists, the restrictions it contains remain in effect through all subsequent changes in ownership. Depending upon each situation, the placement of an ACE on land may provide income, property, and estate tax benefits. Historically, ACEs have often been held by land trusts or local governments, which are responsible for ensuring that the terms of the ACE are upheld. The property proposed for an ACE must have characteristics (e.g., location, soil quality) that make it a priority for the ACE holder organization. If the potential ACE holder wishes to pursue an ACE on the proposed property, it would negotiate terms with the landowner, including price and restrictions.

This strategy is referred to elsewhere in this paper on strategies as a "Conventional Mitigation Approach." As it is normally used in other areas of California, when agricultural land is converted to another use, the strategy requires the preservation and, in some cases, enhancement of other land of similar agricultural value, and is most effective if the ACE is on land that is in the path of development. Thus, typically, ACEs are use to conserve or protect farmland subject to economic pressure to convert to a use other than agriculture. In the Delta, the approach is complicated by the fact that there is little development pressure in the inner Delta due to regulatory restrictions, flood threats, and the large number of acres potentially planned for restoration by DWR and other public and private entities. These circumstances make both the valuation of potential ACE property interests, and the identification of the best locations for ACEs much more complex.

In considering locations for ACEs, the following factors could be considered:

1. Would ACEs provide a sustainable area of high quality or unique farmland in the Delta?

There is significant acreage of high quality farmland in the Delta. Some of the historically productive land is under threat of inundation from sea level rise, and other land would be converted from agricultural use if required for implementation of some BDCP or other HCP/NCCP conservation measures. However,

there may be non-developed uses (e.g., conversion from farming to some recreational or conservation uses) that could cause conversion from agricultural use of high quality soils. Obtaining ACEs on such lands could ensure long-term agricultural uses on Delta farmland.

Determining the best locations for ACEs will depend on soil quality, long-term viability of agricultural uses, owner interest in capitalizing land value through voluntary participation in an ACE program, and local factors, including local governments' interest in preserving agricultural land uses. Where in-Delta and out-of-Delta orchard and crop types or planting patterns are geographically and/or economically linked, there may be a benefit to ensuring long-term protection on in-Delta land, via ACEs, by providing a bridge to preserving agricultural land outside the Delta. The economic vitality of Delta agricultural land may also benefit from protection of land with similar orchard and crop types located adjacent to, or reasonably close to comparable Delta farmland.

To the maximum extent possible, replacement land should be of equal or greater value, using either the Department of Conservation's Important Farmland classifications, the Storie Index for California soils, or using the NRCS soil survey classes. All ACEs should comply with statutory requirements qualifying them as enforceable restrictions pursuant to §421, et seq. of the Revenue and Taxation Code.

2. In considering the use of ACEs as mitigation, what are the possible land loss/easement ratios that could be considered?

Recent custom for mitigation of the conversion of agricultural land for development purposes tends be that a 1:1 ratio for ACEs meets the feasible mitigation standard. This approach appears to recognize that the mitigation would result in a net loss of farmland, since the action would permanently restrict equivalent acreage to agricultural use, but still would not cause an increase in high quality land available for agricultural uses. Other approaches using lower or higher ratios have also been used and in some cases the determination that there is no feasible mitigation has resulted in no ACEs being proposed (see the Appendix, Attachment 3 for a summary of CEQA cases). Where multi-purpose agricultural conservation easements (see below) are used to mitigate for the loss of farmland elsewhere, the 1:1 ratio would most likely be based on the net land available for farming on the easement property (that is, by not counting land from which farming would be excluded in order to meet conservation measures).

A suggestion has been made that acreage restricted to habitat conservation easements should not be counted toward CEQA mitigation for agricultural land. Another suggestion is that a higher ratio may be appropriate, for example, in conversion of a Farmland Security Zone parcel, reflecting the high quality of the land and the longer term commitment by landowners and local governments. A suggestion has also been made that a 3:1 ratio should apply to any conversion of agricultural land to nonagricultural uses.

3. What issues arise with combination habitat conservation and ACEs?

Factors to consider in determining when it is appropriate to use a combination habitat conservation easement and ACE include:

- The extent to which the easement serves both habitat and agricultural purposes;
- Whether, and the extent to which, restrictions needed to conserve or mitigate for loss or replacement of habitat prevent the use of some of the land for agriculture or limit the kind of crops that can be grown; and,

- Whether the farmland preserved for conservation or mitigation of the loss of habitat occurs in areas identified as priorities for preserving agricultural resources.

A suggestion has been made that all habitat restoration projects proposed through BDCP and other state agencies should occur on government owned land first and that any habitat restoration projects on privately owned land should only be considered after all public owned lands used for habitat mitigation activities are exhausted. Private lands shall only be considered on a willing seller, willing buyer agreement with payment of fair and just compensation. Another suggestion is that acquisition of land should be obtained through conservation easements first before fee title is considered by the implementing entity.

RELATED PROGRAMS AND POLICIES.

- California Farmland Protection Program, California Department of Conservation
- California Coastal Conservancy, Grant program for Government agencies (federal, state, local, and special districts) and certain nonprofits.
- Local Williamson Act programs, including Williamson Act "Easement Exchange" actions
- USDA Conservation Reserve and Wetland Reserve Programs
- USFWS LIP program

ISSUES

Issues involve questions of who will negotiate and acquire the ACEs; who will hold the ACEs; how will any ACE be enforced (for performance requirement and to ensure acreage commitments are met); and how would ACEs be endowed, if necessary, to ensure the permanent administration and enforcement of easement rights by the holder(s) of the ACE.

OPPORTUNITIES AND POTENTIAL PARTNERS

Potential Partners include: the Delta Conservancy; private land trusts and conservancies; the Department of Conservation; the California Coastal Conservancy; and USDA, Natural Resources Conservation Service

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy A5 Easements: 102913

SECTION II: POTENTIAL STRATEGIES

Group B. STRATEGIES THAT PROVIDE INCENTIVES FOR CONSERVATION ON AGRICULTURAL LAND

Strategy B1: Partner with others to maintain and enhance environmental quality on agricultural land

DESCRIPTION

Additional funds could enhance existing programs that work with farmers to create and maintain habitat on private land. Many governmental and non-profit entities and private landowners work to improve wildlife habitat and other aspects of environmental quality on farmland. They recognize the value of natural habitat features on agricultural land. Similarly, they may see value in establishing a mosaic of habitat and conventional crops across the landscape.

Thus, many growers build wildlife-friendly features on their farms, including hedgerows, grassed waterways and vegetated tail-water ponds. These have beneficial roles in agriculture and serve as habitat features. Some managers make use of livestock for weed control in habitat areas; e.g., livestock grazing is sometimes the key to maintaining desirable conditions in vernal pools.

RELATED PROGRAMS AND POLICIES

A familiar example is the work of Resource Conservation Districts and the NRCS. They offer ways to improve management of farms and rangeland to benefit both agriculture and wildlife. RCDs work with the NRCS to help fund projects on private land.

Federal Farm Bill programs, including the Conservation Reserve and Wetland Reserve Programs, share costs with landowners to create and maintain habitat on private land.

The Central Valley Joint Venture is another example of successful establishment of countless wetland habitat projects on privately-owned farmland over the past twenty-five years. The projects are compatible with production agriculture and often involve rice land in both the growing and fallow season and winter flooding of other crops.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy B1 Partner to Enhance: 102913

SECTION II: POTENTIAL STRATEGIES

Group B. STRATEGIES THAT PROVIDE INCENTIVES FOR CONSERVATION ON FARMLAND

Strategy B2: Provide incentives for farmers and landowners to take part in a market based conservation program

DESCRIPTION

A consortium (including American Rivers, Environmental Defense Fund, PRBO Conservation Science, Environmental Incentives and Trout Unlimited, Delta Conservancy, and California Department of Conservation) has proposed development of exchanges in which private landowners produce habitat, or otherwise improve environmental quality, and package those accomplishments as credits for sale. Buyers could be either investors or permit-seekers, such as agencies or entities needing to comply with environmental regulations or mitigation requirements. A third-party program administrator would link buyers, producers and regulatory agencies. The consortium is developing the outline of a habitat credit exchange that could be used to improve both flood protection and habitat in the Central Valley and Delta.

The operation of habitat credit exchanges would require creation of scientific techniques to measure benefits (credits), both as acreage and as habitat quality. The consortium is developing such a measurement tool for rice fields, and aims to use it in a pilot project that would compensate rice growers for creating and maintaining high-quality fish habitat. A second pilot project seeks to develop and measure habitat credits for Swainson's hawk, focusing mainly on alfalfa fields and other agriculture-based foraging habitat.

Credits are envisioned as being available on specific land parcels for a fixed period, rather than permanently. Thus, an owner could enroll a parcel and then opt it out of the program at the end of the contract term. The program aim is to keep sufficient acreage enrolled so as to maintain the desired number of credits at all times.

ISSUES

Most environmental market credit programs are in development at this point; neither the crediting process nor the standards that define acceptable habitat projects have been defined. The first few projects will have the burden of proving the feasibility of the programs, including their ability to integrate with existing programs, such as HCPs/NCCPs. Another issue will be whether and how such programs will deal with situations that require mitigation measures to be provided in perpetuity.

SECTON II: POTENTIAL STRATEGIES

Group C. STRATEGIES TO MANAGE LAND TO REVERSE SUBSIDENCE AND SEQUESTER CARBON

Strategy C1: Provide incentives to stabilize or reverse land subsidence on Delta islands

DESCRIPTION

Over the past century, agricultural practices in the Delta have caused the loss of over one million acre-feet of peat soils, causing land subsidence down to 20-25 feet below sea level on some islands. Current agricultural practices continue to remove these soils and, as part of that loss, emit about five million tons of carbon dioxide annually—about 1% of California's total emissions.

This strategy includes two land management options, sometimes referred to as carbon capture wetland farms and low carbon agriculture, that could reduce soil loss and greenhouse gas (GHG) emissions, reduce the flooding and other risks associated with land subsidence, and provide habitat benefits to the Delta ecosystem.

Carbon capture wetland farms are constructed wetlands operated to maximize retention of atmospheric carbon, mainly in the soil, and minimize the release of other GHGs. Native tule wetlands, in particular, can capture and store carbon at very high rates and, in doing so, build soil that continuously reverses subsidence.

Low carbon agriculture refers to farming practices that reduce GHG emissions and rates of ongoing land subsidence. These practices could include increasing groundwater levels during the growing and fallow seasons, winter flooding, reduced tillage, reduced use of nitrogen-based synthetic fertilizer, and conversion to rice production.

RELATED PROGRAMS AND POLICIES

The Delta Stewardship Council's draft Delta Plan recommends that State agencies not renew or enter into agricultural leases on Delta or Suisun Marsh islands if the actions of the lessee promote subsidence, unless the lessee takes part in subsidence-reversal efforts.

The Delta Conservancy strategic plan calls for incorporation of subsidence reversal into habitat restoration projects and collaboration with growers and landowners to identify areas for subsidence mitigation, potentially including rice fields and carbon sequestration wetlands.

Federal Farm Bill programs, including the Wetland Reserve Program, compensate private landowners to remove their land from cultivation and place it in managed marsh or pasture. The federal Conservation Reserve Program specifically targets highly erodible farmland.

DWR operates a 300-acre wetland on Twitchell Island where researchers from UC Davis, UC Berkeley and the private sector are examining the efficacy of shifting land uses toward rice and wetlands. By 2017, about 3100 acres of wetlands on Sherman Island and 1000 acres of wetland and tidal marsh on Twitchell Island will be completed to provide a farm-scale test of the technical and economic viability of carbon capture wetland farming and the success of subsidence reversal.

Some farmers are utilizing low carbon farming practices.

ISSUES

Establishment of tule wetlands for subsidence reversal faces three issues:

- Potential adverse impacts, including contamination from mercury and dissolved organic carbon and the need for mosquito control, need resolution.
- Implementation will be difficult on islands with multiple owners, unless all owners agree to take part in the project.
- Subsidence reversal requires land management practices that differ from much of conventional agriculture in the Delta.

Expansion of low-carbon agriculture, in the form of rice culture, may be an economic issue for farmers because rice yields are lower in the Delta than in the more favorable climate of the Sacramento Valley.

OPPORTUNITIES

Both DPC and DSC policies assert that all beneficiaries of flood protection in the Delta, including landowners, water exporters, CalTrans, and other infrastructure owners, such as privately owned utilities, should help pay for those benefits. Although these policies were developed with levees in mind, they could be clarified to include subsidence reversal projects as part of the long-term solution to flooding. Subsidence reversal should gradually and continuously reduce the cost of levee maintenance and, in the long run, would provide more secure flood protection.

The "walking wetland" management practice pioneered at National Wildlife Refuges in the Klamath Basin allows rotation between habitat crops and conventional crops on a given parcel.

This rotation has proved attractive to growers of conventional crops in the Klamath Basin because it reduces both fertilizer costs and crop losses to pests. In addition, a three-year rotation into wetlands could meet one requirement for organic certification, namely, that the farm field has been free from prohibited synthetic chemicals for three years. If the economic benefits of wetland rotation do not outweigh their costs in the Delta, other incentives might be needed. In addition, there are questions of whether these practices can be applied to subsided areas of the Delta.

POTENTIAL PARTNERS

The State could consider providing funds for the federal Wetland Reserve Program or developing a similar State program. The Delta Plan and the Delta Conservancy's Strategic Plan recognize subsidence reversal as an important component of future Delta management. The Delta Conservancy anticipates funding multi benefit projects that result in subsidence reversal, carbon emission reductions and sequestration.

The State program could publicly solicit participation by landowners, and seek out large contiguous blocks of deeply subsided land, preferably whole islands. Annual payments could be scaled to match habitat and subsidence reversal benefits.

Funds for the program might come from projects that need to mitigate greenhouse gas emissions under CEQA or from proceeds of the AB 32 cap-and-trade allowance auctions. The April 2013 draft investment plan for cap-and-trade auction proceeds recommends funding for "pilot projects for restoration of wetland areas, including the Delta, to increase carbon sequestration and provide co-benefits such as increased native species populations and water quality improvement." It also recommends funding for

"agricultural practices and fertilizing material application practices that reduce GHG emissions, improve water quality and provide other co-benefits."

The Delta Levees Subvention Program at DWR and CDFW requires levee repair and improvement projects to include habitat enhancement in order to be eligible for a State cost share. Development of non-tidal wetlands, such as tule marshes, could be explored as one type of enhancement that could help meet a program requirement and reverse land subsidence.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy C1 Subsidence: 102913

SECTION II: POTENTIAL STRATEGIES

Group C. STRATEGIES TO MANAGE LAND TO REVERSE SUBSIDENCE AND SEQUESTER CARBON

Strategy C2: Assist farmers and landowners to produce and sell greenhouse gas offset credits

DESCRIPTION

As described in the Strategy C1, the greenhouse gas cap-and-trade regulation provides for the use of offset credits to meet compliance obligations. Marketable credits can be generated under methodologies (called protocols) approved by the California Air Resources Board. Protocols for peat wetlands and rice cultivation are under consideration for adoption. This strategy would promote and track the development of such protocols, examine their financial viability in the carbon offset market, and offer financial incentives, if needed.

RELATED PROGRAMS AND POLICIES

The Delta Stewardship Council's Delta Plan proposes that the DSC partner with the California Air Resources Board and the Delta Conservancy to develop a program for Delta farmers to earn AB 32 credits for carbon sequestration by growing native wetland plants and reducing land subsidence. The Delta Conservancy's strategic plan includes a similar idea.

Farm-scale pilot projects to grow tule wetlands on Twitchell and Sherman Islands are in development, as described in Strategy C1. These projects may contribute to development of a protocol for calculation, monitoring and reporting of carbon credits derived from wetland restoration and conservation projects. Such a protocol is essential for carbon captured in wetlands to become marketable in the AB 32 greenhouse gas offset program. The Department of Water Resources, Delta Conservancy, Coastal Conservancy, and several private sector interests are involved.

The Air Resources Board is considering admitting certain rice cultivation activities into the carbon offset program. The source of offsets is a reduction in methane emissions from flooded rice fields. Efforts are under way at the Climate Action Reserve (a nonprofit corporation) to develop a protocol for peat soil, including soils in the Delta.

ISSUES

- Even after protocols are established, Tule farms are unlikely to provide a clear financial incentive to landowners or investors without either fairly high carbon prices in the cap-and-trade program or subsidies for some of the costs of conversion and management. Another factor affecting the market may be that Credits under AB 32 are available only for carbon that remains sequestered for long periods (a 100-year minimum) or in perpetuity--a condition that restricts land uses to those compatible with carbon sequestration.

OPPORTUNITIES

Research on tule wetlands on Sherman and Twitchell Island by USGS, the University of California and DWR shows large reductions in greenhouse gas emissions through a combination of increased carbon sequestration and prevented loss of soil carbon that results from substitution of tules for conventional crops. Economic models are in development to project break-even costs for replacing conventional farmland with wetlands that can provide carbon offset credits for the AB 32 cap-and-trade program.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy C2 Offset credits: 102913

SECTION II: POTENTIAL STRATEGIES

Group C. STRATEGIES TO MANAGE LAND TO REVERSE SUBSIDENCE AND SEQUESTER CARBON

Strategy C3: Investigate options to designate subsidence reduction and carbon sequestration crops as agricultural

production for regulatory and incentive purposes

DESCRIPTION

As markets for Environmental Services evolve, it is possible that landowners could be reimbursed for growing plants and managing the land but not selling the plant products. This alternative to current agricultural uses on land would repurpose land for environmental benefits via soil conservation, carbon sequestration or both. This would be a change in end-use from the traditional production and sale of products in farming. Instead, as markets develop, the farmer would continue to grow plants, but the seasonal/annual harvest would be replaced by retaining the plant material to store carbon or accrete soil elevation for environmental benefits.

This expansion of the traditional concepts of agriculture would require regulatory or statutory recognition in order to obtain the benefits available to traditional agricultural practices, such as fitting within the definition of agricultural products in the Williamson Act or under the definitions necessary to qualify for other conservation programs. Within the past decade, for example, the production of biofuels was added to the definition of agricultural products in the Williamson Act, providing broader opportunity for expanded "agricultural" markets.

This expansion could:

- reduce some of the transfers of land off the tax rolls to governmental or nonprofit ownership, with resulting impacts on local government incomes,
- retain farmers on these lands and, as noted in Strategy E1.2.3, involve the farmer in managing the land and its drainage, maintaining levees, water control structures and other infrastructure, controlling invasive weeds, and providing security against trespass and vandalism,
- allow an expanded spectrum of compatible agricultural uses (and eligibility for participation) within the scope of local Williamson Act programs.

RELATED PROGRAMS AND POLICIES

The Delta Stewardship Council's Delta Plan proposes that the DSC partner with the California Air Resources Board and the Delta Conservancy to develop a program for Delta farmers to earn AB 32 credits for carbon sequestration by growing native wetland plants and reducing land subsidence. The Delta Conservancy's strategic plan includes a similar idea.

ISSUES

Some statutory/regulatory changes may be needed to expand existing definitions of agriculture or agricultural products.

As noted in Strategy B2, most environmental market credit programs are in development at this point; neither the crediting process nor the standards that define acceptable habitat projects have been

defined. Another issue will be whether and how such programs will deal with situations that require mitigation measures to be provided in perpetuity.

OPPORTUNITIES

Research on tule wetlands on Sherman and Twitchell Island by USGS, the University of California and DWR shows large reductions in greenhouse gas emissions through a combination of increased carbon sequestration and prevented loss of soil carbon that results from substitution of tules for conventional crops. Economic models are in development to project break-even costs for replacing conventional farmland with wetlands that can provide carbon offset credits for the AB 32 cap-and-trade program.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy C3 Designate carbon sequestration and subsidence reversal crops as agriculture: 061014

SECTION II: POTENTIAL STRATEGIES

Group D: STRATEGIES THAT SUPPORT AN AGRICULTURAL ECONOMY

Strategy D1: Develop area-wide economic and land use studies

Strategy D1.1: Develop an historic and current land use study

DESCRIPTION

This strategy proposes a comprehensive land use study to collaboratively evaluate Delta land use, past, present, and future. The strategy could help in understanding the most appropriate future uses and help the Delta community, local government, and state and federal agencies to understand how to invest effectively in the Delta.

This type of analysis could answer a number of questions. For instance:

- What are the current land uses by crop type and land use designation?
- How can current habitat restoration efforts support the long-term sustainability of agriculture in the Delta?
- How does the geography—past and current—affect land uses?

To fully understand the potential for agricultural losses from BDCP or other projects or programs and how such losses could be avoided or reduced, a clear understanding of past and current land uses are necessary. Critical to this understanding is knowledge about current land uses in the Delta as well as the historical context for these uses. Once the agricultural landscape of the Delta region is better understood, specific measures to maintain and improve Delta agriculture can be developed. A project such as this could be considered as foundational research that would assist the Delta Conservancy, the Delta Protection Commission and other agencies in understanding how to invest effectively in the future.

RELATED PROGRAMS AND POLICIES

The San Francisco Estuary Institute (SFEI) has been conducting historical topography research to understand how land forms have influenced water flows, levees, and land use. SFEI is now considering an agriculture overlay to better understand the nexus between topography and agricultural land uses.

The Delta Conservancy is managing the Delta Restoration Network (DRN)—a coalition of agencies and nonprofits conducting and planning to conduct habitat restoration in the Delta.

Department of Water Resources' Land and Water Use Data program collects land use data and develops water use estimates required for statewide water planning by conducting surveys of agricultural, urban and environmental land uses, collecting weather and other data required to make crop and landscape water use estimates, and developing annual estimates of land and water uses on a regional basis.

Department of Conservation's Farmland Mapping and Monitoring Program produces maps and statistical data used for analyzing impacts on California's agricultural resources. Agricultural land is rated according to soil quality and irrigation status; the best quality land is called Prime Farmland.

The maps are updated every two years with the use of a computer mapping system, aerial imagery,

public review, and field reconnaissance.

Some of the Delta counties have or are the process of conducting different analyses of agricultural use in the counties.

ISSUES

The primary issues associated with this strategy are financial and organizational. Funding would need to be found to conduct this type of analysis. Funding might come from different grant programs, governmental land use program or education research programs. Interested parties would also have to consider how to identify relevant existing data, what additional information and analyses are needed and who should do the study or studies. There are numerous ways to approach these considerations but all would benefit from input from local interests. One approach would be for the Delta Conservancy and/or the Delta Protection Commission to take the lead on organizing this discussion.

OPPORTUNITIES AND POTENTIAL PARTNERS

The Delta Conservancy and the Delta Protection Commission would most likely be involved in carrying out this strategy. The following organizations may also wish to collaborate to fund, advise, or conduct an agricultural infrastructure analysis, and then help implement any recommendations:

- Delta Stewardship Council
- Departments of Water Resources, Conservation and Food and Agriculture
- SACOG and the Councils of Government which include the Counties of San Joaquin, Contra Costa, and Solano
- The five Delta Counties
- The University of the Pacific
- The University of California
- CSUS
- Local community colleges
- Local labor organizations
- Economic Development Corporations which cover Delta counties

SECTION II: POTENTIAL STRATEGIES

Group D: STRATEGIES THAT SUPPORT AN AGRICULTURAL ECONOMY

Strategy D1: Develop area-wide economic and land use studies

Strategy D1.2: Develop an economic study of agricultural activity and related infrastructure

DESCRIPTION

This strategy proposes a comprehensive economic study to collaboratively evaluate the Delta agricultural infrastructure, and the technical and financial assistance needed to support a sustainable and competitive agricultural community in the Delta. Currently, there isn't a clear and detailed understanding of agricultural infrastructure in the Delta. Agricultural infrastructure includes, but is not limited to production support, distribution, aggregation, processing, storage, and marketing facilities. This strategy could help understand agricultural needs, which could result in additional strategies to (1) minimize the potential loss of agricultural infrastructure; and (2) improve and expand existing and potential markets.

This type of analysis could consider a number of unanswered questions. For instance:

- What types of agricultural infrastructure are needed in the Delta?
- What is the feasibility and economics of developing needed agricultural infrastructure?
- What is the entry point for various types of specialty crop aggregation, distribution and processing?
- What is the strategy to scale up from entry-level position to larger facilities? What are the feasible scales for this region?
- What costs and revenue are associated with developing new infrastructure needed to accommodate current and future agricultural needs at various scales?
- Is collaboration around community-supported agriculture (CSA) feasible amongst Delta growers?
- Are there opportunities for cost sharing with existing distributors, processors, and food banks? Traditionally, food banks have large capacity for storage and can assist in distribution.
- What costs are associated with operating existing and new infrastructure, and how are those costs covered?
- What are the regulatory, marketing, and distribution barriers and other challenges to developing new infrastructure and operating existing infrastructure?
- What are the recommended strategies and suggested action plans for establishing aggregation and distribution site(s) and establishing and expanding processing facilities in the region?
- What is the history of processing, distribution, etc. in the Delta. Why did it change and how has the market changed since then?
- What are the current worker supply issues? Is there adequate housing?

To determine the potential for agricultural infrastructure losses from BDCP or other projects or programs and how such losses could be avoided or reduced, a clear understanding of why these losses could occur is needed. Critical to this understanding is knowledge about the current structure of the Delta region's agricultural infrastructure, potential losses to that infrastructure, and the needs of Delta

agriculture. Once the agricultural landscape of the Delta region is better understood, specific measures to maintain and improve Delta agriculture can be developed. A project such as this could be considered as foundational research that would assist the Delta Conservancy, the Delta Protection Commission and other agencies in understanding how to invest effectively in the future.

RELATED PROGRAMS AND POLICIES

A number of tools currently exist that could be employed individually or in combination that would be most helpful in understanding the agricultural activity and related infrastructure of the Delta:

- RUCS.The Sacramento Area Council of Government's (SACOG) Rural Urban Connection Strategy (RUCS) initiative has been working to answer questions related to stimulating economic development in rural communities around the six-county SACOG region, and expanding market opportunities for agricultural producers. SACOG's current project seeks to answer various questions to better understand the feasibility of expanding existing, and creating new, agricultural infrastructure in Yolo and Sacramento counties. It is possible that this project could be extended to the three other Delta counties to understand and identify the agricultural infrastructure needs in San Joaquin, Contra Costa, and Solano counties, as well.
- IMPLAN. Used locally by Yolo County, IMPLAN is an input-output analysis that examines relationships within an economy, between businesses and between businesses and final consumers. The analysis captures all monetary transactions in a given time period. This type of analysis examines the effects of a change in one or several economic activities on an entire economy (impact analysis).
- LESA. Used by the USDA, the National Agricultural Land Evaluation Site Assessment(LESA) rates soils and places them into groups ranging from the best to the least suited for a specific agricultural use, such as cropland, forestland, or rangeland. A relative value is then determined for each group. California has adapted the model for use as an optional methodology to be used in environmental assessments. The California Agricultural LESA Model evaluates measures of soil resource quality, a given project's size, water resource availability, surrounding agricultural lands, and surrounding protected resource lands. For a given project, the factors are rated, weighted, and combined, resulting in a single numeric score. This type of analysis can assist landowners and others in making decisions regarding land use and conversion.
- Tipping Point Analysis. This analysis calculates how various factors can change an outcome. More specifically, a tipping point analysis (1) identifies the driving conditions that have the greatest impact; (2) determines the points of change in each condition at which a specific strategy would be impacted (tipping points); (3) calculates the probability of reaching each tipping point; and (3) chooses a strategy based on the probability of reaching each tipping point.

In order to determine the best analysis tool—or combination of tools—a clear understanding of the information needed is necessary, as well as more specifics about each analysis tool, a scope of work, and potential funding sources. Project partners and local stakeholders can assist in vetting this information.

ISSUES

The primary issues associated with this strategy are financial and organizational.

Funding would need to be found to conduct this type of analysis. Funding might come from different grant programs, governmental land use program or education research programs.

Interested parties would also have to consider how to identify relevant existing data, what additional information and analyses are needed and who should do the study or studies. There are numerous ways to approach these considerations but all would benefit from input from local interests. One approach would be for the Delta Conservancy and/or the Delta Protection Commission to take the lead on organizing this discussion.

PARTNERS AND POSSIBLITIES

The Delta Conservancy and the Delta Protection Commission would most likely be involved in carrying out this strategy. The following organizations may also wish to collaborate by helping to fund, advise, or conduct an agricultural infrastructure analysis for the Delta, and then helping to implement the recommendations of that program:

- Delta Stewardship Council
- Departments of Water Resources, Conservation and Food and Agriculture
- SACOG and the Councils of Government which include the Counties of San Joaquin, Contra Costa, and Solano
- The Five Delta Counties
- NRCS and associated RCDs
- The University of the Pacific
- The University of California
- CSUS
- Local community colleges
- Local labor organizations
- Economic Development Corporations which include some or all of the five Delta counties
- NGOs associated with agriculture, land trusts and the environment

There is currently much interest in the Sacramento and Bay Area in local food sources. In fact, the City of Sacramento and the Sacramento Convention and Visitors' Bureau has branded Sacramento as the "Farm to Fork Capitol." With this level of interest, and the ideal location of the Delta, midway between the major urban centers of Sacramento, Stockton, and the Bay Area, the momentum is there to help the Delta further develop its agricultural markets. A program to identify, and then help meet, the infrastructure needs of Delta agriculture could help the region's farmers achieve a sustainable and prosperous future.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy D1.2 Economic Study: 102913

SECTION II: POTENTIAL STRATEGIES

Group D: STRATEGIES THAT SUPPORT AN AGRICULTURAL ECONOMY

Strategy D2: Promote economic development

DESCRIPTION

The Delta has many small, isolated, and potentially under-capitalized farms and agricultural support companies. Delta businesses could benefit from increased access to capital and financial expertise.

There are number of ways to support or promote economic development in the Delta t the Delta (or perhaps the Delta plus Suisun Marsh and the Yolo Bypass) that could ensure a central depository for technical expertise, financing, business development, and promotional efforts that would benefit the Delta, including Delta agriculture. These could include some or all of the mechanisms listed below.

- The formation of an Economic Development Corporation (EDC). An EDC is an organization, usually a 501(c)(3) non-profit corporation, whose mission is to promote economic development and job creation within a specific geographic area. It is controlled by a local Board of Directors, and often receives some funds from local governments, and technical expertise from local colleges. It often provides technical advice and low-interest loans to help new businesses get started in the area, and to enable existing businesses, including farms, to expand their operations.
- An Economic Development Summit Conference. While not an ongoing institution, it can help organize and produce thinking about how to move forward.
- An agricultural ombudsman program that assists farmers, ranchers, and agriculture-related businesses with various permitting processes, including assistance with agricultural permitting, standards and reporting as required by regulatory agencies. An ombudsman could help to facilitate and expedite the development and implementation of agricultural projects. (See Strategy D5.2)
- A position within an existing EDC that focuses on part or all of the five-county Delta region.

RELATED PROGRAMS AND POLICIES

There are more than 80 different regional, county, or city-level EDC's or similar organizations in California. Not one covers the Delta. The San Joaquin Partnership covers all of San Joaquin County. The Solano EDC serves all of Solano County. The Sacramento Area Commerce and Trade Organization serves all of Sacramento and Yolo Counties, plus four other counties which do not contain any part of the Delta. While Contra Costa County does not have an EDC, a number of businesses, local government entities, and educators in eastern Contra Costa County have created East Contra Costa Squared (EC2). EC2 is a volunteer-run collaborative focusing on economic development and education and the nexus of the two.

The Kern EDC could serve as a model for a Delta EDC. It works to ensure a "diverse and strong economic climate for all businesses in Kern County." It supports the growth of local "value-added agriculture" by "recruiting related business" to the county and working with existing value-added agricultural businesses – such as wineries. The Kern EDC has formed task forces to aid local agriculture by addressing

some of the industry's challenges, including regulatory burdens, resource needs, logistics, transportation, and infrastructure, as well as research and development.

The Central Valley Business Incubator (CVBI) is a resource for entrepreneurs wishing to start or expand an enterprise. It partners with UC Merced and CSU Fresno-affiliated institutions to help support agricultural and other businesses in the San Joaquin Valley.

ISSUES

Possible issues which could affect developing an organization and implementing a program to support economic development in the Delta include the following:

- Funding. Significant funds, from low-interest loans, grants, and contracts, would be needed to create, and then to operate, a Delta Economic Development Corporation. While some base funding could come from the five Delta Counties, as well as local entrepreneurs and philanthropists, additional funding would probably be needed, at least at the beginning, to get it started.
- Non-political boundaries. Although many EDC's in California cover more than one county, there does not appear to be an EDC which covers a region such as the Delta, which includes parts of six different counties.
- Some of the support given by a Delta EDC would go to non-agricultural companies in the Delta. However, a sustainable and prosperous Delta economy would also benefit Delta agriculture.

PARTNERS AND POSSIBLITIES

- The Discover the Delta Foundation, which promotes tourism and recreation in the Delta, helps preserve the Delta's rich heritage, and supports Delta agriculture by sponsoring Farmer's Markets and other activities.
- Colleges and universities in and near the Delta, including UC Davis, CSUS, the University of the Pacific, and the various local Community Colleges.
- The Sacramento Area Council of Governments, which promotes economic development and local agriculture in two of the Delta Counties (Sacramento and Yolo), plus four other counties.
- The San Joaquin Council of Governments, which promotes economic development in San Joaquin County.
- The Delta Stewardship Council.
- The Delta Conservancy, which is authorized to "spend funds on developing an economic sustainability program" for the Delta
- The Association of Bay Area Governments, which promotes economic development in three Delta Counties (Alameda, Contra Costa, and Solano), plus six other counties.
- The Farm Bureaus of the five Delta Counties.
- The Delta Protection Commission, which authored the Delta Economic Sustainability Plan.
- The local banking community.
- Regional labor organizations.
- Delta region Chambers of Commerce.

For more information about the Kern EDC, visit their Website at http://www.kedc.com/ .

For more information about the Discover the Delta Foundation, please visit:
http://www.discoverthedelta.org/

From Page 2 of an 8/19/10 letter from Mary N. Piepho, Delta Conservancy Chairperson, to Phil Isenberg, Delta Stewardship Council Chairperson.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy D2 Economic Development: 102913

SECTION II: POTENTIAL STRATEGIES

Group D: STRATEGIES THAT SUPPORT AN AGRICULTURAL ECONOMY

Strategy D3: Improve transportation infrastructure

DESCRIPTION

This strategy proposes transportation infrastructure improvements to provide a (1) safe, reliable transportation system for Delta agriculture and commerce and (2) safe and clearly signed access for cars, buses, trains, boats, and bikes for recreation and tourism purposes. Strategy D1.2 addresses agricultural infrastructure, especially distribution and processing which rely heavily on safe and reliable roads.

Potential programs that are more focused on recreation and tourism include:

- Local and CalTrans assistance to encourage compatibility among drivers/tourists and farm operations (e.g., signs, farm signs, crop signs, etc.)
- Project proponent commitment to incorporate hiking and biking routes, as well as public access to waterways for fishing, wildlife watching and non-motorized boating, and publicly-funded levee improvements, where feasible and in coordination with the local communities.
- Local (county) assistance to develop recreational touring routes, including planning, road widening, off-street trails, bridges and signage (one example is implementing the DPC's Great California Delta Trail)
- CalTrans engagement on recreation improvements along State Routes 4, 12 and 160, such as bicycle routes, signage, viewing pull-outs, parking at fishing access points, etc.

RELATED PROGRAMS AND POLICIES

The five counties and the State all have varying degrees of responsibility with the Delta's roadways. Transportation infrastructure improvements are critical for increasing safety and access for Delta agriculture and commerce, and for better safety, access and signage for increased recreation and tourism by car, bus, train, bike, boat, and foot. *The Economic Sustainability Plan for the Sacramento-San Joaquin Delta (ESP)*, states:

"Driving for pleasure in the Delta is very popular and is a prime example of the right of way/tourism-related recreation use. This recreation category also includes bicycling, hiking, and walking. The winding roadways, interesting bridges, scenic views of waterways and agricultural areas, Legacy Communities, and historic structure all contribute to its visual appeal. The ability to buy fresh fruits and vegetables straight from the grower, visit a winery and sample their product, stop and pick up a freshly made deli sandwich or an ice cream at a 50-year-old grocery store all deepen the Delta experience. To many, the resources are part of the charm—the historical town of Locke, the wildlife preserves, or even the beautiful oak tree canopies shading the roadway.[1]

The Delta Protection Commission (DPC) is developing the Great California Delta Trail to create a contiguous land-based trail system throughout the Delta. DPC is meeting with local governments, trail organizations, and locals to discuss trail routes, connectivity, and concerns related to publicly accessible trails. The Delta Conservancy (Conservancy) supports DPC's efforts and is identifying projects that can

contribute to the trail program, including the development of recreation plan for the McCormack-Williamson Tract.

A few towns and chambers of commerce have developed or are interested in developing driving/touring maps that will make it easier to navigate the Delta. Additionally, the Conservancy—in coordination with the DPC—is developing a Delta brand and marketing plan that will coordinate tourism opportunities in the region. In 2011, State Parks released a Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh, which discussed a "Gateway-Basecamp-Adventure" strategy. This strategy would create a network of recreation areas to help manage and coordinate recreation in the region.

Delta agri-tourism organizations currently advertise their trails and farms on the roadways.

The ESP also states that "Several physical and operational constraints have an impact on current facilities and recreation access including…access points…private land trespass, and complex regulations."[2] The Conservancy, DPC, and State Parks are also discussing how to encourage compatibility amongst tourism, recreation, and farm operations.

ISSUES

Farmers are often concerned about trespass - a concern which has eliminated many traditional recreation access points in the region. A program to increase recreation access points, or even provide clarity to recreationists on where they can find legal recreation access points, will reduce trespass. This could include signage, parking and safety improvements at legal access points, and a web-based map guide. The ESP states, "When attracting visitors and expanding recreation access to waterways and landside recreation improvements, potential negative impacts on agriculture from increased tourism and recreation can be minimized by focusing recreation uses and activities through expansion of existing recreation sites, development in Legacy Communities, creating buffer areas adjacent to agriculture, and increasing public safety enforcement."[3] Compatibility needs to be front and center as does including the community in determining how best to address these issues.

OPPORTUNITIES AND POTENTIAL PARTNERS

The Delta Conservancy, Delta Protection Commission, State Parks, Department of Fish and Wildlife and local government.

The State Lands Commission should be involved in identifying legal access points, along with public land managers.

1. Delta Protection Commission, Economic Sustainability Plan for the Sacramento-San Joaquin Delta. 2012. Page 168.

2. Ibid. Page 147.

3. Ibid. Page 148.

SECTION II: POTENTIAL STRATEGIES

Group D: STRATEGIES THAT SUPPORT AN AGRICULTURAL ECONOMY

Strategy D4: Help farmers and landowners earn new revenue from recreation and tourism

DESCRIPTION

This strategy envisions recreation and tourism, including road touring, hunting, wildlife watching, fishing, farm stays, on-farm sales, value-added products, and u-pick harvesting as marketable products of land management whose first product is an agricultural crop.

RELATED PROGRAMS AND POLICIES

There are numerous private hunting clubs in the Delta and Suisun Marsh. Some forms of eco-tourism are also fairly well developed locally. The Department of Fish and Wildlife leads tours of fallow rice fields in the Sacramento Valley and areas in the Delta to view wildlife--mainly birds--and charges visitors a use fee. Many State Wildlife Areas and federal National Wildlife Refuges charge an entry fee. The Nature Conservancy makes several of its properties, including Staten Island and the Cosumnes River Preserve, available for wildlife viewing and other forms of non-consumptive recreation. TNC does not charge an entry fee, but accepts donations. The Habitat Conservation Plan for East Contra Costa County has a preserve system that allows recreation, including hiking, cycling, and horseback riding.

Agri-tourism entities include Solano Grown, Brentwood Farm Trail, Sacramento River Delta Grown, wineries, and the Delta Farmer's Market. The University of California Small Farm Program offers promotional activities and training for agricultural tourism. Both the California Department of Parks and Recreation and the Delta Protection Commission have recommended creation of a network of recreation areas in the Delta, including improved public access to shorelines. California State Parks' *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh* recommends inclusion of recreational facilities in ecosystem restoration projects, as do several recreation-related Delta Plan policies. DPC's *Economic Sustainability Plan* emphasizes enlarging the tourism and recreation economy through private visitor-serving businesses and collaboration and partnerships between public- and private-sector recreation providers.

The Delta Conservancy has committed to work to "design restoration projects that allow for activities that create revenue, including wildlife-friendly farming practices…and bird-watching, to help pay for long-term maintenance and stewardship of the property." The Conservancy has also partnered with the Delta Protection Commission to develop a "Delta brand" and marketing plan that Delta businesses—farmers included—can use to promote their service or destination.

The Delta Conservancy and the Delta Protection Commission have received comments at public forums regarding the need for assistance with risk-reduction measures to help mitigate the effects of increased tourism on agriculture. Both agencies have conducted some research into these issues and are in the process of determining how best to move forward.

ISSUES

These include the following:

- Few growers are knowledgeable about the outdoor recreation business, so that partnerships with professionals may be needed.
- Current agri-tourism organizations are volunteer-run by farmers and others in agriculture with already full-time jobs, limiting the amount of outreach and marketing that can realistically be conducted.
- Recreation on or near private farmland raises issues for the landowner, including liability, trespass, sanitation, pesticide management, vandalism, traffic, and litter.
- Planning for recreational uses on BDCP habitat lands could complicate the permitting process, because the regulatory agencies would need to consider how to manage the property so that tourism is not a threat to covered species.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy D4 Recreation and Tourism: 102913

SECTION II: POTENTIAL STRATEGIES

Group D: STRATEGIES THAT SUPPORT AN AGRICULTURAL ECONOMY

Strategy D5: Assist farmers and landowners in working with governmental agencies

Strategy D5.1: Public adviser for government projects

DESCRIPTION

Public participation can improve project development and implementation. Likewise, landowners can benefit from direct interaction with agencies performing projects on or near the landowners' properties. A public adviser could improve communication between landowners and agencies by informing landowners of the agencies' activities, and providing landowners with easily accessible means of giving input. Landowners would be able to access information about a project from a designated source, without the need to navigate through a maze of government offices. Similarly, agencies could maintain a central information repository about who has contacted the adviser about the project and what type of information the public is interested in.

There are several ways that a public adviser position could be established and structured, including those listed below:

- Create a public adviser position assigned to cover a specific project and to communicate with interested people and entities on behalf of all agencies involved in undertaking the project.
- Designate a public adviser within a specific agency that covers all projects the agency is undertaking, either within a specific region or Statewide.
- Create a public adviser position assigned to cover all projects that are taking place in a certain region.

A public adviser could be housed within an agency that is undertaking a project, in an agency that already works with landowners in a specific region, or as a separate office within a county government. Regardless of where the public adviser is housed, the public adviser could advise agencies involved in a project on how best to communicate with the public.

RELATED PROGRAMS AND POLICIES

The California Energy Commission employs a Public Adviser. The CEC's Public Adviser, who must be an attorney licensed to practice law in California, is nominated by the CEC and appointed by the Governor for a term of three years. The Public Adviser assists the public in understanding the process and complexities of the CEC's meetings, workshops, and hearings, and makes recommendations to the public on the best way to be involved so that public involvement in CEC proceedings can be effective and meaningful. The Public Adviser performs public outreach efforts, such as the preparation and release of a CEC practice guide in December 2006 on the process of licensing the construction, operation and closure of thermal power plants 50 megawatts or greater, "Public Participation in the Siting Process: Practice and Procedure Guide," which is available online. The Public Advisor also maintains a roster of interested parties in various proceedings, organizes appearances of members of the public at CEC proceedings and makes formal introductions to the Commission, and suggests consolidation and coordination among various members of the public who have similar interests or views. The Public

Adviser does not represent any member of the public or NGO, and does not advocate any position on substantive issues before the CEC.

In addition to communicating with members of the public, the Public Adviser communicates with the CEC regarding its proceedings. For example, the Public Adviser makes recommendations to the CEC regarding the measures it should employ to assure open consideration and public participation in its proceedings. By facilitating public participation in CEC proceedings, the Public Adviser assists the CEC in compiling a comprehensive public record upon which the Commission can base its decisions.

The Public Advisor also disseminates notice of CEC meetings and public hearings to interested groups and to the public at large, and makes recommendations to the CEC on how to improve the accuracy and timeliness of its notices.

ISSUES

Possible issues which could affect the development of a public adviser position include the following:

- Funding. Creation of a new position would require funding. Funding could be included in the budget for projects when approved. If the public adviser is assigned to cover more than one project or multiple agencies' projects, arrangements would need to be made to allocate funding responsibilities among the various agencies and/or projects.
- Non-political boundaries. Projects are not necessarily limited to existing political boundaries, which could make it difficult to identify the appropriate location to house a public adviser position. For example, projects that would be carried out in the Delta, such as the BDCP, cross multiple county lines.

OPPORTUNITIES AND POTENTIAL PARTNERS

- County Governments
- Delta Conservancy
- Delta Protection Commission
- SACOG and other Councils of Government

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy D5.1 Public Advisor for Government Projects: 061014

SECTION II: POTENTIAL STRATEGIES

Group D: STRATEGIES THAT SUPPORT AN AGRICULTURAL ECONOMY

Strategy D5: Assist farmers and landowners in working with governmental agencies

Strategy D5.2: Farmbudsman - Help farmers and landowners navigate regulatory requirements for farm activities.

DESCRIPTION

There are multiple local, State and Federal permitting processes and regulations that affect the way that farmers do business. It can be difficult for farmers to navigate the various levels of regulations or simply to understand all that exist from water quality, to environmental health, to business regulations. An agricultural ombudsman or farmbudsman program can assist farmers, ranchers, and agriculture-related businesses with various permitting processes, including assistance with agricultural permitting, standards and reporting as required by regulatory agencies. An ombudsman could help to facilitate and expedite the development and implementation of agricultural projects.

RELATED PROGRAMS AND POLICIES

The idea of an agricultural ombudsman program was first discussed locally prior to 2008. Both Solano and Yolo counties' General Plans incorporate the concept of the ombudsman position. Solano County was the first to develop the concept into a real position with the Farm Assistance, Revitalization, and Marketing Coordinator that existed in the county from 2008-2009. In November 2011, the Solano and Yolo Counties Joint Economic Summit identified an Ombudsman Program as an "opportunity to enhance the value of agriculture within the two counties and decrease actual and perceived regulatory obstacles on agriculture-related businesses seeking to expand, enhance, and/or maintain their operations." Working with the Small Business Development Center at Solano College, Yolo and Solano counties released a request for qualifications for consultant services for the Farmbudsman Program. A consultant was selected in mid-2013.

Sonoma and Marin counties also have agricultural ombudsman programs managed by Agriculture and Natural Resources – Cooperative Extension at the University of California. San Mateo County is in the process of starting an ombudsman program, as well.

ISSUES

The Sacramento-San Joaquin Delta encompasses parts of five counties, however, the focus of a Delta-specific ombudsman could be reduced to three counties by collaborating with the Yolo and Solano Farmbudsman. In addition to geographic logistics, a few other issues exist:

- Funding – start-up and on-going. Yolo and Solano counties both contribute $27,000 per year to the part-time position.
- Location and office space. The Delta is large. Ideally the position would be housed somewhere in the middle. Funding and space availability, however, may make a less central location more appropriate.
- Consensus. With five counties and multiple agencies already working in the Delta, consensus on the position's focus, scope, location, etc., could be challenging.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy D5.2 Farmbudsman: 102913

SECTION II: POTENTIAL STRATEGIES

Group D: STRATEGIES THAT SUPPORT AN AGRICULTURAL ECONOMY

Strategy D5: Assist farmers and landowners in working with governmental agencies

Strategy D5.3: Work with others to better align regulatory processes to expedite wildlife friendly agriculture

DESCRIPTION

Ecological restoration and enhancement projects, including habitat restoration, are generally subject to the same regulatory permit requirements as projects that convert agricultural and open space lands to developed, urban uses. The result can be long lag times, an uncertain approval process, and extra costs. This can create barriers to achieving voluntary ecosystem improvements.

To encourage continued participation of farmers in ecosystem enhancements, the following actions could be explored, taking advantage of recent and on-going efforts discussed below:

- Provide third-party support to facilitate completion of permitting requirements; Resource Conservation Districts have played this role
- Identify a core set of conservation practices and environmental protection measures and develop a programmatic permit for such projects
- Clarify CEQA Guidelines for restoration programs
- Create an inter-agency permit coordination task force

RELATED PROGRAMS AND POLICIES

Recent efforts by the California Biodiversity Council (CBC) have highlighted this topic in their resolution adopted February 6, 2013. The Resolution, “Strengthening Agency Alignment for Natural Resources Conservation,” includes a related goal and specific recommendation. The goal, “better alignment of planning, policies and regulations across governments and agencies; and coordinated and streamlined permitting to increase regulatory certainty,” addresses statewide concerns that are specifically relevant to ongoing BDCP mitigation of impacts to agriculture.

Other studies and workgroups that have looked at the issue include:

- California Public Policy Institute of California: “Integrated Management of Delta Stressors – Institutional and Legal Options” (April 2013 publication) and “Partners in Restoration (PIR) Permit Coordination Program – DRAFT – Comprehensive Program Assessment” (September 2010 briefing paper)
- Roundtable on Agriculture and the Environment (CRAE) November 2010 publication, “Permitting Restoration – Helping Agricultural Land Stewards Succeed in Meeting California Regulatory Requirements for Environmental Restoration Projects”
- California Rangeland Conservation Coalition “California Restoration and Enhancement Permitting: Challenges to California’s Permitting Process for Restoration and Enhancement Projects” publication – offers insights and recommendations on the topic

- UCLA and UCB report, “Room to Grow: How California Agriculture Can Help Reduce Greenhouse Gas Emissions” Task Force to Remove Barriers to Restoration – California Natural Resources Agency, 2003

Partners in Restoration (PIR), a project begun by Sustainable Conservation in 1998, has successfully coordinated among permitting agencies in Santa Cruz, Marin, Mendocino, and other counties. The PIR experience suggests that programmatic, regional, and even statewide permits for environmental enhancements would be advantageous on agricultural lands.

ISSUES

- Difficult to coordinate multiple agencies with multiple objectives
- Agencies may not have a clear mandate to treat environmental preservation or enhancement projects differently from “development” projects
- Inadequate staffing and resources at regulating/permitting agencies
- Possible insufficient capacity at some RCDs to manage the permit requirements for establishment and implementation of habitat enhancement projects
- Lag time, uncertain approval process, and undue costs
- Consistency of interpretation (or lack thereof), including clear definition of required information

OPPORTUNITIES AND POTENTIAL PARTNERS

- Biodiversity Council, Delta Conservancy and Delta Protection Commission, Delta Stewardship Council
- California Association of RCDs – Guide to Watershed Project Permitting for the State of California
- Sacramento River Watershed Program – Online Regulatory Permitting Guide
- The Central Valley Joint Venture is engaged with the State Water Resources Control Board to simplify requirements in the Board’s Draft Water Quality Control Policy for Wetland Area Protection and Dredged or Fill Permitting as they apply to habitat enhancement

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy D5.3 Regulatory Alignment for Wildlife Friendly Agriculture: 102913

SECTION II: POTENTIAL STRATEGIES

GROUP E: STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E1: Project Planning

Strategy E1.1: Early Project Planning

DESCRIPTION

This strategy encourages project proponents to plan early and collaboratively. Even if it not required, proponents might want to consider an Agricultural Land Stewardship Plan (ALSP). ALSPs can be used at any level – landscape, regional or site-specific. See Framework for ALS Planning – IB. Develop ALS Plans for Projects. Factors to take into consideration include:

- Obtain information on existing and planned land uses and the project's relation to these uses. Include acreage of all land devoted to agriculture, including farmland of local importance, grazing land, and confined animal agriculture. (See also Strategies D1.1, D1.2 and D1.3).
- Identify how a proposed project can be part of or complement existing and planned land uses, including agricultural use; flood management; mitigation and enhancement of aquatic and terrestrial habitat; recreation; and tourism. This is particularly important when there are multiple uses being considered for one specific area of land, but it is also important to look at how the project affects or fits into other plans for the region or sub-regions where the project is located. (See also Strategies A1.1, B1.1, B1.2, C1.1, C1.2 and D4).
- Consider whether the proposed land use is consistent with State, regional and local plans. See discussion below on Related Programs and Policies. (See also Strategy E2.1).
- Consider whether agriculture and/or habitat management activities undertaken pursuant to the proposed project are consistent with State and local policies relating to flood protection and whether they might provide additional protection because, for example, they (i) provide flood management activities that provide additional protection for agricultural activities or (ii) prevent or divert potential higher groundwater levels that would thwart flood control efforts. (See also Strategy A1.1).
- Make use of available communication forums to let local interests learn about project and provide an opportunity for their input. (See also strategies E2.1 and D5.1).
- Site projects and project footprints to minimize the permanent conversion of Important Farmland, to nonagricultural uses. Where choices are possible among or between particular parcels or lands that are available for a project, project proponents should look at the characteristics of the different parcels or lands to determine whether one choice would be better from an agricultural resource perspective. If choices can be made regarding different locations for a project and still achieve the project purposes, it may be possible to avoid areas that may have more value from an agricultural resources perspective such as whether the property is (1) "high quality" farmland. (2) unique or has special values, (3) important to maintaining viability of agriculture in a certain area, (4) important to maintaining habitat lands in agriculture in a certain area. (See also Strategies D1.2 and D1.3).
- Give priority to appropriate public lands and existing conservation lands, considering the purpose for which the property was acquired and the benefits it currently provides as wildlife habitat and for the public before purchasing additional private land. (See also Strategy A5).

- Try to be consistent with local planning requirements and with existing Williamson Act contracts and preserves and follow appropriate notice and findings requirements. (See also Strategies E2.1, E2.2, and E2.3).
- Develop measures to reduce conflict between agriculture and nearby habitat lands by implementing good neighbor policies such as managing project lands to minimize the introduction of invasive species or weeds that may affect agricultural production on adjacent agricultural land, establishing buffer zones, and developing compensation funds and agreements that protect landowners from endangered species liabilities. (See also Strategies A3.1, A3.2, A3.3, A4.1, A4.2, and A4.3).
- Develop ways to track implementation of project components and mitigation measures include providing a framework that encourages adaptive management with regard to agricultural land and a plan for reporting and monitoring actions necessary to show that actions agreed to are being carried out. (See Strategies E1.2, E1.2 and E1.3).

Timing and Early consultation

Whether or not an ALSP is required, development of ways to avoid and mitigate for agricultural impacts should occur early in the planning process of a project and should involve the local community along with local, state and federal agencies. Involvement of the landowner and the county where the property is located is particularly important and recognizes that local interests have unique and specialized knowledge of the region. See also Strategies E1.2 and E1.3). In addition to the farmers and landowners affected, the following list of organizations or types of organizations is a starting place on who else should be consulted:

- Local government, SACOG and other councils of government
- Federal and state resource and regulatory agencies, including the California Natural Resources Agency, the California Department of Water Resources, the Central Valley Flood Protection Board , the California Department of Conservation, the California Department of Food and Agriculture, the California Department of Fish and Wildlife, the United States Fish and Wildlife Service, the National Marine Fisheries Service, and the U.S. Department of Agriculture, including the Natural Resources Conservation Service.
- Organizations with a regional interest such as the Delta Conservancy, the Delta Protection Commission and the Delta
- Stewardship Council
- Resource Conservation Districts
- Tribal Interests
- Local colleges and universities, including the Agricultural Extension Service
- Local labor and farm worker organizations
- Local economic development corporations
- NGOs representing farmers
- NGOs representing entities that promote habitat protection and restoration activities.

RELATED PROGRAMS AND POLICIES

Related programs and policies will be different depending on the area involved. Several high level statements regarding preservation of natural resources and agricultural land include:

- California @ 50 Million: California's Climate Future, The Governor's Environmental Goals and Policies Report (Draft September 2013)
- California Agricultural Vision: Strategies for Sustainability (December 2010)
- CDFA Climate Change Consortium for Specialty Crops: Impacts and Strategies for Resilience
- California Air Resources Board Cap and Trade Auction Proceeds Investment Plan FY 2013 – 2014 through 2015 – 2016 (May 2013)
- 2009 California Natural Resources Agency Climate Change Adaptation Strategy and the 2013 Safeguarding California Plan.
- California Water Plan Update 2013
- California Fish and Wildlife Vision for California's Strategic Wildlife Action Plan Update 2015

Regional efforts to deal with some of the measures identified above include:

- Delta Stewardship Plan
- The Delta Restoration Network, hosted by the Delta Conservancy
- Ways to Restore Delta Habitat and Protect Land Owners workshops sponsored by the Delta Conservancy and Water Education Foundation
- Delta Conservancy Strategic Plan
- Delta Protection Commission Land Use and Resource Management Plan and Economic Sustainability Plan
- County General Plans

ISSUES

Comprehensive, consistent and usable information on land uses or on the effect of changes in land uses may not be available or different parties may interpret the data in different ways. Although there are efforts to establish regional strategies for restoration projects in the Delta, there has not been active participation by local landowners up to this point. Developing collaborative groups can be difficult, especially at the beginning, and is not a guarantee to consensus or success. Funding for developing information, costs of avoiding agricultural land and for good neighbor activities may not be available. Resource agencies must be willing partners in multi-use projects and in helping to craft accidental take and other good neighbor activities.

PARTNERS AND OPPORTUNITIES

Farmers and Landowners and other entities listed above in the Description.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E1.1 Early Project Planning: 061014

SECTION II: POTENTIAL STRATEGIES

GROUP E: STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E1: Project Planning

Strategy E1.2: Work with farmers and landowners

Strategy E1.2.1 Involve farmers and landowners in project planning

DESCRIPTION

This strategy encourages project proponents to consult with farmers and landowners on the role they wish to take, if any, in project planning and development. Consultation could involve possible roles regarding participating in project activities, how project activities could affect them either directly or indirectly, or integration of project activities into other land use issues in the area.

Issues to consider include whether:

- To the extent that a project includes maintaining farmland on project lands, consideration should be given to providing flexibility to the farmer and to developing working landscapes on project lands. Farmers of land affected by project facilities and activities could maintain or obtain full or partial ownership of the land on which project activities will be carried out or could be compensated to manage project lands. (See also Strategies E1.2.2 and E1.2.3).
- Some or all of the ownership interests on any project land could remain in private hands where possible in order to keep the property in nongovernmental ownership and thereby on the County tax base. Agriculture could take place within areas identified for habitat restoration under the project without undermining the achievement of the project goals and objectives. (See also Strategies E2.3 and E2.5).
- Opportunities exist to partner with landowners and others to maintain and enhance environmental quality on farmland. Existing agricultural operations on lands could be modified, through such things as crop change, new integrated pest management strategies, altered water usage, or full or partial conversion to habitat uses, in a manner that renders such operations consistent with the goals and objectives of the project by enhancing environmental outcomes in a manner beneficial to species covered by the project. (See also Strategy B1).
- Opportunities exist to manage land for purposes other than conventional crop production. Subsidies, carbon payments or other market mechanisms could be used to encourage economically viable rice farming or managing wetlands or other habitat areas due to the environmental benefits of such rice farming such as the stabilization of subsiding areas or the creation of sinks for greenhouse gases and methylmercury. (See also Strategies C1, C2, and C3).
- Opportunities exist to provide incentives to take part in market based conservation programs. (See also Strategy B2)

RELATED PROGRAMS AND POLICIES

See related discussions in Strategies B1, B2, C1, C2 and C3

ISSUES

Some of the measures described above, such as managing lands to maintain and enhance environmental quality, have been practiced by farmers, resource conservation districts, and others for many years. Others, such as development of carbon credits and payments to "farm" the land in a way that reverses subsidence, are newer or still in the process of development. Although are efforts to establish regional strategies for restoration projects in the Delta, there has not been active participation by local landowners up to this point. It may be difficult to find funding for developing or implementing the measures. To the extent that agricultural land is involved in project purposes, long term (often in perpetuity) conservation easements and funding assurances will have to be developed. Strategies that seek to serve multiple benefits such as maintaining agricultural uses, meeting species-based regulatory requirements, and getting carbon credits, will still need to meet the standards of all of those things in order to be viable, and finding ways to do that will be challenging.

PARTNERS AND OPPORTUNITIES

Farmers, Landowners and other entities listed in Strategies B1, B2, C1, C2 and C3. They include:

- Local government, SACOG and other councils of government
- Federal and state resource and regulatory agencies, including the California Natural Resources Agency, the California Department of Water Resources, the Central Valley Flood Protection Board , the California Department of Conservation, the California Department of Food and Agriculture, the California Department of Fish and Wildlife, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the U.S. Department of Agriculture, including the Natural Resources Conservation Service.
- Organizations with a regional interest such as the Delta Conservancy, the Delta Protection Commission and the Delta Stewardship Council
- Resource Conservation Districts
- Local colleges and universities, including the Agricultural Extension Service
- Local labor and farm worker organizations
- Local economic development corporations
- NGOs representing farmers
- NGOs representing entities that promote habitat protection and restoration activities.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E1.2.1 Involve Farmers and Landowners: 061014

SECTION II: POTENTIAL STRATEGIES

Group E. STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E1: Project Planning

Strategy E1.2 Work with farmers and landowners

Strategy E1.2.2: Compensate farmers and landowners to manage agricultural land for project purposes

DESCRIPTION

Where agricultural production is consistent with or necessary for the conservation purpose of BDCP, farmers and ranchers could be paid to manage habitat lands, either as owners or lessees. Examples of practices that have been carried out in the Delta or elsewhere are these:

- cultivation of alfalfa and irrigated pasture as foraging habitat for Swainson's hawks, tricolored blackbirds and sandhill cranes
- cultivation of rice, wheat and feed corn for sandhill cranes
- rangeland management that supports burrowing owls
- rice cultivation that supports giant garter snakes
- seasonal flooding of agricultural land on floodplains and enhancement of channel margin habitat for fish

RELATED PROGRAMS AND POLICIES

Managers of several properties in the Delta area, including Cosumnes River Preserve, Staten Island, and Yolo Bypass Wildlife Area, lease land to growers, who successfully integrate commercial crops and valuable habitat. The Habitat Conservation Plan for the Natomas Basin in Sacramento and Sutter Counties includes a habitat reserve area, most of which is kept in commercial crops, leased to farmers, and managed to provide habitat for Swainson's hawk. Some commercial habitat mitigation banks are built around farm property and managed by farmer owners, e.g. Sacramento River Ranch in Yolo County, owned by Wildlands, Inc.

ISSUES

One important issue is the reluctance of growers to accept restrictions on their choice of crops or management practices.

OPPORTUNITIES AND POTENTIAL PARTNERS

The Delta Conservancy's Strategic Plan aims to "evaluate options for public/private partnerships to develop restoration projects." The Delta Conservancy's Strategic Plan recognizes the need to evaluate options for public/private partnerships to develop restoration projects and to give priority to management models that preserve economic uses of the land. The Conservancy has proposed establishment of a Delta Restoration Network of entities with knowledge about habitat restoration opportunities and concerns.

SECTION II: POTENTIAL STRATEGIES

Group E. STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E1: Project Planning

Strategy E1.2: Work with farmers and landowners

Strategy E1.2.3: Compensate farmers and landowners to manage project habitat lands

DESCRIPTION

Landowners could be retained to establish and manage habitats that have replaced agricultural land uses. Management could involve contouring the land and reconfiguring its drainage, maintaining levees, water control structures and other infrastructure, controlling invasive weeds, and providing security against trespass and vandalism.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E1.2.3: Compensate farmers to manage project habitat lands: 102913

SECTION II: POTENTIAL STRATEGIES

Group E: STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E1: Project Planning

Strategy E1.3 Avoid, minimize and mitigate for impacts to agricultural land from project

Strategy E1.3.1: Reduce Impacts on land

DESCRIPTION

This strategy encourages project proponents to design and implement projects in a way that reduces impacts on agricultural activity of the lands affected by the project. It identifies specific measures that should usually be considered in developing mitigation measures under CEQA/EPA and that can be used in the development of an Agricultural Lands Stewardship Plan (see Framework I.B on developing Agricultural Land Stewardship Plans for projects that affect agricultural lands). When considering implementation of the following measures, project proponents will need to consider many factors, including feasibility and compliance with environmental and other permitting programs.

- Design projects so as to optimize contiguous parcels of agricultural land of a size sufficient to support their efficient use for continued agricultural production
- Where the construction or operation of a facility could limit access to ongoing agricultural operations, maintain a means of convenient access to these agricultural properties as part of project design, construction, and implementation
- Minimize extent of excavation and soil disturbance
- Dispose of spoils, reusable material, and dredged material in a way that reduces impacts to or provides benefits to agriculture
- Salvage, stockpile, and replace topsoil and prepare a topsoil stockpiling and handling plan
- At borrow sites to be returned to agricultural production, remove and stockpile, at a minimum, the upper 2 feet of topsoil replace the topsoil after project completion as part of borrow site reclamation
- In areas permanently disturbed by project activities, and where topsoil is removed as part of project construction and not reused as part of the project, make the topsoil available to less productive agricultural lands that could benefit from the introduction of good-quality soil
- Relocate, upgrade and/or replace wells, pipelines, power lines, drainage systems, and other infrastructure that are needed for ongoing agricultural uses and would be adversely affected by project construction or operation
- Minimize disturbance of farmland and continuing agricultural operations during construction by (1) locating construction laydown and staging areas on sites that are fallow, already developed or disturbed, or are to be discontinued for use as agricultural land and (2) using existing roads to access construction areas
- Consult with landowners and agricultural operators to develop appropriate construction practices to minimize construction-related impairment of agricultural productivity. Practices may include coordinating the movement of heavy equipment and implementing traffic control measures

- Consult with landowners and agricultural operators with the goal of sustaining existing agricultural operations, at the landowners' discretion, until the individual agricultural parcels are needed for project construction
- Perform geotechnical studies to assess condition of soil and identify measures to reduce or eliminate potential problems related to levee stability, liquefaction, seepage, settlement of embankments or structures, subsidence, and soil bearing capacity
- Evaluate placement of power line poles and towers to avoid impacts on agricultural lands and activities
- Develop and implement erosion and sediment control plans to avoid impacts on adjacent farmland
- Develop and implement a fire prevention and control plan
- Implement measures to control fugitive dust
- Locate new transmission lines and access routes to minimize the removal of trees and shrubs and pruning needed to accommodate new transmission lines and underground transmission lines where feasible
- Develop and implement an area management plan to reduce aesthetic and visual impacts
- Locate concrete batch plants and fuel stations away from sensitive visual resources and receptors and restore sites upon removal of facilities
- Underground new or relocated utility lines where feasible
- Conduct a survey of inaccessible properties, including agricultural buildings, to assess eligibility as a cultural resource, determine if these properties will be adversely impacted by the project, and develop treatment to resolve or mitigate adverse impacts
- Implement site-specific construction traffic management plan to reduce effects on access to and from agricultural parcels
- Limit hours or amount of construction activity on congested roadway segments to reduce effects on access to and from agricultural parcels
- Make good faith efforts to enter into mitigation agreements to enhance capacity of congested roadway segments to reduce effects on access to and from agricultural parcels
- Prohibit or limit construction activity on physically deficient roadway segments to reduce effects on agricultural operations
- Improve physical condition of affected roadway segments as stipulated in mitigation agreements or encroachment permits to reduce effects on agricultural operations
- Verify locations of utility infrastructure to avoid impacts to system operations
- Relocate utility infrastructure in a way that avoids or minimizes any effect on operational reliability
- Relocate utility infrastructure in a way that avoids or minimizes any effect on worker and public health and safety
- Develop and implement a greenhouse gas mitigation program to reduce construction-related greenhouse gas emissions to net zero (0). This mitigation measure could include incentives to farmers to deliver agricultural wastes to existing waste conversion facilities or finance rice cultivation in the project area
- Test dewatered solids from solids lagoons and dredged sediment prior to reuse and/or disposal

- Where applicable, provide compensation to property owners for losses due to implementation of the project.

RELATED PROGRAMS AND POLICIES

See Issues section below.

ISSUES

Many of these practices are considered best management practices. While there does not appear to be a standard approach statewide or within the region, projects constructed could be examine to see what kinds of contractual or other types of agreements have been used in the past. Some of the measures identified may be considered standard environmental impact mitigation measures and would be part of the project cost and incorporated into contract specifications for construction of projects. Others mitigate or reduce economic impacts. In most cases, these measures would not legally be required, but could be entered into on a voluntary basis and/or project proponents could help seek funding to cover the costs of these measures.

PARTNERS AND OPPORTUNITIES

- Farmers and Landowners
- Local government, SACOG and other councils of government
- Reclamation and irrigation districts
- Resource Conservation Districts
- NGOs representing farmers Federal and state resource and regulatory agencies, including the California Natural Resources Agency, the California Department of Water Resources, the Central Valley Flood Protection Board, the California Department of Conservation, the California Department of Food and Agriculture, the California Department of Fish and Wildlife, the United States Fish and Wildlife Service, the National Marine Fisheries Service, and the U.S. Department of Agriculture, including the Natural Resources Conservation Service.
- State agencies such as the Department of Transportation, the Department of Conservation, and the Department of Parks and Recreation
- Organizations with a regional interest such as the Delta Conservancy, the Delta Protection Commission and the Delta Stewardship Council

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E1.3.1 Reduce Impacts on Land: 052414

SECTION II: POTENTIAL STRATEGIES

GROUP A: STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E1: Project Planning

Strategy E1.3 Avoid, minimize and mitigate for impacts to agricultural land from project

Strategy E1.3.2: Reduce Impacts on ground water levels

DESCRIPTION

Water quality, and particularly the salinity of irrigation water, is an important factor for crop production. In general, crops have varying degrees of tolerance to irrigation water salinity, and tolerance can vary by growth stage. Salinity of surface water supplies are dependent upon water year type, time of year, and flow conditions.

Groundwater levels are generally shallow in the Delta, and many reclamation districts, irrigation districts, and water agencies operate canals and ditches that are used both for irrigation and drainage. Increases in local groundwater levels can seep onto adjacent lands, requiring additional drainage pumping (and additional costs) to ensure that crop roots are not exposed to excess water that can cause root rot. A related concern is associated with dewatering activities for construction, in which groundwater levels on adjacent areas could drop below levels necessary for crop irrigation.

This strategy proposes a number of measures that could reduce impacts on agricultural activities from changes in groundwater levels that could be caused by project construction and/or operations.

Actions to avoid or reduce seepage effects

When subject to the jurisdiction of the California DWR's Division of Safety of Dams. forebays and reservoirs must be constructed to comply with the requirements of the Division of Safety of Dams, which includes design provisions to minimize seepage. These design provisions would minimize seepage under embankments and onto adjacent properties. Once constructed and placed in operation, the operation of forebays would be monitored to assure that seepage does not exceed performance requirements. In the event seepage does exceed performance requirements, the project proponents would need to modify the embankments or construct seepage collection systems that would ensure any seepage would be collected and conveyed back to the forebay or reservoir or other suitable disposal site.

Prior to construction, project proponents should also determine areas potentially subject to seepage caused by habitat restoration and enhancement actions or operation of water supply facilities. These areas should be monitored and evaluated on a site-specific basis to identify baseline groundwater conditions. Restoration sites, along with the sites of water supply features that could result in seepage would be subsequently monitored once construction is completed. Monitoring would include placement of piezometers and/or periodic field checks to assess local groundwater levels and associated impacts on agricultural field conditions. In areas where operation of water supply facilities or habitat restoration is determined to result in seepage impacts on adjacent parcels, potentially feasible additional mitigation measures should be developed in consultation with affected landowners. These measures could include installation or improvement of subsurface agricultural drainage or an equivalent drainage measure, as

well as pumping to provide for suitable field conditions (groundwater levels near pre-project levels). Such measures would be designed to ensure that the drainage characteristics of affected areas would be maintained to the level existing prior to project construction.

Actions to avoid or reduce dewatering effects

Prior to construction, project proponents should determine the location of wells within the anticipated area of influence at construction sites where dewatering would occur. Based on available information, the location of wells, depths of the wells, and depth to groundwater within the wells would be determined. It may also be feasible to schedule dewatering activities to occur during the drainage season, when adjacent land managers may be draining excess water and dewatering activities could be a benefit to agricultural operations. During construction, monitoring wells would be installed sufficiently close to the groundwater dewatering sites, or if possible, water levels in existing wells would be monitored, in order to be able to detect changes in water levels attributable to dewatering activities.

If monitoring data or other substantial evidence indicates that groundwater levels have declined in a manner that could adversely affect adjacent wells, the project proponents could offset agricultural water supply losses attributable to construction dewatering activities by ensuring that agricultural water supplies are maintained during construction or by providing compensation to offset for crop production losses. Measures to consider include:

- install wells to recharge groundwater, install cutoffs (such as sheet piles, soil freezing, or slurry walls) to depths below groundwater elevations
- deepen or modify wells to ensure agricultural production supported by water supplied by these wells is maintained.
- secure a temporary alternative water supply or
- compensate farmers for production losses attributable to a reduction in available groundwater supplies.

RELATED PROGRAMS AND POLICIES

Many of the considerations and actions related to groundwater are considered best management practices that may be included in the design of the project, may be included in contract specifications, and/or may be included in permit requirements (for example, compliance with Division of Safety of Dams regulations).

ISSUES

While many of the actions associated with groundwater effects are considered best management practices, there are a couple of considerations or issues that could arise while implementing these actions. One potential issue relates to securing access to land for the placement of monitoring equipment at appropriate locations. The project proponents may not be granted access to all areas that could be within the area of influence and, therefore, may not be able to gather complete information regarding whether or not the project is affecting groundwater levels on adjacent areas. Another consideration is the fact that, depending on timing and site-specific conditions, changes in groundwater levels created by the project could create beneficial effects for agricultural operations by requiring less pumping for irrigation or drainage.

PARTNERS AND OPPORTUNITIES

- Farmers and landowners
- DWR Division of Safety of Dams
- Reclamation and Irrigation Districts
- Local governments
- Resource Conservation Districts
- NGOs representing farmers

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E1.3.2: Reduce Impacts on Ground Water Levels: 061014

SECTION II: POTENTIAL STRATEGIES

GROUP A: STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E1: Project Planning

Strategy E1.3 Avoid, minimize and mitigate for impacts to agricultural land from project

Strategy E1.3.3: Mitigate for conversion of agricultural land

DESCRIPTION

Sometimes early planning (Strategy E1.1), working with landowners (Strategy E1.2.1 E1.2.2 and E1.2.3) and counties (E2.1, E2.2 and E2.3), and mitigating on site (Strategies E1.3.1 and E1,3,2) will reduce environmental and economic impacts on agricultural land or agriculture, but will still involve the conversion of agricultural use to another use. Factors to consider in determining appropriate mitigation or assistance for conversion of agricultural land include the factors discussed below. The discussion is divided into environmental mitigation under the California Environmental Quality Act (CEQA) and mitigation for impacts not covered by CEQA. The National Environmental Policy Act (NEPA) has similar considerations. The following discussion identifies some factors to consider; however compliance with CEQA/NEPA is a legal question and should be discussed with legal counsel.

Environmental Mitigation under CEQA/NEPA

1. CEQA Requirements: Under CEQA/NEPA, project proponents should consider adverse environmental impacts on agricultural resources and feasible mitigation measures that could reduce potentially significant impacts.

2. Basis for Mitigation: The first step in determining significance of environmental impacts is to determine the basis for mitigation. With regard to agriculture, the CEQA Guidelines ask whether the project would:

- Convert farmland identified as prime agricultural land, unique land or farmland of statewide significance as identified on the Farmland Mapping and Monitoring Program of the California Natural Resources Agency to non-agricultural land uses (the program is administered by the California Department of Conservation(DOC), see http://www.conservation.ca.gov/dlrp/fmmp/Pages/Index.aspx),
- Conflict with existing zoning for agricultural use, or a Williamson Act contract, or
- Involve other changes to the existing environment, which due to their location or nature could result in the conversion of farmland to non-agricultural use.

3. More on Basis for Mitigation: Other factors a lead agency may consider include:

- Use of the California Agricultural Land Evaluation and Site Assessment Model (1977) developed by DOC http://www.conservation.ca.gov/dlrp/Pages/qh_lesa.aspx.,
- The extent to which other kinds of farmland may be affected by the project. DOC and other sources also identify farmland of local significance, grazing land and other agricultural uses of land such as confined agriculture, or
- Whether the impacts are temporary or periodic.

4. Mitigation: Once an impact on agricultural resources has been determined to be significant, the project proponent must consider feasible mitigation. Issues to consider include:

- the Conventional Approach for mitigation for significant adverse impacts to agricultural resources uses an agricultural conservation easement or ACE that keeps land in agriculture in perpetuity or forever. Historically the goal of an ACE has been to maintain agricultural land in active production by removing the development pressures from the land. Mitigation ratios suggested for different projects have ranged from less than 1:1 up to 3:1. See Strategy A5 for a discussion on ACEs.
- Some projects require habitat conservation easements as mitigation requirements for biological resources values (e.g. for its value as habitat for Swainson's hawk). For some terrestrial species the habitat conservation easement may require that land be kept in agriculture. These easements usually put restrictions on the property with regard to what can be grown on the land and how the land is to be managed. Some projects have included land that is required to be kept in agriculture for habitat conservation easements as mitigation for impacts on agricultural resources where the easements for biological values also incorporate agricultural preservation. See Strategy A5 on ACEs.

Impacts Not covered by ACEs

1. CEQA Requirements: CEQA does not usually require mitigation for social or economic impacts. Farmland conversion may have impacts in terms of changes to high quality soils, changes to land use and loss of habitat. Whether or not conversion of agricultural land is environmental or social/economic is a distinction that is sometimes difficult to make in the context of agricultural resources, especially where the land converted will stay in open space, but agricultural use will either be prohibited or reduced.

2. Additional Commitments: Project proponents can consider measures in addition to the Conventional Approach. Project proponents may agree to implement additional commitments as part of their projects.

3. Working with others to find further funding: Even if project proponents do not fund additional measures, they can work with others to find funding to mitigate for impacts not otherwise mitigated. Possible funding sources include establishing a greenhouse gas offset market using credits created through the development and restoration of wetlands; using "Cap and Trade" program funds, reinstating state funding for California Land Conservation Act subventions; recommending funds to be included in any bond measure; and others. See Strategy E1.4.

4. Possible approach for use of strategies in addition to the Conventional Mitigation Approach:

- The ALS strategies provide a tool box that can be used in considering what additional measures project proponents might want to implement that would maintain and promote agricultural vitality in the area affected. See especially Strategies A1.1, A1.2, A1.3, A2, A3.3.1, A3.3.2, E1.1, E1.2, D2, D3, D5.1, D5.2, and D5.3).
- The ALS tool box also includes measures that would encourage landowners to carry out activities that would keep them on the land such as incentives for conservation on farmland or

to manage land for purposes other than conventional crop production. See especially Strategies B1, B2, C1, and C2.

5. Possible approach for use of strategies in conjunction with the conventional mitigation as an Optional Agricultural and Land Stewardship Approach:

- Conventional mitigation may be complicated in situations, such as the inner Delta, where there is little development pressure, due to regulatory restrictions, flood threats, and the large number of acres potentially planned for restoration by DWR and other public and private entities. Agricultural interests may see additional ACEs as unnecessary or unwanted limitations on agricultural lands. The draft BDCP EIR/EIS proposes an Optional Agriculture and Land Stewardship Approach that uses some or all of the funds that would normally be used to purchase ACEs to be used for other activities that would maintain agriculture in the area affected.
- The approach requires the project proponents to first determine:
    - Whether there is Important Farmland in the Delta reasonably accessible to the BDCP proponents and/or to the owner(s) and/or operators for use for agriculture and/or habitat management in a manner consistent with the goals and objectives of the BDCP
    - Whether there is Important Farmland that might not remain in agriculture if it was not protected by means of an agricultural conservation property interest because of threats of urban development (e.g. in the secondary zone in the Delta) or wind/solar and other non-renewable energy projects, or the productive value of which is so high, it should remain in agriculture instead of being used for restoration or other open-space projects because, for example, it is:
        - unique or has special values
        - important to maintaining viability of agriculture in the region
        - critical to prevent a tipping" point that could lead to elimination of a crop in the region
        - important to maintaining habitat lands in agriculture in the region
    - Whether Agricultural and Land Stewardship Strategies benefit agricultural lands by providing feasible CEQA/NEPA mitigation (or providing funding for such mitigation) for potential significant environmental agricultural impacts at both the farm and the regional level. In determining whether the funds necessary to make an Optional Agricultural and Land Stewardship Approach feasible are available, the project proponents shall be guided by the principle that funds that might otherwise be used for off-site preservation or another form of compensation may be made available instead to assist with making the Optional Agricultural Land and Stewardship Approach work.
- If it is determined that the factual situation is one where the Optional Agricultural and Land Stewardship Approach works, the project proponents can then work with interested parties to develop a plan. Under the draft BDCP EIR/EIS, approval of the landowner and the appropriate county is necessary. See Possible Partners and Possibilities below for other interested parties.

RELATED PROGRAMS AND POLICIES

CEQA and NEPA are discussed above. See also Cases dealing with Agricultural Resources.

ISSUES

Different interests have different views with regard to what CEQA requires with regard to what is a significant impact to agricultural resources and what are appropriate mitigation measures.

To the extent that mitigation measures are identified that are not required by CEQA/NEPA, there may be problems with finding funds to pay for them and with concerns regarding setting precedents for other projects.

The strategy suggests options that involve trying to find a consensus in which every party benefits. This type of effort can be very time-consuming and assumes that all parties share some kind of common goal. A lot of time and money can be spent on negotiations that, in the end, fail.

PARTNERS AND OPPORTUNITIES

- Landowners and operators
- State agencies such as the California Natural Resources Agency, California Department of Water Resources, Central Valley Flood Protection Board, California Department of Conservation, California Department of Food and Agriculture, and California Department of Fish and Wildlife
- Federal agencies such as the United States Fish and Wildlife Service, National Marine Fisheries Service, and U.S. Department of Food and Agriculture, including the Natural Resources Conservation Service
- Organizations with a regional interest such as the Delta Conservancy, the Delta Protection Commission and the Delta Stewardship Council
- Tribal interests
- Local labor and farm worker organizations
- Local land trusts
- NGOs representing farmers
- NGOs representing entities that promote habitat protection and restoration activities

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E1.3.3 Mitigation for conversion: 061014

SECTION II: POTENTIAL STRATEGIES

GROUP E: STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E1: Project Planning

Strategy E1.3 Avoid, minimize and mitigate for impacts to agricultural land from project

Strategy E1.4 Implementation and Funding

DESCRIPTION

How an ALS Strategy might be implemented will depend on what kind of activity it is intended to carry out. Measures to take into consideration include:

Implementation

Implementation of a strategy could be carried out with regard to one or more of three different kinds of activities. These activities are identified below.

- Project planning to include agricultural considerations.

Some of the strategies are standards of practice that are or could be included as part of the project. Others could include ways to involve farmers in managing project lands for project purposes and could range from payments to use the land to partnerships to manage the land. Some of these might not result in any additional costs to the projects. Others might add to project costs.

- CEQA/NEPA mitigation.

As discussed in Strategy E1.3.3, mitigation for impacts to agricultural resources is usually accomplished by purchasing agricultural conservation easements or other property interests. To the extent that strategies are selected as a result of the Optional Agricultural and Land Stewardship Approach for CEQA/NEPA mitigation, it is expected that they would not be more costly than the Conventional Agricultural Approach which would be based on the costs to acquire necessary agricultural conservation easements or other property interests.

- Additional Commitments to Sustain Vital Local Economies

Because of the complex nature of farmland as a natural and economic resource, there can be different views on when an impact is economic and when it is environmental. In addition, there may be policy reasons to support and encourage farmers and agriculture that go beyond current legal requirements. Additional Commitments could include some of the same strategies considered for the Optional Agricultural Land Stewardship Approach for CEQA/NEPA mitigation, but the funding would have to come from other sources.

<u>New funding on a case by case basis.</u> Some of the strategies have (or have had in the past had) funding, for example Williamson Act subvention funds and funding for Weed Management Areas and funding has been reduced or eliminated for budgetary reasons. It is possible that additional funding could be found for these programs. Alternatively, new funding may come from new programs such as from a market to buy carbon credits or environmental services on the land. Each of these might require additional legislation, funding allocations or executive

decisions. They would be pursued case by case and would be subject to other priorities determined by the administration and the Legislature.

New funding as part of a new program to fund Agricultural Land Stewardship Strategies not part of environmental mitigation. Funding sources could come from new sources – such as from new bond funds or grants from new programs such as Cap and Trade funds or money used to mitigate for other projects. Funds from existing programs or new money to existing programs could also become part of such a program. There are a number of ways to set up such programs. Several options are listed below:

1. Give the funds to a governmental agency such as the California Department of Conservation, the California Department of Food and Agriculture, the Delta Conservancy, the Delta Stewardship Council, the Delta Protection Commission or to Regional Conservation Districts. This option could also involve the creation of a new organization or a Joint Powers Agency consisting of relevant local agencies. The agency could distribute funds based on a set of factors to be determined.

2. Give the funds to a governmental agency to distribute as competitive grants similar to programs run by the California Department of Fish and Wildlife for the Environmental Restoration Program or the California Department of Water Resources for the Integrated Regional Water Management Program. The agency could distribute funds based on a set of factors to be determined.

3. Give the funds to a governmental agency to distribute based on the recommendations of an advisory group composed of appropriate local agencies. All (or a specified percentage of the members) would have to agree on a specified project before funding could be disbursed. Consideration would need to be given to whether there would be any limitations on the funding besides consistency with relevant state and local policies.

Funding

The following potential sources of funding could be considered.

- Funded as part of project planning
- Funds for project environmental mitigation.
- Grants from state Integrated Regional Water Management and different Flood Management Programs and from federal National Resource Conservation Service and other similar sources.
- Grants from Non-profit organizations
- Funds that might be used for mitigation of greenhouse gases could be used to support agriculture friendly GHG reduction activities
- California Air Resources Board (CARB) established greenhouse gas offset market using credits created through the development and restoration of wetlands
- Funding from CARB's "Cap and Trade" program developed pursuant to the Global Warming Act Solutions Act of 2006 (AB 32)
- Bond measure(s) placed on the statewide ballot

ISSUES

There can be different views on what is "mitigation" and what is "additional commitments". A number of interests would object to use of mitigation funds to cover anything other than agricultural conservation easements. Funding for additional commitments may be difficult to find. It may be difficult to obtain agreement on governance for distributing funds for implementing different strategies.

BDCP and EIR/EIS

BDCP includes a number of mitigation measures and additional commitments.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E1.4 Implementation and Funding: 061014

SECTION II: POTENTIAL STRATEGIES

GROUP E: STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E2: Work with Local Government

Strategy E2.1: Coordinate with local planning efforts

DESCRIPTION

There are a number of regional and local plans, policies, and regulations that may be relevant to implementation of a proposed project Generally, state and federal agencies, as well as some local or regional agencies involved with the location or construction of facilities for the production, generation, storage, treatment, or transmission of water, are not subject to local land use regulations and inconsistency with a specific local land use regulation is not by itself an adverse effect on the environment.

Local governmental agencies, however, are in a unique position to know and understand the local and regional planning issues for their area. Factors to consider in working with the county and other regional entities include the factors discussed below:

- Meet with the counties and other local entities that are located in or near the project area discuss the project. Consider entering into agreements with the appropriate counties to participate in the planning and development phases of the project.
- DP P1 of the Delta Plan states that water management facilities, ecosystem restoration, and flood management infrastructure must be sited to avoid or reduce conflicts with existing uses or those uses described or depicted in city and county general plans for their jurisdictions or spheres of influence when feasible, considering comments from local agencies and the Delta Protection Commission. Plans for ecosystem restoration must consider sites on existing public lands, when feasible and consistent with a project's purpose, before privately owned sites are purchased. Measures to mitigate conflicts with adjacent uses may include, but are not limited to, buffers to prevent adverse effects on adjacent farmland.
- DP R4 of the Delta Plan states that agencies acquiring land for water management facilities, ecosystem restoration, and flood management infrastructure should purchase from willing sellers, when feasible, including consideration of whether lands suitable for proposed projects are available at fair prices.
- DP R7 of the Delta Plan states that cities, counties, and other local and State agencies should work together to protect and enhance visitor serving businesses by planning for recreation uses and facilities in the Delta, providing infrastructure to support recreation and tourism, and identifying settings for private visitor serving development and services.

RELATED PROGRAMS AND POLICIES

State programs: Consider state programs dealing with a specific geographical area such as the Delta Plan of the Delta Stewardship Council. State entities are subject to the requirements of the Plan's regulations. Any project subject to the DSC review must file a certification of consistency with the Delta Plan. Although the BDCP is not a project for which a certification of consistency must be prepared, the

analysis in the Draft BDCP EIR/EIS discusses how the BDCP is consistent with the 14 policies of the Final Draft Delta Plan.

Regional programs

- The Delta Protection Commission's Land Use and Resources Management Plan. The Plan is composed of seven elements: Land Use, Agriculture, Natural Resources, Recreation and Access, Water, Levees, and Utilities and Infrastructure. Many of its goals and policies support long-term viability of agriculture and to discourage inappropriate development of agricultural lands.
- The Delta Protection Commission's Great California Delta Trail Blueprint Report for Contra Costa and Solano Counties which is also intended to serve as a template for the Great Delta Trail planning process in Sacramento, San Joaquin and Yolo counties.
- Suisun Marsh Local Protection Plan
- San Francisco Bay Plan

Other Habitat Conservation Plans, including the following existing and potential plans:

- Placer County Conservation Plan
- Yuba-Sutter HCP/NCCP
- Natomas Basin HCP
- Yolo Natural Heritage Program
- South Sacramento HCP
- Solano County Multispecies HCP
- East Contra Costa County HCP/NCCP
- San Joaquin County Multi-Species HCP and Open Space Plan
- East Alameda County Conservation Strategy

State and federal plans for fish and wildlife and parks such as:

- U.S. Fish and Wildlife Service - Stone Lakes National Wildlife Refuge Comprehensive Conservation Plan
- California Department of Parks and Recreation - General Plan for Brannan Island and Franks Tract State Recreation Areas
- California Department of Parks and Recreation - Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh
- California Department of Fish and Wildlife - Yolo Bypass Wildlife Area Land Management Plan
- California Department of Fish and Wildlife - Lower Sherman Island Wildlife Area Land Management Plan

Local Airport Land Use Compatibility Plans

Under the provisions of the Planning and Zoning Act (Gov. Code §65000, et seq.) cities and counties must prepare general plans, incorporating seven mandatory elements, including land use, open space and conservation. A number of cities and the following counties include land in the Delta:

- Alameda
- Contra Costa

- Sacramento
- San Joaquin
- Solano
- Sutter
- Yolo

ISSUES

The form and nature of discussion with the counties and other local entities may be different depending on among other things:

- the type and scope of the project
- who pays for the time and resources of local government staff involved
- the role of local government – advisory, part of governance structures, other

OPPORTUNITIES AND POTENTIAL PARTNERS

The counties would normally be the primary or initial contact for working with local government. Other partners could include any of the parties identified in the section above on Related Programs and Policies.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E2.1: Coordinate with Local Planning: 061014

SECTION II: POTENTIAL STRATEGIES

GROUP E: STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E2: Work with Local Government

Strategy E2.2: Implement actions required by the Williamson Act

DESCRIPTION

The Williamson Act is an agricultural land protection program enacted by the California Legislature in 1965 to help maintain the agricultural economy of the state by preserving its agricultural land. The act discourages premature and unnecessary conversion of agricultural land to urban uses. The legislation benefits landowners by allowing them to enter into long-term contracts (10 or 20 years) with the state of California to keep agricultural land in production. In return, the state reduces property taxes based on a complex calculation tied to agricultural income.

The Williamson Act is implemented when a city or county creates an agricultural preserve. Once a preserve is established, the landowner enters into a contract with a city or county. The landowner and any successors-in-interest are obligated to adhere to the contract's enforceable restrictions, unless the contract is rescinded or cancelled. The minimum Williamson Act contract term is ten years and the contract is automatically renewed each year, adding an additional year to its term. If a county agrees to establish a Farmland Security Zone (FSZ, or "Super-Williamson Act") program, landowners may choose to enter into a 20-year contract to establish an FSZ or include the land within an established FSZ. In return, FSZ contracts offer landowners greater property tax reduction than under a 10-year Williamson Act contract.

These Williamson Act and FSZ contracts may be terminated by non-renewal or by cancellation. If a 10- or 20-year contract is terminated through non-renewal, a 9- or 19-year non-renewal period must be initiated by either the landowner or the city or county, during which time the land is still under contract, and the property taxes rise by a statutory formula during the last nine years of either form of contract. If a contract is terminated through cancellation, a city or county must make findings specific to each type of contract to justify cancellation.

Under several provisions of the Act, land under contract may be removed from contract in order to convert land to a non-agricultural use. Land may be acquired from a willing seller or by public acquisition for a public improvement project. The statute sets forth a number of requirements for public agency project proponents that want to implement projects within agricultural preserves and subject to Williamson Act contracts subject to Williamson Act contracts. The following discussion identifies some factors to consider where applicable; however compliance with CEQA is a legal question and should be discussed with legal counsel.

- Comply with applicable provisions of California Government Code Sections 51290–51295 with regard to acquiring lands within agricultural preserves and subject to Williamson Act contracts. Sections 51290(a) and 51290(b) specify that State policy, consistent with the purpose of the Williamson Act to preserve and protect agricultural land, is to avoid locating public improvements and any public utilities improvements in agricultural preserves, whenever

feasible. If it is infeasible to locate such improvements outside of a preserve, they shall be located on land that is not under contract, if feasible.

- Whenever it appears that land within a preserve or under contract may be required for a public improvement, the Department of Conservation (DOC) and the city or county responsible for administering the preserve must be notified (Section 51291(b)). Within 30 days of being notified, DOC and the city or county must forward comments, which will be considered by the proponents of the public improvement (Section 51291(b))
- A public improvement generally may not be located within an agricultural preserve unless the project proponents make specific findings to the effect that (1) the location is not based primarily on the lower cost of acquiring land in an agricultural preserve and (2) for agricultural land covered under a contract for any public improvement, no other land exists within or outside the preserve where it is reasonably feasible to locate the public improvement (Sections 51921(a) and 51921(b)). Findings do not need be made if the action falls within one of the exemptions in Section 51293. The contract is normally terminated when land is acquired by eminent domain or in lieu of eminent domain (Section 51295).
- DOC must be notified within 10 working days upon completion of the acquisition (Section 51291(c)).
- DOC and the city or county must be notified before completion of any proposed work of any significant changes related to the public improvement (Section 51291(d)).
- If, after acquisition, the acquiring public agency determines that the property would not be used for the proposed public improvement, DOC and the city or county administering the involved preserve must be notified before the land is returned to private ownership. The land will be reenrolled in a new contract or encumbered by an enforceable restriction at least as restrictive as that provided by the Williamson Act (Section 51295).

RELATED PROGRAMS AND POLICIES

The Williamson Act provides some exemptions from the findings listed above. These exemptions are identified in §51293 of the California Government Code and are listed below.

- The acquisition of either (1) temporary construction easements for public utility improvements, or (2) an interest in real property for underground public utility improvements. The exemption applies only where the surface of the land subject to the acquisition is returned to the condition and use that immediately predated the construction of the public improvement, and when the construction of the public utility improvement will not significantly impair agricultural use of the affected contracted parcel or parcels.
- The location or construction of the following types of improvements, which are hereby determined to be compatible with or to enhance land within an agricultural preserve [not a contract]:

  (1) Flood control works, including channel rectification and alteration.

  (2) Public works required for fish and wildlife enhancement and preservation.

  (3) Improvements for the primary benefit of the lands within the preserve.

- All facilities which are part of the State Water Facilities as described in subdivision (d) of Section 12934 of the Water Code, except facilities under paragraph (6) of subdivision (d) of that section
- The acquisition of a fee interest or conservation easement for a term of at least 10 years, in order to restrict the land to agricultural or open space uses as defined by subdivisions (b) and (o) of Section 51201.

ISSUES

Project proponents need to remember that there are specific policies and requirements that may apply when changing land use to non-agricultural uses when the land in question is within an agricultural preserve and subject to Williamson Act contracts. Unless specifically stated in the statute, state agencies are not exempt from these requirements.

Some land uses may be compatible with the agricultural use. Project proponents should check with the county in which the project is located to determine what uses are compatible.

As discussed above, contracts may be terminated by non-renewal. This process takes either 10 or 20 years, depending on what type of contract is involved.

PARTNERS AND POSSIBLITIES

- Farmers/landowners
- County in which the project is located.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E2.2 Implement actions required by the Williamson Act: 061014

SECTION II: POTENTIAL STRATEGIES

Group E. STRATEGIES FOR SUCCESSFUL PLANNING BY PROJCT PROPONENTS

Strategy E2: Work with local government

Strategy E.2.3: Work with counties to expand Williamson Act authorized uses

DESCRIPTION

As noted in Strategy E2.5, the Williamson Act was enacted in 1965 to help lessen the impacts of rapidly spiraling land values and property taxes, and to ensure that California would continue to benefit from a long-term supply of agricultural and open space land. In the 48 years since, the Act has been primarily used by local governments to preserve agricultural land in California. However, the Act also provides options for non-agricultural open space contracts (e.g. for wetland and wildlife habitat) per Government Code § 51205. Cities and counties have the authority to include open space, habitat, and recreation as primary uses in agricultural preserves and to provide for those uses in their Williamson Act contracts. In the Delta, relatively few, if any agricultural preserves currently provide for exclusive open space contracts to be set up. Accordingly, open space, habitat, and recreation uses can occur as a "compatible use" but not as a primary use.

The Williamson Act (Government Code § 51254) provides for the conversion of existing agricultural contracts to open space contracts (or open space easements). The contracting parties, by mutual agreement, can rescind an existing agricultural contract and simultaneously enter into a new open space contract. Securing the cooperation of the Delta counties in the conversion of Williamson Act agricultural contracts to open space contracts could facilitate a farmer's ability to remain on the land by allowing habitat/open space as the primary use while retaining Williamson Act property tax benefits. The farmer could then act as property manager for the habitat land and, if feasible, continue to farm a portion of the land as a secondary use. Keeping the land in private ownership retains the property's contribution to the respective county's tax base.

RELATED PROGRAMS AND POLICIES

Under the provisions of the Planning and Zoning Act (Gov. Code §65000, et seq.) cities and counties must prepare general plans, incorporating seven mandatory elements, including land use, open space and conservation. Within these elements, a city or county normally provides direction and future intent for the land identified as agricultural or open space land. The Williamson Act provides a narrower spectrum of land that can be compatible as open space within agricultural preserves and under Williamson Act contracts. These limited uses, which are further defined within the Act, include: (1) a scenic highway corridor, (2) a wildlife habitat area, (3) a saltpond, (4) a managed wetland area, (5) a submerged area, or, (6) an area enrolled in the United States Department of Agriculture Conservation Reserve Program or Conservation Reserve Enhancement Program.

ISSUES

The loss of OSSA funding makes the resulting reduction in property tax revenues a greater challenge for counties. Conversion of producing agricultural land to lower production or open space could also reduce the income from affected land. The strategy could also be viewed as reducing agricultural production and income options and detrimental to the local economy. On the other hand, if there is no agreement

to provide for a change from agricultural to open space use, BDCP participants may choose to not renew the existing Williamson Act contracts which could lead to uncertainty with regard to property tax values, in lieu taxes and the potential for subventions. Achieving cooperation from the participating counties will be the key to the success of this strategy and the development of identifiable benefits or meaningful incentives could encourage the counties to consider changing the existing contracts.

OPPORTUNITIES AND POTENTIAL PARTNERS

Many NGOs, such as The Nature Conservancy, the Trust for Public Land, and regional and local land trusts, have dealt with the issue of Williamson Act agricultural restrictions on lands that they have acquired for restoration. The conversion of existing Williamson Act agricultural contracts to open space contracts or open space easements could facilitate habitat restoration and the development of recreational opportunities, which are goals that are shared by many groups. These shared goals could provide partnering opportunities that expand the scope and effectiveness of this strategy. Converting Williamson Act agricultural contracts to open space contracts or easements could provide options to facilitate habitat restoration and the development of recreational opportunities, while avoiding potential conflicts with local Williamson Act rules that may limit nonagricultural open space uses.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E2.3 Williamson Act Open Space Contracts: 102913

SECTION II: POTENTIAL STRATEGIES

GROUP E: STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E2: Work with Local Government

Strategy E2.4: Investigate options for in lieu tax revenue for local governments

DESCRIPTION

Project investments in land can result in public ownership of property, removing it from property tax rolls and reducing property tax revenues to local government. Other public investments could result in the transfer of less than full property ownership in the form of lesser interests in land, such as agricultural conservation easements and other forms of conservation easements. Under existing provisions of the Revenue and Taxation Code, creation of these easements would result in a permanent reduction in assessments for the properties subject to conservation easements.

Some of the ways proposed to make local governments whole as a result of public projects are to:

- commit to fully replace lost tax revenue on land that will be acquired in fee by public agencies;
- reinstitute Open Space Subventions, reducing tax losses from enforceably restricted land;
- provide reimbursement for any losses from enforceably restricted land not otherwise reimbursed by Open Space Subventions;
- commit to pay for applicable special district costs imposed on landowners.

RELATED PROGRAMS AND POLICIES

California Constitution, Article XIII, Section 8 - Provides the basic authority to permit preferential property taxation contingent upon the adoption of enforceable restrictions by the Legislature.

Revenue and Taxation Code §420, et seq. establishes qualifying enforceable land use restrictions and sets forth tax formulae for restricted lands.

The Open Space Subvention Act - Government Code §16140, et seq. -Provides for State payments to participating counties and cities based on the type of land and amount of land enrolled in Williamson Act contracts ($5/acre for prime land, $1/acre for land other than prime). The Act also provides for the State's oversight of local programs, including standing to bring suit to enforce.

The Williamson Act (California Land Conservation Act) - Government Code §51200, et seq. - sets forth the structure for establishing agricultural preserves, entering to and terminating contracts, approving compatible uses for preserves and contracts; and enforcement of restrictions required by the Constitution in exchange for tax benefits.

§51252 provides: "Open-space land under a contract entered into pursuant to this chapter shall be enforceably restricted within the meaning and for the purposes of Section 8 of Article XIII of the State Constitution and shall be enforced and administered by the city or county in such a manner as to accomplish the purposes of that article and of this chapter."

ISSUES

Loss of open space subventions (See E2.5) – The Williamson Act was enacted almost 50 years ago, and in the intervening period has had a profound effect by helping to retain large swaths of agricultural land and open spaces in California. However, it did not become widely popular in California before the enactment of the Open Space Subvention Act (OSSA) in 1969. The OSSA, until it was defunded in 2010, reimbursed participating cities and counties for a portion of their tax revenue losses resulting from limiting the property taxes on landowners of land contracted under the terms of the Williamson Act. Two Delta counties, San Joaquin and Yolo, were among the top 10 counties receiving subventions before defunding occurred. In 2009, San Joaquin received $1,872,435 and Yolo received $1,309,555 from the State General Fund. For the other Delta counties, 2009 subventions were: Contra Costa - $66,947; Sacramento - $517,933; Solano - $644,178.

Because of the loss of OSSA subventions, the Delta Counties already face significant unreimbursed tax revenue losses from property tax restrictions on land. Much of the land that is expected to be affected by the use of various conservation easements would be valued under the same Revenue and Taxation code provisions that now apply to the land subject to Williamson Act contracts. In the case of the Williamson Act or Farmland Security Zone contracts, the counties are free to "nonrenew" the contracts, causing taxes to return to a Prop. 13 basis over the remainder of their 10- or 20-year terms. However, conservation easements will be eligible for lower taxes in perpetuity, so long as the Revenue and Taxation Code formulae for enforceably restricted land remain on the books.

Currently, the Bay Delta Conservation Plan provides no proposed offset for revenue loss for easements – However, Assessors are required to consider conservation easements as enforceable restrictions that will affect property valuation (See R&T Code §§421, 422, 422.5).

Making local governments "whole" The Delta Five-County Coalition has signaled that it expects that payments associated with BDCP will "make the Counties whole" by replacing lost tax revenues, and that special districts will also receive full payments for revenue lost to public ownership effects on the tax rolls.

PARTNERS AND POSSIBLITIES

- The California Climate and Agriculture Network
- California Department of Food and Agriculture
- California Department of Conservation
- California Natural Resources Agency
- Delta Five County Coalition
- California Special Districts Association

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E2.4 In lieu tax options: 102913

SECTION II: POTENTIAL STRATEGIES

GROUP E: STRATEGIES FOR SUCCESSFUL PLANNING BY PROJECT PROPONENTS

Strategy E2: Work with Local Government

Strategy E2.5: Work with others to explore the value of reinstating state funding of Williamson Act subventions

DESCRIPTION:

The Williamson Act has proven to be a popular and successful farmland and open space conservation tool for almost 50 years. 53 of 58 counties participate in the voluntary program that provides property tax relief to landowners in exchange for accepting development restrictions on their land for a term of 10 or 20 years. Subvention payments from the State to the participating counties and cities for the lost property tax revenue have been mainstay of the program until 2009. State budget cuts have dramatically reduced funding for the Williamson Act, which places an increased burden on the participating counties and cities and casts doubt on the future of one of the nation's oldest land conservation programs.

Recent research, published in the winter 2012 issue of California Agriculture, surveyed 700 ranchers who have Williamson Act contracts and found that 37 percent of ranchers predicted they would sell some or all of their rangeland without property tax reductions provided under the Act. Of those who would sell, 76 percent predicted that the buyers would develop the land for nonagricultural purposes. This suggests that a significant amount of California's agricultural and open space land is in jeopardy of conversion without the property tax reductions provided by the Williamson Act. While land in the primary zone of the Delta is protected from development by the Delta Protection Act of 1992, the Williamson Act undoubtedly increases the economic viability of agricultural operations in the Delta by reducing the property tax burden to farmers and ranchers. It also limits the price of land because of the contract restrictions, and the effects of changes to ownership on the tax burdens. The Act allows farmers to purchase land without feeling the full tax burden of a sale from a seller with long-held ownership (which is limited by Proposition 13 rates) to a new owner (whose land will be valued at the new purchase value unless the tax rate is restricted by the Williamson Act).

In order to offset some of the property taxes lost to cities and counties participating in the Williamson Act, the Open Space Subvention Act (OSSA) was enacted in 1970. The OSSA reimbursed participating local agencies based on the amount and quality of land under contract (for a time, the amount of payment for prime land under contract was also keyed to whether the land was within three miles of a city). Until the OSSA funding was cut in 2010-11, the state had paid approximately $1 billion to cities and counties for subventions, and also backfilled property tax support to school districts for losses tied to lower tax rates. Some counties adopted agricultural preserve programs with additional restrictions or benefits to participants.

This strategy involves working with the counties, the California Department of Conservation and others to investigate options that could improve the economic base of the counties that participate in the Williamson Act. Some of the options could include looking at the benefits of restoring OSSA-type incentives and/or to provide incentives to counties to either maintain their current Williamson Act agricultural contracts or to encourage the rescinding of those contracts and the simultaneous signing of

new open space/habitat contracts. This strategy could allow farmland to remain privately owned and on the tax rolls while keeping the Williamson Act contracts in place. At the same time it would provide economic relief to counties who have suffered the loss of Williamson Act subventions that have resulted from the recent State budget cuts.

RELATED PROGRAMS AND POLICIES

See discussion above.

ISSUES

The greatest issue is the cost of the subvention program to the state general fund. Before funding was terminated, the state paid $39 million annually to the cities and counties with Williamson Act programs. Another issue could arise if limited payments are targeted at the BDCP Planning Area only. Even if such payments were identified as "in addition" to any increased statewide subvention program, targeted payments could be viewed as counterproductive to efforts to reinstate the subvention program statewide.

OPPORTUNITIES AND POTENTIAL PARTNERS

The counties have been carrying most of the burden of reduced property tax payments under the Act since 2009. Some of the 53 participating counties have placed moratoriums on new contracts due to the uncertainty surrounding the future of subventions funding; however, at present none of the five Delta counties has placed a moratorium on establishing new Williamson Act contracts. The California State Association of Counties currently has a policy and promotes efforts to fully fund Williamson Act Subventions funding and could be an effective potential proponent in bringing this strategy to fruition. In addition to local government, a diverse and sizable roster of organizations have demonstrated their support for reviving funding Williamson Act subventions including environmental and agricultural groups, in addition to various coalitions. The California Farm Bureau has been a prominent voice in explaining the value and success of the Williamson Act and has provided continued support and guidance to California counties on changes and status of the Act. The California Rangeland Conservation Coalition is currently in the process of creating a workgroup to develop ideas that could reinvigorate subvention funding. The Working Lands Coalition, a consortium made up of the California Farm Bureau Federation, the American Farmland Trust, the California Rangeland Trust, several agricultural associations, and many more regional land trust groups, has developed a proposal to fund a comprehensive agricultural land and open space protection with greenhouse gas cap and trade auction revenue. The proposal includes the restoration of Williamson Act subventions and links subventions and planning money to incentives for counties and cities to adopt strong open space and agricultural protection programs.

ALS Workgroup: ALS Framework and Strategies: Section II: Strategy E2.5 Williamson Act Subventions: 102913

Good Neighbor Checklist (As developed in 2014)

The Sacramento-San Joaquin Delta (Delta) is the home of numerous habitat restoration efforts. Many Delta farmers are concerned that habitat lands could harm nearby agriculture in various ways. They would like assurance that entities that establish and manage habitat projects will consult with their neighbors and find ways to avoid impacts and resolve problems if they arise.

Restoration project managers can use the following checklist to ensure that they comprehensively consider and examine the impacts of their project on neighbors, and vice versa. The checklist is based on a discussion paper, "Agricultural and Land Stewardship Strategies" (see https://water.ca.gov/programs/california-water-plan/water-resource-management-strategies/agriculture-and-land-stewardship-framework), which identifies a menu of mitigation measures and enhancements for the Delta. The measures described in the discussion paper, called Strategies, are referenced in the checklist.

- Have project proponents consulted with all neighboring landowners and operators about the project and its potential impacts? (See Strategy E1.1, which recommends involvement of landowners in project planning.)
- Have project proponents designated a local contact person to meet with neighboring landowners and discuss any issues of concern? (See Strategy D5.1, which suggests establishment of a public advisor position to help the public work with government agencies.)
- Will the project need access through other properties? If so, have access agreements been obtained?
- Does the management plan for the project provide for an on-site patrol or manager to deter trespass and vandalism? (See Strategy A4.3, which suggests the hiring of game wardens, sheriff's deputies, or private security guards.)
- Will the project increase the presence of vegetation susceptible to fire? (If yes, see Strategy A4.3.)
- Will the project discontinue maintenance of flood control features, involve prolonged or repeated flooding of previously dry land, or affect wind fetch across waterways? (If yes, see Strategy A1, which discusses flood protection improvements, and Strategy E1.3.2, which discusses drainage and seepage.)
- As a result of the project, are species on the project site expected to increase markedly in abundance and move from the site to neighboring lands or waterways? If yes, which species? (And see Strategy A4.2, which suggests ways to protect landowners from liability under endangered species laws.)
- Is it reasonably possible that species in the project area could damage crops or promote the growth of weeds or diseases on neighboring farms? (If yes, see Strategy A3, which suggests ways to control weeds, and Strategy A4.1, which suggests the use of buffer zones and mechanisms for compensation for crop damages.)
- Will the project disturb utilities, roads, bridges, or other infrastructure that serve agricultural uses? (If yes, see Strategy D3, which suggests improvements to transportation infrastructure.)
- Will the project fragment or isolate farmland? (If yes, see Strategy E1.1, which encourages collaborative project planning.)
- Do domestic or feral animals or livestock occur on lands neighboring the project? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)

- Do neighboring farms use chemicals as fertilizer, or to control weeds or crop pests? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)

Cases and other Resources dealing with California Agriculture (updated as of November 2018)

California Litigation Dealing with Agricultural Resources

Conversion of Agricultural Land or Williamson Act

CEQA Cases

City of Irvine v. County of Orange (2015)
Court of Appeal, Fourth District, 238 Cal. App. 4th 526

Friends of Kings River v. County of Fresno (2014)
Court of Appeal, Fifth District, 232 Cal. App. 4th 105

Masonite Corporation v. County of Mendocino, et al.,
(2013), Court of Appeal, First District; 218 Cal.App.4th
230.

Save Panoche Valley et al. v. San Benito County (2013)
Court of Appeal, Sixth District, 217 Cal. App.4th 503.

Citizens for Open Government v. City of Lodi, (2012)
Court of Appeal,Third District, 205 Cal.App.4th 296.

Cherry Valley Pass Acres and Neighbors v. City of Beaumont,
(2010) Court of Appeal, Fourth District, 190 Cal.App.4th 316.

California Farm Bureau Federation v. California Wildlife Conservation Board (2006)
Court of Appeal, Third District, 143 Cal.App.4th 173

Defend the Bay v. City of Irvine, (2004)
Court of Appeal, Fourth District, 119 Cal.App.4th1261.

Bozung v. LAFCo (1975),
13 Cal. 3d 263; *superseded in part by statute per California Unions for Reliable Energy v. Mojave Desert AQMD (2009) 178 Cal.App. 4th 1225*

Unpublished/Depublished Cases

Wagner Farms, Inc. v. Modesto Irrigation District, (2006)
Court of Appeal, Fifth District, Unpublished, Docket N. F049311
2006 Cal.App.Unpub. LEXIS 8097; 2006 WL 2615166

West Davis Neighbors v. Regents of the University of California,
(2005) Court of Appeal, First District, Unpublished, Docket N.
A108104
2005 Cal.App.Unpub. LEXIS 11200; 2005 WL 3293040

South Citizens for Responsible Growth v. City of Elk Grove, (2004) Court of Appeal, Third District; Unpublished, Docket N. C042302 2004 Cal.App. Unpub. LEXIS 1208; 2004 WL 219789

County of Santa Cruz v. City of San Jose, (2003) Court of Appeal, Sixth District; Unpublished, Docket N. H023956 2003 Cal.App.Unpub. LEXIS 2999; 2003 WL 1566913

Friends of the Kangaroo Rat v. California Department of Corrections, (2003) Court of Appeal, Fifth District 4 Cal.Rptr.3d 558 - Ordered Not Officially Published; Previously published at 111 Cal.App.4th 1400

Williamson Act Cases

Save Panoche Valley et al. v. San Benito County, (2013)
Court of Appeal of California, Sixth Appellate District, 217 Cal. App.4th 503.

County of Colusa v. California Wildlife Conservation Board (2006)
Court of Appeal, Third District, California,145 Cal.App.4th 637.

People ex rel. Dept. of Conservation v. Triplett, (1996)
Court of Appeal, Fifth District, 48 Cal.App.4th 233.

Stanislaus Audubon Society, Inc. v. County of Stanislaus (1995)
Court of Appeal, Fifth District, 33 Cal. App. 4th 144.

Borel v. County of Contra Costa, (1990)
Court of Appeal, First District, 220 Cal. App. 3rd

Lewis v. City of Hayward, (1986)
Court of Appeal, First District, 177 Cal.App.3rd 103.

Delucchi v. County of Santa Cruz, (1986)
Court of Appeal, Sixth District, 179 Cal. App. 3rd 814.

Honey Springs Homeowners Ass'n v. Board of Supervisors,
(1984) Court of Appeal, Fourth District, 157 Cal. App. 3rd 1122.

Shellenberger v. Board of Equalization (1983)
Court of Appeal, Third District, 147 Cal. App. 3rd 510.

Sierra Club v. City of Hayward (1981)
California Supreme Court, 28 Cal.3rd 840

Dorcich v. Johnson, (1980)
Court of Appeal, First District, 110 Cal. App. 3rd 487.

Kelsey v. Colwell, (1973)
Court of Appeal, Fifth District, 30 Cal. App. 3rd 590.

County of Marin v. Assessment Appeal Bd., (1976)
Court of Appeal, First District, 64 Cal. App. 3rd 319.

DRAFT Discussion Paper
BDCP and Delta Farmland

I. Introduction[1]

The State is pursuing multiple activities in the Delta that could affect Delta Farmland. These include near-term projects of the state and federal water projects to meet current endangered species requirements and future projects under the Bay Delta Conservation Program (BDCP).

This discussion paper is intended to encourage a wide-ranging dialogue among many interested parties about issues and opportunities that may result from these projects and particularly their relationship to, and potential effect on, farmland and agriculture in the Delta. It does not commit any agency to the approach discussed in this paper, but it does provide an opportunity for all parties interested in this issue to discuss whether the approach is a good one and, if so, what should DWR and other agencies consider in going forward with regard to the approach

This paper describes an integrated and collaborative approach using a variety of agricultural stewardship principles and strategies for addressing the conversion of farmland[2] to different uses, assuming the future implementation of a project. The discussion would explore a voluntary framework for the project proponents to pursue to develop working landscapes that provide environmental and habitat benefits. A critical objective of the framework would be that the project would have, at a minimum, a neutral economic effect on farmers farmland, and local government in the Delta, taking into consideration:

- the desire of individual Delta farmers to continue working on their land,
- the long-term viability of regional agricultural economies,
- the economic health of local governments and special districts, and
- the Delta as an evolving place.

The approach outlined in this document seeks to maintain agricultural and economic viability in the Delta by encouraging strategies that help provide benefits such as:

- economic choices to manage land in a way that contributes to maintaining and improving the ecological health of the Bay-Delta system;
- ways to reverse subsidence;
- flood protection;
- groundwater seepage protection; and
- improved water quality

The approach supports local government and special districts planning and helps them stay fiscally sound by providing strategies that help provide benefits such as :

- opportunities to keep county revenue neutral or positive and
- ways to minimize potential land use conflicts with local plans,

[1] This is a draft paper prepared to encourage discussion regarding the issues raised in the paper. Any comments or requests to meet to discuss the issues should be sent to kspanos@water.ca.gov.

[2] When discussing farmland or agricultural land in general terms, we have used the term "farmland" throughout this paper.

This approach also recognizes that local interests, including Delta farmers, have unique and specialized knowledge and seeks to involve these interests in the process.

POTENTIAL IMPACT*:* The permanent footprint for the tunnel option for a conveyance facility component of BDCP would be around 5,000 acres of farmland (the footprint of the conveyance facility could range from 2500 18,000 acres depending on the alternative selected). Additional farmland may be affected temporarily during construction. Habitat restoration components of the BDCP include more than 100,000 acres of restored and protected habitat, a significant percentage of which is currently farmland. Much of this farmland provides habitat for native terrestrial species.

Habitat for species*:* A separate conservation strategy is currently being developed to address the effects of changes to habitat for species adversely affected by the conversion of farmland for BDCP project purposes. This strategy is likely to call for the permanent protection (through easements or other means) of other farmland to benefit the terrestrial species that depended on the converted lands for habitat.

MITIGATION FOR FARMLAND IMPACTS*:*

Conventional Mitigation Approach: The conventional approach for mitigation for potential significant adverse environmental effects relating to agricultural resources has generally been to purchase off-site agricultural conservation easements for land of similar agricultural quality in areas that are threatened with encroaching urban development. Aside from monetary compensation for the direct loss of land, the conventional approach does little to help the individual farmer whose land was converted or otherwise impacted by the project. In addition, given the lack of development pressure in the inner Delta due to regulatory restrictions, flood threats, and the large number of acres potentially planned for restoration by DWR and other public and private entities, it is possible that the conventional approach might look for off-site land outside the Delta.

Optional Agricultural Land Stewardship Approach*:* This paper proposes consideration of an optional approach that focuses on the effect of the projects on the landowner and the Delta. This approach is designed to encourage early planning that will result in multiple-benefits and long-term partnerships with local interests that result in sustainable projects that benefit both the environmental and social-economic communities in the Delta and would include the following considerations

- The approach suggests that the parties evaluate the extent to which the project can be part of or complement existing or planned land uses for the Delta. As a threshold issue, this means thinking about ways to prevent or avoid farmland loss.

- To the extent that farmland is part of the project, , consideration should be given to developing working landscapes[3] on project lands that recognize other land use

[3] The Cal-Fed Working Landscapes Subcommittee of the Bay Delta Public Advisory Committee defined a working landscape as "*a place where agriculture and other natural resource-based economic endeavors are conducted with the objective of maintaining the viability and integrity of its commercial and environmental values. On a working landscape, both private production, as well as public regulatory decisions account for the sustainability of families, businesses and communities, while protecting and enhancing the landscape's ecological health. The working landscape is readily adaptable to change according to economic and ecosystem needs. With respect to CALFED, a working landscape is both an objective and a means to achieve it. A working landscape is efficiently managed largely by private agricultural landowners and managers who are supported and encouraged to manage their lands in ways that fulfill CALFED goals, allowing them to pursue*

activities taking place in the Delta. These activities include ones designed for mitigation and enhancement relating to aquatic and terrestrial habitat; agricultural use; recreation; agritourism; ecotourism; and flood management.

- This paper identifies a number of agricultural land stewardship strategies that could be considered with respect to project lands that could be integrated with project and other relevant land use strategies where appropriate.

- To the extent that there are still impacts to agriculture, the paper identifies other strategies to consider that may take place outside of the project property both within and outside of the Delta that could provide mitigation for impacts to the Delta.

Relationship to other programs*:* There are a number of other current and proposed activities and programs that affect Delta farmland and that are carried out by DWR and other entities. These activities are developed pursuant to legislative and administrative authorities that are different from those that guide BDCP. Although it is possible that this paper's approach or some aspects of it may be applicable to these other activities, the concepts in this discussion paper are not being considered for any activity other than those related to the BDCP.

Environmental and Economic Impacts*:* One of the key questions in approaching mitigation for conversion of farmland from one use to another for project purposes is whether the impacts identified are economic[4], environmental, or a mixture of the two. In general, it is not legally necessary to mitigate for purely economic impacts unless they lead to reasonably foreseeable secondary environmental impacts. However, because of the complex nature of farmland as a natural and economic resource, it is often difficult to determine when an impact is an economic impact and when it is an environmental impact. The framework proposed by this paper does not make an attempt to distinguish strategies based on whether they deal with environmental or economic effects, but instead considers whether they maintain the economic viability of Delta agriculture. Although these strategies are not focused on means of reducing environmental impacts on agricultural resources to a level of insignificance, these strategies may result in a substantial reduction of those environmental effects and a reduction or elimination of secondary environmental effects on Delta farmland. Nonetheless, the BDCP EIR/EIS may determine that even with these strategies in place, the potential environmental impact as a result of changing the current use of farmlands in the Delta is expected to be significant.

Relationship to other processes: This approach is not intended to take the place of other ongoing processes designed to achieve similar objectives, but rather to take advantage of processes proposed (or to be proposed) by the Delta Conservancy, the Delta Stewardship Council, the Delta Protection Commission, the California Water Plan, the California Department of Food and Agriculture's Environmental Farming Science Panel, local county, city and regional planning processes, and other conservancy programs. This approach builds upon "visioning" documents and plans that came before, such as those produced by CALFED, the Delta Vision process, the Delta Protection Commission Economic Sustainability Plan, the California Fish and Wildlife Strategic

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ecological health goals while yielding economic returns on investments, and generating tax revenues that support their local governments". (need citation)

[4] In this context, references to economic impacts may also include social or social/economic impacts.

Vision, the Department of Food and Agriculture's Agriculture Vision, the California Water Plan Agricultural Land Stewardship Strategy, the Delta Conservancy's Strategic Plan, the Delta Stewardship Council's White Paper on Agriculture, the Department of Water Resources' Climate Change Strategies for California's Water, the California Natural Resources Agency's California Climate Adaptation Strategy, the California Roundtable on Ag and the Environment and the California Roundtable on Water and Food Supply, including recommendations regarding Agricultural Water Stewardship, and on local plans for agriculture and natural habitat.

II. Background

Within state government, different agencies have taken different and sometimes conflicting approaches in addressing conversion of farmlands for ecosystem improvements, based, in part, on their missions. However, in October 27, 2004, a memorandum from the Secretaries of the Resources Agency and the Department of Food and Agriculture committed the two agencies to work together in a complementary, rather than conflicting, approach on these issues. On May 4, 2005, the Secretary of the Resources Agency followed up with a directive that "in selecting and developing resources related projects, departments under the Resources agencies should incorporate, where appropriate, the strategies identified in the CALFED EIR to reduce the impact of the CALFED Ecosystem Restoration Program on agricultural land and water use." The Secretary recommended several steps that affected departments should take in cases involving agricultural lands, including the following: (1) projects should include both restoration and agricultural preservation efforts; (2) the lead agency should analyze each situation on a case-by-case basis; and (3) CEQA documents involving resource-related projects that involve agricultural land should include a separate section that describes the social and economic consequences of a conversion.

Separate from CEQA, the 2009 Delta Reform Act and related legislation on Delta activities contemplates that these activities will involve the conversion of agricultural land to other uses and requires consideration of the agricultural values of the Delta. Notably, in Public Resources Code section 29702, the Legislature declared that the "coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem . . . shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and *agricultural* values of the Delta as an evolving place." (Emphasis added.) [5] Echoing this concern for Delta agriculture, Public Resources Code section 32301[d] notes that "[t]he Delta contains more than 500,000 acres of agricultural land, with unique soils, and farmers who are creative and utilize innovative agriculture, such as carbon sequestration crops, subsidence reversal crops, wildlife-friendly crops, and crops direct for marketing to the large urban populations nearby."

Federal law, through the Farmland Protection Policy Act, recognizes that the Nation's farmland is a unique natural resource and provides food and fiber necessary for the continued welfare of the people of the United States; that each year, a large amount of the Nation's farmland is irrevocably converted from actual or potential agricultural use to nonagricultural use; that the extensive use of farmland for nonagricultural purposes undermines the economic base of many rural areas; and that Federal actions, in many cases, result in the conversion of farmland to nonagricultural uses where alternatives actions would be preferred.[6]

[5] Similar language is found in Water Code section 85020.

[6] 7 USC 4201, Section 2; For a link to the Farmland Protection Policy Act see http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1042432.pdf

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Vision and Policy Documents: The paper will summarize positions, approaches, analyses and recommendations of related past and concurrent documents, including: CALFED; Delta Vision; CA Department of Conservation; CA Department of Food and Agriculture; CA Department of Fish and Game; Delta Protection Commission; Delta Stewardship Council; Delta Conservancy; the California Water Plan and local land use plans.

III. Basic Integrated Approach: Working Landscapes

This approach proposes a framework that would work on a case by case basis. Each project proponent would be encouraged to establish a working landscape for the project that integrates project activities with other uses. Properly structured, the affected landscape could produce multiple benefits and long-term partnerships among state and local interests in order not only to meet the conservation objectives and ecological benefits of the project, but also to result in more sustainable projects that also improve the social and economic basis of the Delta region.. This may be easier or more difficult depending on how the project area is defined. In some cases the project area may be all of a component such as the conveyance footprint or all of a BDCP habitat restoration area. In other cases it may a part of a component that is being developed sequentially. Each project would include an Agricultural Land Stewardship Plan (ALSP)[7] that discusses all the elements listed below. Although not the focus of this paper, it may be worthwhile to consider whether there would be a benefit to developing a overall agricultural land stewardship program for the entire Delta region that could provide a framework for individual ALSPs.

A. Describe area affected: After describing the project area, identify acreage of "Agricultural land" potentially affected. In this paper Agricultural land means prime farmland, farmland of statewide importance, or unique farmland, as defined by the United States Department of Agriculture land inventory and monitoring criteria as modified for California.[8]

B. Avoid agricultural land: Plan the project to avoid Agricultural land conversion where feasible; where choices are possible, avoid "highest quality" Agricultural land. This paper recognizes that "highest quality" may be a subjective term, but does not try to define it. This paper

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[7] The idea of an ASLP is not to have another layer of requirements that could delay implementation of the basic integrated approach, but rather to have some level of documentation that shows that all the elements have been considered. It could be a checklist or something more extensive. The scope and timing for an ASLP are several of the many items to be discussed and may change over time during implementation of the project.

[8] This definition comes from CEQA (Pub. Resources Code section 21060.1 (a)). Note also that in the Council on Environmental Quality regulations interpreting the National Environmental Quality Act (NEPA) that define the term "significantly", in the subsection that discusses the intensity or severity of impacts, there is a specific reference to prime farmland: "Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, **prime farmlands**, wetlands, wild and scenic rivers, or ecologically critical areas" (40 CFR 1508.27(b)(3)) and that the federal Farmland Protection Policy Act defines the term farmland, for the purposes of the act, to includes all land defined as follows: (A) prime farmland …, (B) unique farmland…, (C) farmland, other than prime or unique farmland, that is of statewide or local importance…." [7 USC 4201] Section 2 (c).

assumes that if choices can be made regarding different locations for a project, and still achieve the project purposes, it may be possible to avoid the areas where the "quality" of the resource is higher. How such determinations could be made would be the subject of further discussion. **Determine amount of Agricultural land that will not continue to be farmed as a result of the project.**

C. Mitigate on-site: Plan the project to mitigate on-site if feasible. This could include converting areas currently not in agriculture to agriculture or making improvements to the land that result in higher quality farmland for the land that remains in agricultural production (e.g. , improved drainage)[9]. Some of this planning may overlap with the consideration of strategies discussed in Paragraph F below. **Determine amount of Agricultural land that will not continue to be farmed as a result of the project.**

D. Determine potential impact: Analyze the individual project and the affected land to determine whether there is a potential significant environmental impact that could be reduced by feasible mitigation requirements under CEQA. This is a multi-faceted analysis that focuses on Agricultural land that is currently farmed and can continue to be farmed economically and on a sustainable basis for an indefinite period of time absent a conversion to a different use under the project. In this paper this land is called **Important Farmland**. The analysis could look at factors such as the following: the LESA[10] score, if appropriate; the sustainability of agricultural farming (e.g., whether particular properties are subject to subsidence, have an adequate water supply, are economically viable, etc.); whether the impact is temporary and use of the land for agriculture can be restored or whether it is irreversible; whether the area is designated natural habitat in a local plan; and whether there are other benefits that help preserve agricultural resources on or near the project area (e.g., improved flood protection). As a result, in some cases, it may be determined that even though some Agricultural land will be converted, the environmental effect is not potentially significant. **Determine amount of Important Farmland that will be impacted and not continue to be farmed as a result of the project. This is land that is potentially subject to a CEQA mitigation feasibility analysis**.

E. Coordinate with off-site terrestrial mitigation: Some Important Farmland that may be converted to non-farm uses may currently serve as habitat for terrestrial species. Conservation strategies may propose to mitigate for loss of agricultural habitat for certain terrestrial species through protection of off-site lands that have similar habitat value as those being impacted . Conservation strategies may also require restrictive easements on such lands to maintain certain kinds of crops that provide the desired habitat value and, in some cases, may require land to be purchased in fee title. Determine the amount of off-site land to be protected for mitigation of terrestrial species and determine what amount of this off-site land will be Important Farmland. Subtract this amount from the Important Farmland in Paragraph D. **The**

[9] Although mitigation on site, such as conversions to agricultural use may be unlikely, this paper suggests exploring such options to the extent they are feasible. Such conversions might have other environmental impacts subject to mitigation requirements.

[10] LESA refers to the "land evaluation and site assessment" system developed by the Department of Conservation, in consultation with the United States Department of Agriculture, pursuant to Public Resources Code section 21095[b]. The project score can be part of the consideration when determining whether a project's potential impacts on agriculture are significant within the meaning of CEQA. ,

remainder is the Important Farmland that is potentially subject to a CEQA mitigation feasibility analysis as described below in Paragraph F.

F. Optional mitigation approach: As described in the beginning of this paper, the conventional approach for mitigation for significant adverse environmental effects relating to agricultural resources does little to help the individual farmer whose land was converted or otherwise impacted by the project. This paper proposes an optional working landscapes approach that, although it might include aspects of the conventional approach, focuses on the effect of the project on the landowner, local governments and the Delta.

Mitigation Option 1 (Optional Agricultural Land Stewardship Approach). The Optional Agricultural Land Stewardship Approach would seek opportunities to protect and enhance agriculture in the Delta as part of the project landscape and focus on maintaining economic activity on farmlands. The project proponent would partner with the landowners, farmers, local government and other interests either directly or through third-parties (e.g., the Delta Conservancy or NGO land trusts) with relevant expertise to integrate project activities (including mitigation and restoration) with other uses such as agriculture[11], flood management, recreation, agritourism and ecotourism. The goal would be to incorporate farmers' diverse needs for maintaining agriculture and economic vitality in the Delta while carrying out the conservation components needed to achieve the project's goals and objectives. This would be carried out by considering different agricultural land stewardship strategies. The agricultural stewardship strategies proposed to be explored are discussed below in Section IV and may include some aspects of the Conventional Mitigation Approach discussed below. Some of the strategies would involve keeping the landowner/farmer on the land being affected in a way that would eliminate or reduce a potential conventional mitigation requirement. Others would consider mitigation elsewhere in the Delta (or outside the Delta if it provided a benefit to the Delta). The Optional Agricultural Land Stewardship Approach would include reporting and monitoring actions necessary to show that the actions agreed to were being carried out. Examples of the strategies being explored include:

- pay landowners to manage converted farmland as tidal wetlands
- define wetlands privately managed for profit as agriculture in order to gain benefits given to agricultural production
- work with counties to harmonize Williamson Act preserve designations to reflect more diverse uses
- provide additional support for levee improvements or sediment removal projects which benefit Delta agriculture
- provide financial incentives for farmers to manage subsided land as managed wetlands
- purchase permanent easements on some high quality agricultural land in and near the Delta
- work with counties in an effort to provide a neutral or positive effect on county revenues.

[11] Note that some of the strategies discussed later in the paper advance a broad view of "agricultural" activities.

Some of the strategies of the Optional Agricultural Land Stewardship Approach would help reduce or mitigate some of the direct and indirect environmental effects of the project on agricultural resources in the Delta. These strategies are likely to result in a reduction of potential environmental effects and in many cases further project objectives. Nonetheless, even with these strategies in place, it is possible that there could be a determination that the environmental impact on agricultural resources is still potentially significant; decision-making agencies will then have to determine whether there are additional feasible environmental mitigation measures and/or whether to go forward with the project despite a finding of significance.

The Optional Agricultural Land Stewardship Approach would seek to involve the local community in the planning process for the project along with state and federal agencies. At its core would be involvement of the landowner and the county where the property was located. If agreement cannot be reached on the optional stewardship approach, the conventional mitigation approach described below would be used.

Mitigation Option 2 (Conventional Mitigation Approach): Mitigation for agricultural resources would most likely be coordinated with requirements to protect farmland off-site for mitigation of terrestrial species displaced from converted farmland. Different farmland mitigation projects have taken different approaches to what is provided in the way of mitigation. Some projects have purchased easements at a 1:1 (or greater or smaller) ratio, some have used more qualitative measures, and some have found that the purchase is infeasible either because of cost or distance from project. The conventional approach usually has focused on protecting land in the path of urban development. This approach does not usually consider the impacts on the farmer displaced or the county where the displacement occurred since these are economic impacts.

The Conventional Mitigation Approach could lead to a determination that the conversion of farmland is potentially significant and that the purchase of easements for all significant and unavoidable impacts may not be feasible because of the cost or availability of appropriate farmland.

IV. Agricultural Land Stewardship Strategies

This is a list of strategies proposed by different vision and policy papers that could be part of an Agricultural Land Stewardship Plan under the Optional Agricultural Land Stewardship Approach. Strategies are included that are also applicable to the Conventional Mitigation Approach since those strategies may also have a role in the Optional Agricultural Stewardship Approach. As this paper is further developed, the discussion of each strategy will probably be expanded to1-3 pages. Each strategy will be examined for feasibility, difficulties, obstacles and other potential implementation issues. Each strategy, as implemented, would also have to align and be consistent with the project, including relevant conservation strategies. After further study, some may be found to not be feasible; some may be modified; and new ones may be identified. Many of the strategies have been used in other programs; a review or evaluation of projects that have used these strategies would not only help identify different types of strategies, but may also provide some insight as to whether

the strategies work. No effort has been made to prioritize or organize strategies with the exception that strategies to keep farmers[12] on farmland are generally earlier in the list while off –site strategies is later in the list. However, it should be kept in mind that many of the strategies may apply both on-site and off-site.

Each strategy will also need to be considered in the context of what kind of land is involved, such as for example: (a) project land that is a necessary part of the facilities footprint; (b) project land that is a necessary part of the habitat conservation measures footprint; (c) project land that is mitigation land required by a conservation strategy to preserve terrestrial species displaced because of facilities or habitat restoration measures; (d) non-project land that is not part of a conservation strategy but that is kept (or put in) agriculture as a result of agricultural land stewardship strategies; and (e) project or non-project land that is benefitted by strategies (such as flood protection or improving water reliability or quality) that do not change land use but could protect or improve agricultural productivity in the Delta. Some strategies may apply only to one kind of land; others to several.

A. Farmers manage habitat land for project purposes

In some cases, existing owners/operators would be compensated to manage restored or other conserved land consistent with easements that meet the project purposes. Another option would be to pay to maintain easements on land managed by other third parties (i.e., private or public land trusts or conservancies). Where agricultural use is consistent with the conservation purpose of the easement, it is possible that these lands could be leased to farmers, as a revenue source to the land trust or conservancy and to provide proper management of the conservation lands. This could allow farmland to remain privately owned by the farmer, bringing income to the farmer and keeping the farmland as part of the tax base.

B. Work with farmers, counties and other agencies to identify and incorporate recreational, agritourism, and ecotourism components and other potential new market products in ecosystem restoration projects that could bring income to the farmer.

This could allow some farmland to remain privately owned by the farmer, bringing in income to the farmer and keeping the farmland as part of the tax base.

C. Designate for-profit habitat protection as agricultural production for specifically defined purposes.

There may be instances where there is an economic value to a farmer if the land can be shown to be involved in specific kinds of agricultural production but the definition of agricultural production may not include habitat "production". This strategy would seek to change such designations if they are a barrier to habitat production. Federal conservation reserve programs may provide an opportunity or a model. An example where this has been done was state legislation enacted in 2008 that included biofuels as a compatible use under the Williamson Act.

[12] In this paper, farmer is used as a generic term that includes farmers, ranchers, landowners, or tenants if they are currently farming the land and want to continue managing the land if it is used for project purposes, The approach suggested in this paper would not prohibit farmers from selling or leasing their land for project purposes if they do not want to continue to farm the land themselves.

This could allow farmland to remain privately owned by the farm, bringing income to the farmer and keeping the farmland as part of the tax base.

D. If management by farmer or easements on farmer's land is not feasible, consider other options

Consider purchase by state government and transfer to private or public land trusts or conservancies or purchase by state government with an agreement to pay tax equivalent. This could allow farmland to still provide a tax benefit to the counties.

E. Work with counties to include habitat lands in Williamson Act preserves

Under current law, counties decide whether recreational and habitat lands are included in Williamson Act preserves, and can serve as a basis for local contracts. Many of the current Williamson Act preserve designations by counties with land in the Delta do not include recreational or habitat lands, as primary (as opposed to compatible) uses. This may discourage farmers from converting their land to habitat use because such a use might conflict with or lose the advantage of current Williamson Act designations. Working with counties to include habitat land covered under a Williamson Act preserve could allow farmland to remain privately owned by the famer, keeping the farmland as part of the tax base.

F. Re-invigorate Williamson Act Program

State funding of Open Space Subventions that offset local property tax losses has been greatly reduced or eliminated during the past several budget cycles, although the Open Space Subvention Act remains in statute. While this and the previous strategy deal with the Williamson Act, the previous strategy would involve working with the county to maintain a tax benefit for the landowner. This strategy would involve working with the counties and others to provide an improved economic base for the counties that implement the Williamson Act. Currently, local governments bear the loss of property tax revenues on contracted land. Under this strategy, the state would work with others to re-invigorate the State Williamson Act incentives. This would include considering ways to provide incentives for counties to continue to keep and place land under Williamson Act contracts, or to permit contracts to be rescinded and replaced with either Williamson Act Open Space contracts or open space easements in ways that might provide the county with additional funding.

Priorities could be focused on land that remains under Williamson Act in an Open Space Contract, land for which the contract is rescinded and replaced with a permanent open space easement, and land that is brought into new contracts as part of a mitigation strategy. This strategy could allow farmland to remain privately owned by the farmer, and on the tax rolls, and keep it in the Williamson Act or open space easements. At the same time, it could provide economic relief for counties currently faced with loss of Williamson Act subsidies unrelated to the project.

G. Provide technical and financial assistance to support stabilization or reversal of subsidence in the Delta

This could include farming of rice or other wetland vegetation and creation of permanently flooded wetlands and may provide a potential net sink for carbon and methyl-mercury

through particle settling and photodemethylation. This could allow farmland to remain privately owned by the farmer, bringing income to the farmer and keeping the farmland as part of the tax base.

H. Provide technical and financial assistance to support water supply reliability benefits to agricultural water users

Identify areas where water supply reliability is a concern to Delta farmers and look at ways to improve water reliability. This could allow farmland to remain privately owned by the farmer, adding value to the farmland and keeping it as part of the tax base.

I. Consider ways to improve water quality for Delta farmers.

Identify areas, both within and outside the Delta, where water quality is a concern to Delta farmers and look at ways to improve Delta water quality. This could allow farmland to be privately owned by the farmer, adding value to the farmland and keeping it as part of the tax base.

J. Provide technical and financial assistance for flood management activities which provide additional protection for agricultural activities

This could be used to provide additional funding for flood management activities proposed by local flood districts or by the state or federal government. This could allow farmland to remain privately owned by the farmer, keeping the farmland as part of the tax base, adding value to the farmland, reducing flood loss and lowering the costs of fighting floods

K. Provide technical and financial assistance for activities which prevent or reduce potential higher groundwater levels

This could be activities geared towards reducing potential seepage problems caused by project or non-project activities. This could allow farmland to remain privately owned by the farmer, keep the farmland as part of the tax base, add value to the farmland and reduce agricultural management costs.

L. Provide technical and financial assistance for sediment removal to improve agricultural diversions

In some areas sedimentation may have created problems for pumping water from the Delta. Assistance could be provided to help expedite the regulatory process and for sediment removal. This could allow farmland to remain privately owned by the farmer, keeping farmland as part of the tax base, adding value to the farmland and expediting potential regulatory measures that could reduce agricultural management costs.

M. Establish buffer zones as part of habitat restoration projects ensuring that vegetation will have minimal potential to harbor pests and diseases

This would provide assurances to owners or operators of neighboring properties that they will not be harmed by proposed projects. This could keep farmland as part of the tax base, add value to the farmland and expediting potential regulatory measures that could reduce agricultural management costs.

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N. Off-site mitigation

To the extent that off-site mitigation, in addition to off-site mitigation for terrestrial species, is determined to be appropriate, efforts should first consider helping to maintain a large "sustainable" area of high quality farmland in the Delta. Even though parts of the Delta are not in the path of urban development, there may be reasons to preserve and enhance specific agricultural areas in those parts of the Delta. Those reasons include providing a firm basis for agricultural industries and businesses, and providing a bridge to preserving neighboring farmland outside of the Delta Primary (or even Secondary) zone. At least in the context of the BDCP, the conversion of farmland can be thought of in terms of its regional significance and it may be appropriate to go beyond the project's immediately surrounding area, including considering easements outside of the Delta that might provide benefits to the Delta.

O. Consider effects on agricultural infrastructure and/or concentric economic impacts

These would most likely be considered indirect economic impacts and are likely to be harder to quantify. One possibility would be to consider whether it makes sense to suggest limiting the percentage of change in farmland use in a specific area.

P. Consider opportunities to coordinate with others in helping to maintain a sustainable agricultural social and economic community in the Delta Region consistent with ecosystem conservation and restoration activities

There are state, local and non-profit efforts directed at conserving and restoring wetlands and/or farmland. There may be ways to coordinate and enhance such efforts,[13] such as through sharing information; developing common definitions; and identifying common objectives and goals.[14] Increased funding for law enforcement might be another activity that could benefit landowner, local government and resource agency interests.

Although not the focus of this paper, it may be helpful to develop a land stewardship program for the Delta region which looks at all land uses and would provide a framework for individual projects. A programmatic approach could be developed that recognizes the value of natural habitats with agricultural components or agricultural habitats with natural components rather than treat each land use independently. Some of the strategies identified might work better if there is a coordinated approach to the development of an overall restoration/land use strategy for the Delta. Thought could also be given to working

[13] An initial list would include the five Delta counties, Central Valley Flood Protection Program, the Delta Levees Program, the Regional Advance Mitigation Program, the DFG Environmental Restoration Program, the State Wildlife Action Plan, the California Water Plan, Department of Conservation and Food and Agriculture, Delta Protection Council, Delta Conservancy, existing and planned habitat conservation plans and natural community conservation plans, Natural Resources Conservation Service programs and other non-governmental conservation and restoration plans of agencies such as the Nature Conservancy, , Ducks Unlimited, Point Reyes Land Trust.

[14] One approach to consider is the Ramsar Convention for Wetlands that includes the concept of "wise use" of wetlands described as the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development. See http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1_4000_0_

with Delta counties to coordinate restoration and preservation activities in the context of creating and funding a Delta Economic Development Corporation that would help create jobs and income growth for the Delta[15].

Q. Consider timing of components and timing of mitigation measures

Include adaptive management principles with regard to farmer involvement to accommodate new agricultural stewardship practices that meet project performance standards, and comply with the regulatory authorizations..

R. Consider ways to provide incentives for farmers to participate in proposed projects and make the regulatory system work better for individual farmers participating in conservation and restoration actions.

Look at whether there is information that could help regulatory agencies do their job better and sooner.

Provide safe harbor agreements for farmers carrying out habitat conservation and restoration.

Look at ways to provide multiple benefits from mitigation actions.

Coordinate and align regulatory reviews and reduce duplication, where appropriate.

Consider possibility of Delta-wide (or sub-region) permits.

Other options.

V. Potential Sources of Funding

A. Use funds that would otherwise be used to purchase "conventional" easements.

B. Seek funding from Cap and Trade Funds to provide research and incentives for developing technologies and practices relating to carbon sequestration.

C. Work with CARB to provide funding for a carbon-offset program for property that supports wetlands.

D. Private and public funds for developing wetlands.

E. Seek additional bond funding.

[15] This kind of corporation works towards improving the regional economy by attracting new employers, promoting local markets, and promoting the formation of new businesses. (http://www.uwex.edu/ces/cced/economies/developmentorganizations/economic_dev_corp_steps.cfm

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F. Other

VI. References

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Proposed Good Neighbor Actions for Prospect Island Restoration Project
Local Agencies of the North Delta
2019

Goal: Increase value and resilience of restoration projects by appropriately limiting and planning effective responses to foreseeable negative impacts on neighboring private property and infrastructure. Avoid economic and social costs of continued controversy and inefficient means to address foreseeable conflicts. These or similar actions should be applied, as appropriate, to all DWR restoration projects.

LEVEE PROTECTION

Monitoring

- Establish a final, pre-project bank LiDAR and bathymetry data layer, in a data format usable by the consultant. Complete a LiDAR and bathymetry scan (at the same starting and ending points covering the common border of the islands in the same or better resolution or detail) in June every 5 years post-opening of the levee breach and submit to consultant by August of that year; unless a flow event of greater than a 10-year flow event on USGS 11455165 Miner Slough (HWY 84 BRIDGE, HWB, 11455165), or if that station is providing provisional data or not functioning at Sacramento River at USGS 11447650 Freeport (FPT, 11447650). The greater than 10-year event triggers a new 5-year monitoring cycle.
- Define adverse effects: any visible new scour features greater than 2 meters in area, levee undermining, or bank erosion or slumping, or rock facing loss of greater than 0.03 meters in any direction on the Ryer levee.

Strengthening

- Increase resiliency of neighboring levees by taking actions such as:
  - Installing rock or rip rap on Ryer Island levee across from project breaches;
  - Constructing dirt/rock groins on the inside of and perpendicular to Prospect Island levee; and/or
  - Utilizing other buffer methods such as adjusting slope of Ryer Island levee.
- Avoid siting levee breaches at right angles to the predominant wind direction.
- USACE permitting for the project should be amended to include these strengthening measures.

Responsive Mitigation

- Provide cost share proportionate to impacts for maintenance of Ryer Island levee for life of project.
- Better control breaches for resilience across varying hydrologic and other conditions by taking actions such as:
  - Armoring levees across from breaches;
  - Installing concrete apron or rock to harden the bottom of breach openings; and/or
  - Installing operable gates at breaches (or setting a contingency plan for installation).
- Annual inspections of levee condition adjacent to project by a qualified registered civil engineer with experience in Delta levees. Plantings should be allowed to grow at least for 3-5 years before being exposed to deep water wave run-up.

RDEIR: No mitigation included.

DISCUSSION DRAFT

Proposed Good Neighbor Actions for Prospect Island Restoration Project

Local Agencies of the North Delta

2019

SEEPAGE PROTECTION

- Establish seepage monitoring criteria and action level triggers prior to construction.
  - Confirm extent of existing seepage areas. (See RDEIR, Fig. 3.1-7.)
  - The data from the well network will be provided continuously through a public web platform.
  - Wells and their piezometers must be maintained in functional condition for the life of the project.
  - Define Adverse Effect: increase in hydraulic head elevation on a Ryer Island well that correlates to the most proximate Prospect well.
- Prevent increases in seepage by taking actions such as:
  - Install cutoff walls on Prospect or Ryer Island, as appropriate.
- Provide mitigation in the event of seepage impacts, such as decreased agricultural productivity and additional pumping and repair costs. (E.g., NDWA Contract provision for damages; see also 2013 Delta Wetlands Settlement Agreement.)
- Address any increases in seepage that occur during and after project construction by taking actions such as:
  - Installation of interception or relief wells;
  - Development of interception plans; and/or
  - Other drainage improvements.

RDEIR: No mitigation included.

INVASIVE SPECIES PROTECTION

- Establish invasive clam and mussel monitoring and response plan.
- Further develop invasive species control plans to include specific density standards.

RDEIR, pp. 5-34 to 5-38.

AGRICULTURE PROTECTION

- Establish appropriate protections for ongoing agricultural operations in the event occurrence of special-status species is increased in the vicinity of the project. Such measures may include take protection programs for ongoing agricultural operations.

RDEIR: No mitigation included

ROAD MAINTENANCE

- Establish a performance standard for the need for road maintenance on all road used by project.

RDEIR, p. 5-176, Mitigation Measure 3.17-1.2 (refers only to 4 roads – Courtland Road, Teal Road County Road 107 and the DWSC levee road). What about SR 84/Jefferson Boulevard?

RESTORATION OMBUSDSMAN

- Establish Ombudsman office for stakeholders and affected landowners and districts to contact and work through offsite impacts and other concerns.
- Provide alternative to inefficient Government Claims Act process.

DISCUSSION DRAFT

Delta Conservation Framework

PARTNERSHIPS AND PLANNING TOOLS FOR 2050



Vision for a Delta in Common

California Department of Fish & Wildlife

California Department of Fish & Wildlife

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This report was produced by the California Department of Fish & Wildlife, December 2018.

Cite as
Sloop, Christina, Brooke Jacobs, Randi Logsdon, and Carl Wilcox. 2018. *Delta Conservation Framework – A Delta in Common*, California Department of Fish and Wildlife, Sacramento, CA

http://wildlife.ca.gov/DeltaConservationFramework

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Publication date: Version 12/31/18

Table of Contents

Executive Summary 5

Section I: A Common Framework for Building a Resilient Delta 13

Framework Goals 15

Planning History 18

Vision for Delta 2050 21

Framework at a Glance 24

The Everglades: A National Model 25

Guide to Related Plans and Programs 30

Section II: Integrating Delta Community with Conservation 39

The Delta as an Evolving Place 43

A Regional Approach to Conservation 45

Goal A: Regular Stakeholder Communication 46

Goal B: Delta Promotion at Local, State, National Levels 49

Goal C: Floating All Boats 51

Central Delta Public Parcels Conservation Opportunity Region 63

Guide to Supporting Partnerships & Programs 70

Section III: Value of Conserving the Delta Ecosystem 77

Historic Change in Ecosystems & Uses. 80

Resilient Delta Landscapes 82

Goal D: Conserving Ecosystem Function 84

Yolo-Cache Conservation Opportunity Region 91

Guide to Delta Ecosystems & Habitats 102

Section IV: Delta Conservation Based on Science 107

One Delta, One Science 109

Adaptive Management 110

Goal E: Assessing Progress 111

Priority Science Actions 113

Conservation Status 116

Climate Change Effects 118

West Delta Conservation Opportunity Region 121

Guide to Related Plans & Programs 128

Section V: Facilitating Permitting & Funding for Delta Conservation 133

Common Permits, Agreements & Disclosures 134

Goal F: Improving Agency Capacity 136

Goal G: Securing Long Term Funding 144

Suisun Marsh Conservation Opportunity Region 149

Guide to Related Tools, Permits, Requirements & Programs 157

Section VI: Conservation Pathways to 2050 165

Regional Approach 168

Individual Project Approach 171

Lasting Sustainability 172

The Way Forward 173

North-South Delta Conservation Opportunity Region 175

Guide to Planning Tools 184

Index of Key Terms 166

Online Appendices

Appendix 1: Endnotes & References

Appendix 2: Conservation Opportunity Regions (Extended Versions)

Appendix 3: Bay-Delta Conservation Plan

Appendix 4: *Delta Conservation Framework* 2016 Workshop Series

Appendix 5: Species Recovery Briefs, 4 Terrestrial Species

Appendix 6: Regulatory Compliance and Permitting for Conservation Implementation

Appendix 7: Grants

Delta Conservation Framework and Appendices

www.wildlife.ca.gov/conservation/watersheds/dcf

YOUR GUIDE TO THE DELTA CONSERVATION FRAMEWORK

HOW IT'S ORGANIZED

Executive Summary

EACH SECTION HAS THREE USEFUL PARTS

1. **Framework Explained**
   Goals, strategies, rationale, context
2. **On-the-ground, Site Specific Examples**
   Existing regional partnerships and plannning efforts in conservation opportunity regions throughout the Delta.
3. **All-in-One Reference Guides**
   Quick reference summaries of related plans, programs, tools, and checklists that can help landowners, partners, and stakeholders begin to understand and navigate the complexities of conservation work in the Delta.

SECTION I
Vision
Background, Purpose

SECTION II
Community Integration
GOALS A • B • C

SECTION III
Ecosystem Function
GOAL D

SECTION IV
Conservation Based in Science
GOAL E

SECTION V
Permitting, Funding
GOALS F • G

SECTION VI
Path Forward, Partnerships, Processes & Tools
Regional Conservation Strategies

MORE DETAILS
Bay-Delta Conservation Plan
Conservation Opportunity Regions
Species Recovery Briefs
Grants
Endnotes
and much more

Appendices



Illustration: Akoon Rozavi

Delta Conservation Framework

Partnerships and Planning Tools for 2050

Developing a framework for planning and implementing conservation in a dynamic place with close ties to native biodiversity, California history, agriculture, and statewide economies is a challenging task. Add to that consideration of the myriad existing plans and conservation initiatives that apply to California's Delta, and the task boggles the mind. Then consider the perils and uncertainties presented by climate change and the task becomes a very tall order.

This document, called the *Delta Conservation Framework*, is the product of three years of work (2016-2018) led by the California Department of Fish and Wildlife and developed in partnership with Delta stakeholders. These stakeholders included federal, state, and local government representatives, conservation practitioners, non-profit organizations, landowners, residents, and business owners.

Three primary sets of resources guided development of the Framework:

1. Feedback from a series of public workshops held in 2016
2. Prior plans focused on the people and ecosystems of the Delta
3. Best available science on ecosystem processes in the Delta

From this foundation emerged seven conservation goals, 26 strategies to reach those goals, 200 pages of details, seven appendices, and a 30-year vision for a healthier Delta for both humans and wildlife: the *Delta Conservation Framework*.

VISION 2050

In 2050, the Delta is composed of resilient natural and managed ecosystems situated within a mosaic of towns and agricultural landscapes, where people prosper and healthy wildlife communities thrive.

Hopes for the Delta Expressed by Various Stakeholders in 2016 Workshops

- **MULTI-BENEFIT OUTCOMES:** In 2050, the Delta is a network of multiple-use landscapes where agricultural productivity, economic vitality, and ecosystem conservation are achieved in a manner that mutually supports the needs of people and wildlife.
- **CONSIDERATION OF LANDSCAPE DYNAMICS:** In 2050, the Delta is recognized as part of a greater system that functions within the context of California's largest watersheds.
- **HEALTHY, RESILIENT ECOSYSTEMS:** In 2050, the Delta has healthy, resilient ecosystems with the capacity to adapt through time to impacts associated with climate change, sea level rise, and other environmental uncertainties.
- **COLLABORATION:** In 2050, state, federal, and local government agencies collaborate with each other and Delta stakeholders to achieve multi-benefit outcomes where possible.
- **DECISIONS BASED ON SCIENCE:** In 2050, policy decisions and desired conservation outcomes are informed and evaluated through coordinated Delta science endeavors.
- **LOCAL SUPPORT:** In 2050, Delta residents promote the management of healthy ecosystems as the basis of a healthy and economically thriving Delta region.
- **LOCAL BENEFITS:** In 2050, Delta residents and visitors actively enjoy the region's unique cultural and natural resource values through wildlife-friendly agricultural practices, tourism, outdoor recreation, and environmental education activities for all ages.
- **RELIABLE LOCAL WATER:** In 2050, effective integrated water management in the Delta promotes good water quality and a reliable water supply for users in the Delta.
- **MULTI-BENEFIT FLOOD MANAGEMENT:** In 2050, the Delta's flood management system provides both improved flood protection and increased habitat value for fish and wildlife, where possible.

History of the Push to Reframe Delta Conservation

The California Water Code recognizes the Delta as "the most valuable ecosystem on the west coast of North America and South America." However, over the last century, the wildlife habitats and ecosystem services that the Delta provides have been impacted by environmental degradation, land use conversions, and economic shifts. Efforts to protect, enhance and restore the Delta's natural riches and ecosystem services are ongoing. Indeed large-scale conservation of Delta aquatic and terrestrial habitats is called for in a wide variety of California state laws, mandates, plans, mitigation requirements, and initiatives, many of which are the result of decades-long debates, and reports based on scientific research.

The origins of the *Delta Conservation Framework* derive from changes in Delta conservation and water policies between 2006 and 2016. In 2006, Delta planning agencies began crafting the *Bay Delta Conservation Plan* (BDCP), intending to provide a comprehensive tool for planning and permitting conservation projects and new water conveyance infrastructure. The resulting 2013 BDCP public draft contained measures to protect 54 sensitive native species and specific actions to protect and restore habitat in the Delta. The BDCP also contained plans to add three new water intakes along the Sacramento River to divert water for the state and federal water projects. In spring 2015, the Brown administration announced a shift from the BDCP to two parallel but separate programs: California WaterFix, to pursue water supply infrastructure; and California EcoRestore, to implement focused restoration in the Delta.

Since then, the California Department of Fish and Wildlife (CDFW) has continued to work to maintain and increase the momentum of conservation planning and implementation that began with the BDCP. To this end, CDFW started a new initiative in 2016 called the *Delta Conservation Framework.* The department began by holding a series of meetings with its state partners to present the new initiative, gather feedback, and hear perspectives. The group collectively acknowledged two key points: 1) the need for a new approach to conservation planning after the BDCP and 2) the need to bring Delta stakeholders into the planning process early. Two years later, the result is the 200-page *Delta Conservation Framework* described in this executive summary.

Outside the variety of scientific resources, planning tools, and regional partnerships brought together under the umbrella of this new 30-year Framework, the strongest current state guidelines for overarching conservation and management of Delta aquatic and terrestrial ecosystems are the 2009 Delta Reform Act and subsequent 2013 *Delta Plan*, the 2014 *California Water Action Plan* as well as the 2006-2013 work to draft the *Bay Delta Conservation Plan* described above. Additionally, in 2016, the San Francisco Estuary Institute completed the last of three important reports establishing a strong foundation of science on the Delta's historical ecology, transformation by humans, and future restoration prospects: *A Delta Renewed*. The latter is an important science basis for the *Delta Conservation Framework*.

What is not in the *Delta Conservation Framework*, however, are any conservation actions associated with changing flows into or through the Delta. Nor are there any acreage targets or maps showing where conservation should occur. Instead, the Framework offers a guide for how best to plan and implement conservation.

In the coming decades, this planning context for Delta conservation will be challenged by substantial additional changes to the region due to climate change. While California has long experienced droughts, floods, wildfires, and other climate-driven events, recent extremes and accelerated climate change clearly derive from human activities such as the burning of fossil fuels. As a result, Delta managers and residents must prepare for sea level rise, extreme droughts, and storms with associated flooding. These events will influence the evolution of the Delta landscape, ecosystems, and economy far into the future.

What is the Delta?

The Delta, once a vast freshwater marsh, drains the watersheds of California's Sacramento and the San Joaquin Rivers. Combined with Suisun Marsh, this inland reach of the San Francisco Estuary spans six counties and 1,300 square miles of land and water. Nearly half of California's surface water unites in the Delta, flowing through hundreds of miles of interconnected waterways west to San Francisco Bay. Ecologically rich and diverse prior to European settlement, the Delta is now largely a center for agricultural operations interspersed with small towns and communities, and bordered by larger cities including Stockton and West Sacramento. A vast levee system protects over 400,000 acres of high-quality farmland, communities, and municipalities that are situated within the historic Delta floodplain.

The Delta plays a crucial role supporting California's economic vitality as a central component of the state's water supply infrastructure and contributor to the state's substantial agricultural productivity. Statewide, more than 3 million acres of prime irrigated farmland and two-thirds of the state's population depend on the Delta watershed for some portion of their water supply. The Delta is also home to a growing population of more than 550,000 people. Delta communities are primarily concentrated in the large and expanding cities around its fringes.



Framework Goals & Strategies

The *Delta Conservation Framework*'s goals and strategies, used collaboratively, offer pathways to realizing the vision of the Delta as a place where people prosper and wildlife communities thrive by 2050.

Goals A, B and C underscore a growing recognition of the role people and communities must play as partners in conservation. Public agencies, restoration practitioners, and scientists can all benefit from working in collaborative partnerships with Delta residents, landowners, farmers, tribes and nongovernmental organizations, at the local and regional levels, to plan conservation projects. The intention of these partnerships is to overcome the current climate of guardedness and move toward sustained communication and collaboration. Mutual respect for, and a commitment to, evaluating challenges and opportunities together is essential to the success of conservation.

Goal D highlights the importance of conserving Delta ecosystems and ecological processes and functions, and is founded on a landscape-scale approach that directly aligns with recommendations in *A Delta Renewed*. Delta ecosystems have degraded substantially over time, and continue to do so, because of a host of factors including land use changes, poor water quality, reduced sediment supply, and invasive species. Populations of native fish and wildlife species have seriously declined in the past decade. The Delta's capacity to supply ecosystem services, drinking and irrigation water, and agricultural livelihoods to its residents and the state, while also sustaining its native fish and wildlife, continues to decrease. The novel, much altered, current Delta ecosystem is weak and climate change will exacerbate its weaknesses. Any conservation effort must embrace the importance of scale and ecosystem function to be resilient.

Framework Goals

People: Communicating, engaging, educating

- GOAL A: Ensure that regular communication among stakeholders and socioeconomic considerations are integrated into all Delta conservation initiatives.
- GOAL B: Support and expand existing public outreach efforts advancing Delta conservation.
- GOAL C: Develop multi-benefit conservation and land management strategies and plans that balance environmental and human needs.

Ecosystem: Making science-based decisions

- GOAL D: Conserve Delta ecosystems and their ecological processes and functions to benefit society and wildlife, and to enhance resilience to climate change.
- GOAL E: Evaluate conservation progress and address climate change stressors and other drivers of change by implementing the science strategies and priorities of the Delta Science Program and Interagency Ecological Program, the adaptive management program for Biological Opinions related to state and federal water project operations, and adaptive management recommendations emerging from interagency integration teams.

Permits & Funds: Thinking ahead collectively

- GOAL F: Improve resource agency and regulatory capacity for permitting Delta conservation projects.
- GOAL G: Optimize use of existing short-term funding and support current and new mechanisms to secure long-term funding for continued conservation implementation and management.



Delta landscapes are a mixture of water, farms, wildlife habitats, and small towns. Photo: Amber Manfree

Goal E highlights pre-existing and ongoing scientific research and adaptive management efforts necessary to successfully implement conservation in the Delta. Understanding the complexities, and reverberating impacts on the use of the Delta by both people and native species, requires collaborative multi-interest science, long-term monitoring, and adaptive management based on this research and monitoring. Without science-based conservation practices that support rapid responses to crises and provide long-lasting solutions, Delta conservation may not be successful in the long term.

Goals F and G recognize that there are major challenges to the timely and cost-effective implementation of conservation projects in the Delta related to permitting and funding. Even the most seasoned engineers, resource managers, biologists, and advocates for conservation projects struggle with the complexity and cost of moving projects through planning, permitting, compliance, and construction. The Framework offers strategies and tools for how facilitate permitting and funding for conservation.

Each section of the *Delta Conservation Framework* includes three parts: a description of goals and strategies; on-the-ground examples of regional-scale conservation planning efforts already underway; and reference guides introducing readers to the many existing plans and programs in the Delta, as well as useful tools, checklists, and models. The Framework also provides the basics on Delta science enterprise and adaptive management efforts. One section summarizes the most current landscape-scale science on how to implement conservation to support ecosystem function. Other sections provide an invaluable counterpart, describing how farm fields, pastures, and working lands can contribute to ecosystem health and conservation. By pulling it all together in one place, and by identifying all the latest policy, regulatory, science, and management resources available, the document is much more than another plan on the shelf.

An Emphasis on Regional Approaches

A strong thread throughout the *Delta Conservation Framework* is to focus on "regions" that make sense in terms of landscapes, watersheds, ecosystems, human history, or communities as an organizing principle for conservation work in the future.

The Framework references a number of different kinds of "regional" approaches:

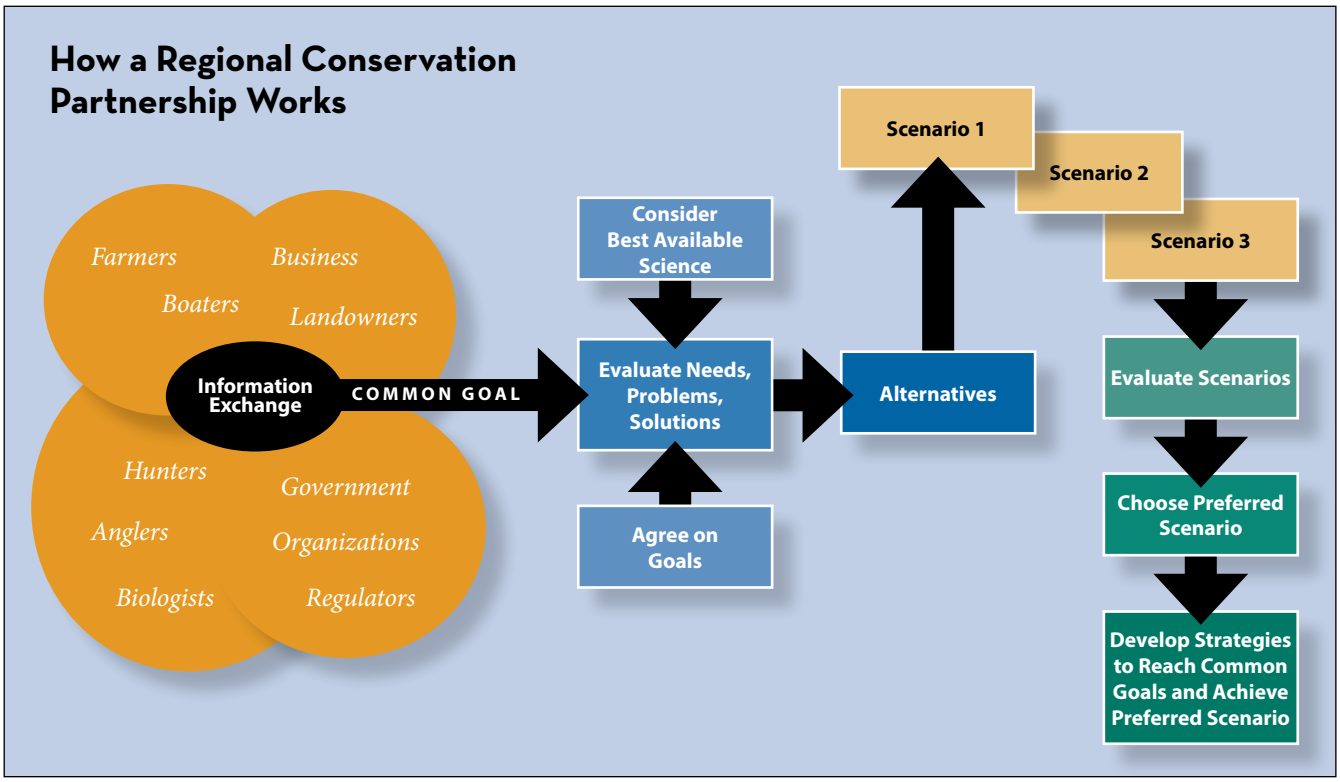
- **Regional Conservation Partnerships** made up of diverse interests, public and private, that work together to achieve landscape level goals;
- **Regional Conservation Strategies** developed by regional partnerships that map out how conservation goals might be achieved in the regions with an eye toward fitting the regional pieces together across a larger landscape picture;
- **Conservation Opportunity Regions** roughly identified by Delta stakeholders where promising opportunities for major conservation and restoration successes exist;
- **Regional Conservation Investment Strategy** (RCIS), a California Department of Fish and Wildlife program offering a structure for analysis, assessment, scenario-planning, investment and mitigation to regions interested in developing nonbinding, voluntary conservation and habitat enhancement actions around focal species and habitats (see also Section V).*

Of the above, the "regional conservation strategy" is a central organizing idea for implementation of the *Delta Conservation Framework*. A regional strategy might be an existing plan, such as the *Suisun Marsh Habitat Restoration and Management Plan*, or may be the result of a new effort.

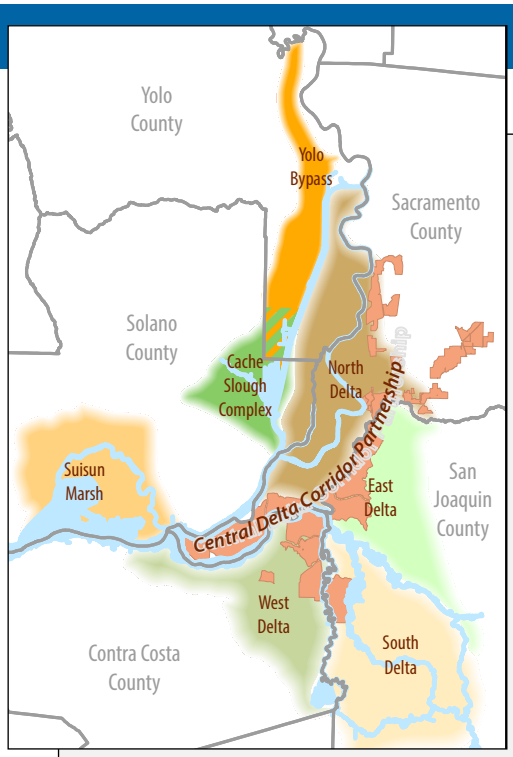
The main idea is to develop non-regulatory, long-term, broadly-supported regional conservation action plans. These would be developed collaboratively by regional planning partnerships comprised of public agencies, Delta community stakeholders, representatives of existing regional partnerships and tribes, other interest groups, scientists, restoration practitioners, non-governmental organizations, and interested citizens.

The resulting strategies or plans would focus on public lands or collaborations with willing private landowners in a given "conservation opportunity" region. The Framework identifies seven conservation opportunity regions of the Delta that include public lands, existing conservation lands, or existing planning partnerships (see map next page). This sub-regional division of the Delta, derived from stakeholder discussions during the 2016 *Delta Conservation Framework* public workshops, reflects variation in local land use, communities, ecosystem types, and public lands.

Each resulting regional conservation strategy would tailor a set of conservation objectives, specific actions, and an adaptive management framework to the needs of each sub- region. To achieve multiple, landscape scale benefits, however, these strategies would also be aligned with the overarching goals and strategies of the *Delta Conservation Framework.**



** While the core ideas of regional partnerships, strategies, and conservation opportunity regions presented here are the foundation of the Framework, they appear largely without capitalization throughout these pages to underscore an intent of inclusivity and collaboration.*



Delta Conservation Projects and Opportunity Regions

Yolo County
Sacramento County
Solano County
Contra Costa County
San Joaquin County
Alameda County
West Sacramento
Yolo Bypass
Yolo Bypass and Cache Slough Complex
Sacramento Deep Water Ship Channel
Freeport
Clarksburg
Elk Grove
Hood
Stone Lakes NWR
Courtland
Cache Slough
Cache Slough Complex
North Delta
Cosumnes River Preserve
Walnut Grove
Thornton
McCormack Williamson Tract
Ryde
Sacramento R.
Rio Vista
Isleton
Fairfield
Suisun Marsh
Decker Island Wildlife Area
Staten Island
Twitchell Island
Bouldin Island
East Delta
Lodi
Webb Tract
Sherman Island
Sherman Lake
Franks Tract
Winter Island
Pittsburg
Benicia
Dutch Slough
Holland Tract
Oakley
Bacon Island
Martinez
Antioch
San Joaquin R.
Stockton
Brentwood
West Delta
Discovery Bay
Byron
South Delta
Lathrop
Mountain House
Tracy

Conservation Projects
Farmland in Delta Region
Central Delta Corridor Parcels
COR Areas

0 5 10 Miles

N

Source: CDFW, 2018

Building on Existing Plans and Partnerships

Any evaluation of conservation opportunities in the Delta requires consideration of the many existing planning documents, programs, and related regulatory requirements. The *Delta Conservation Framework* does not supersede these individual planning efforts, but instead connects and integrates them into the larger landscape-scale perspective. It also suggests them as important references for consideration as part of ongoing or future regional conservation strategies and individual projects. To make this integration more transparent, the Framework provides summarized guides to related plans and programs.



The tricolored blackbird, a threatened species with diminishing habitat in the Delta. Photo: Matt Elyash, CDFW

Current Major Initiatives Aligned with the Delta Conservation Framework

Agricultural Lands Stewardship Framework and Toolkit: A working group launched by the Department of Water Resources in 2014 to develop a list of strategies to provide project proponents and those affected by proposed conservation projects with an integrated and collaborative approach to address protecting and changing uses of agricultural land.

California Department of Fish and Wildlife Grant Solicitation Guidelines: Draft 2018 Proposition 1 solicitation guidelines make it a priority to fund the development of regional planning partnerships and to facilitate the collaborative development of regional conservation strategies or plans in the Delta.

Central Delta Corridor Partnership: A partnership launched in 2017 to coordinate planning and restoration on a network of roughly 50,000 acres of publicly-owned or funded lands in the central Delta.

Delta Plan Interagency Implementation Committee: A committee established in 2013 to facilitate *Delta Plan* implementation through increased coordination and integration among local, state and federal agency participants. The committee has encouraged the development of programmatic permitting tools for conservation projects.

Delta Science Program Social Science Task Force: The Delta Science Program is coordinating a Social Science Task Force tasked with developing a strategic plan to strengthen and integrate social sciences into the science, management, and policy landscape of the Delta. Composed of individuals with a diverse set of expertise in the social sciences, the task force's key goal will be to develop a set of recommendations that can be acted upon by the Delta science community.

Franks Tract Feasibility Study: A study led by the California Department of Fish and Wildlife aimed at restoring portions of Frank's Tract to tidal marsh. This effort solicited feedback from local residents, boaters, and anglers and includes a locally proposed design.

Yolo Bypass Cache Slough Partnership: A partnership of representatives from local, state, federal agencies who signed a memorandum of understanding to oversee collaborative implementation of conservation in this region, all before initiation of the Framework in 2016.

Additional Important Regional Plans & Partnerships

Central Valley Joint Venture Implementation Plan, outlines objectives for Central Valley habitats that support shorebirds, waterbirds, and riparian songbirds.

Delta Working Landscapes Program, coordinated through the Delta Protection Commission, provides examples of what wildlife friendly agriculture and wetland restoration measures private landowners could adopt on larger scales throughout the Delta.

Habitat Conservation Plans & Natural Community Conservation Plans: The *Delta Conservation Framework* defers to the species and acreage targets outlined in HCPs and NCCPs, or relevant Conservation Strategies, where they overlap with the Delta planning region. These include: the East Alameda Conservation Strategy; the East Contra Costa County HCP/NCCP; the South Sacramento HCP/NCCP; the Solano Multispecies HCP; the San Joaquin County Multi-Species HCP and Open Space Plan; and the Yolo HCP/NCCP.

Migratory Bird Conservation Partnership – comprised of Audubon California, Point Blue Conservation Science, and the Nature Conservancy – works with a broad array of partners to develop multi-benefit conservation solutions for birds, wildlife, and human communities to address issues concerning bird habitat and biological needs.

Nature Conservancy BirdReturns, a pilot project combining crowd-sourced data, hard science and economic incentives, provides pop-up habitats for birds on rice fields in the Sacramento Valley.

North Delta Habitat Arc, a reconciled ecosystem strategy, creates an arc of habitats connected by the Sacramento River to benefit native fish and other wildlife.

***Suisun Marsh Habitat Management, Preservation and Restoration Plan*,** established in 2013, provides a structure for conservation planning and implementation in the Suisun Marsh region.

Permitting, Funding & Planning Tools – The Implementation Questions

Whether it's restoring a few acres of wetland or planting riparian vegetation on levees or removing invasive weeds, most conservation projects on Delta landscapes, let alone infrastructure upgrades, require permissions and permits from government regulators.

Myriad regulations reflect federal, state, regional and local goals for environmental quality, wildlife protection, public safety, land use, and other areas of public interest and common good. Faced with the many layers of regulatory oversight governing Delta projects – not to mention sometimes conflicting definitions and directives –even the most seasoned practitioners struggle with the complexity and cost of moving projects through planning, permitting, compliance, and construction. By the time projects are approved and shovel-ready, the dollars and equipment required to do the job may have already evaporated.



The *Delta Conservation Framework*, as an overarching framework for coordinating large-scale conservation, recognizes that these are major challenges to the timely and cost-effective implementation of conservation projects in the Delta. The Framework offers strategies and solutions for how to facilitate permitting and funding for conservation, as well as how to develop conservation plans on project, local and regional scales with the Framework in mind.

Permitting Strategies

The Framework recommends supporting and increasing the capacity of regulatory agencies to review and approve conservation projects. It also supports the development of easily accessible online resources to explain permitting guidelines and requirements clearly, as well as the development of more regional and programmatic permitting frameworks for the Delta. The Framework also includes various examples of how to tackle permitting challenges.

Funding Strategies

The Framework explores both short-term and long-term funding challenges. It underscores the need to shift from the parcel-by-parcel, project-by-project thinking that pervades short term funding models to landscape scale, regionwide, longer-term models. It also advocates for the development of more long term funding opportunities for Delta conservation and adaptive management, ranging from direct budget allocations and environmental trust funds to emerging carbon markets.

Planning Scales – Regional or Individual

The Framework recognizes two approaches to future conservation. The first approach is to continue, or form, independently facilitated, multi-stakeholder regional partnerships in each suggested conservation opportunity region. These partnerships would then work together to develop recommendations and project lists relevant to their region. The second approach allows for individual project implementation in areas without an established regional partnership.

Planning Tools

The Framework describes a number of well-established planning tools to aid decision-making by regional partnerships and individual project proponents. These include: the Open Standards for the Practice of Conservation; scenario planning; and structured decision-making. These tools are specifically designed to bring unconscious prejudices to the surface, tackle complexity, move through uncertainty, weigh alternatives, consider trade offs and arrive at priority conservation actions and strategies.

The Path Forward – A More Resilient Delta in 2050

The path toward more ecologically functional Delta ecosystems within a thriving Delta community remains controversial. Despite mitigation requirements for infrastructure projects and the state and federal water projects, and a long history of public investment in Delta ecosystems through bond funds, few projects have been initiated and managed over the long term. Implementing conservation in the Delta will continue to stall unless Delta stakeholders are willing to work collaboratively, knowing they may have to be open to considering and accepting tradeoffs. If no solutions can be found, Delta ecosystem conservation will remain on hold, or occur in a piecemeal fashion. In the meantime, Delta ecosystems and their important services to humans and wildlife will continue to decline.

Multi-benefit projects that float all boats may seem like an impossible dream. But in reality, what local landowners, hunters, farmers, anglers, and boaters want may not be that far off from what species need to survive and what public infrastructure projects need to provide the greatest good for the lowest price. Every interest – both human and wild – faces the common uncertainty of drought, fire, earthquakes, and political change. There is an equally common reverence, however, for the Delta landscape and a desire to renew the riches of the past in the future.

The *Delta Conservation Framework* is an invitation to all interested stakeholders to come to the table. It is a call to continue the work of improving ecosystem health, supporting and recovering Delta wildlife, and growing the science capacity to learn from conservation actions. It is a warning of the urgency of facing the challenges of climate change, drought, and flooding head on.

Find your place, your region, your partners, review the goals and tools provided in the *Delta Conservation Framework*, and set out to make positive progress.

It's up to each and every one of us to build the conservation commons of the future within the unique landscape, and among the unique people, that comprise the Delta.



Photo: Bassmaster Elite, CDFW

What Does the Framework Mean to Me?

- **For farmers** – ideas and support for wildlife friendly agriculture, and a seat at the conservation planning table.
- **For landowners** – opportunities to participate in bottom-up conservation planning, and affirmation that conservation goals focus on public lands first.
- **For residents** –ideas for how your way of life may be preserved, and protected from floods and climate change.
- **For policymakers** – a concrete glimpse of how multi-benefit projects and regional conservation partnerships can optimize conservation spending.
- **For scientists** – briefs on the most current recommendations, science initiatives, and adaptive management programs designed to nurture species resilience and ecosystem processes.
- **For birders, hunters, and anglers** – avenues for protecting and improving the habitats, migration routes, and food supplies of the Delta's fish, birds, and wildlife.
- **For boaters** – improved access to Delta waterways due to conservation activities that often support invasive weed management.
- **For regulators** – a call to consider common delta guidelines and regional permits, and support for these efficiencies. Opportunities to shift away from time-consuming project-by-project approvals to more landscape scale conservation.
- **For conservation and resource managers** – Pathways for going beyond single species management, a way to work together at larger scales, and a guide to navigate permitting.
- **For you** – a way to fit in with all of the above and cherish your Delta.

The *Delta Conservation Framework* Online
wildlife.ca.gov/DeltaConservationFramework

The California Department of Fish and Wildlife acknowledges and appreciates the support of the Sacramento-San Joaquin Delta Conservancy beginning with the 2016 public workshops. The Delta Conservancy facilitated communication with Delta stakeholders through the use of its Delta interests contact list, funding for professional facilitation services, and engagement in each of the public workshops.

The Delta Conservation Framework.
California Department of Fish and Wildlife
Publication Date: Version 12/31/18

Authors: Christina Sloop, Brooke Jacobs, Randi Logsdon, Carl Wilcox
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SECTION 1

A Common Framework for Building a Resilient Delta

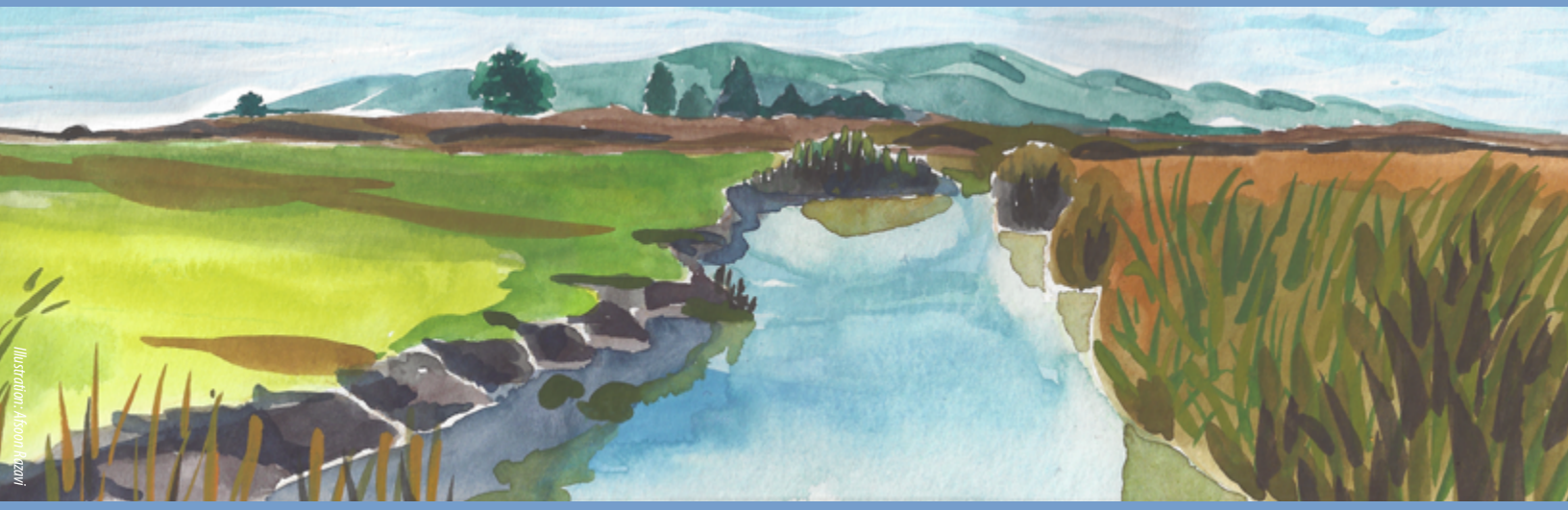


Illustration: Alyson Razavi

Framework Goals 15
Planning History 18
Vision for Delta 2050 21
Framework at a Glance 24
The Everglades: a National Model 25
Guide to Related Plans & Programs 30

KEY TERMS

- **COEQUAL GOALS** - As mandated by the Delta Reform Act of 2009, coequal goals means the "two goals of providing a more reliable water supply for California, and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place." (CA Water Code §85054) Additionally, Water Code Section §85021 states that it is the Policy of the State to "reduce reliance on the Delta in meeting California's future water supply needs."
- **CONSERVATION** is defined as the protection, enhancement, and restoration of ecological function of Delta ecosystems.
- **DELTA STAKEHOLDERS** are residents, landowners, farmers, and businesses situated in the Delta; the public, including citizens who rely on the Delta for water supply or for recreational uses; beneficiaries up- and downstream of the estuary; restoration practitioners; local, state and federal agencies; non-government organizations; Native American tribes; academic institutions; private entities; and policy-makers.
- **DELTA COMMUNITY** refers to the residents, landowners, farmers, and businesses situated in the Delta.
- **DELTA** refers to the Sacramento-San Joaquin Delta as defined in Water Code §85058, Suisun Marsh and Bay, and the northern Yolo Bypass. This "Delta" area includes the principal conservation opportunity regions described in Section VI and Appendix 2. Areas immediately adjacent to the "Delta" comprise the supplementary conservation opportunity regions to be considered in long-term planning.
- **ECOSYSTEM SERVICES** are "the direct and indirect contributions of ecosystems to human well-being. They support directly or indirectly our survival and quality of life." Ecosystem services can be categorized into four main types: provisioning, regulating, habitat and cultural services.
- **WILDLIFE** refers to all native plant and vertebrate and invertebrate animal species that inhabit the Delta as permanent residents or during part of their migratory life cycle.

The Delta Conservation Framework *footnote and endnote references can all be found in Appendix 1 online by section.*

Introduction

The 2018 *Delta Conservation Framework* provides a new, integrated, toolbox and guide to landscape-scale planning and implementation of conservation projects in the Sacramento-San Joaquin Delta, Suisun Marsh, and the Yolo Bypass (collectively, the "Delta").

The Framework was developed by the California Department of Fish and Wildlife as part of a three-year collaborative stakeholder process founded on openness, listening, and direct engagement by public agencies with landowners and stakeholders. The resulting vision for 2050 is of a Delta composed of resilient natural and managed ecosystems situated within a mosaic of towns and agricultural landscapes, where people prosper and healthy wildlife communities thrive. Beyond this vision, the Framework presents seven specific conservation goals, 26 strategies to reach those goals, 200 pages of details, and seven appendices.

The process that resulted in this *Delta Conservation Framework* involved stakeholders in a collaborative approach to conservation planning at a pivotal time for Delta science and policymaking. This pivotal time followed a period of changes in Delta conservation and water policies between 2006 and 2016 that are summarized as follows, in order to provide context for development of the Framework.

In 2006, Delta planners and agencies began crafting a *Bay Delta Conservation Plan* (BDCP), intending to provide a comprehensive tool for planning and permitting conservation projects and new water conveyance infrastructure. The resulting 2013 BDCP public draft[1,2,3] contained measures to protect 54 sensitive native species and specific actions to protect and restore habitat in the Delta. The BDCP also contained plans to add three new water intakes along the Sacramento River to divert water for the state and federal water projects. In spring 2015, the Brown administration announced a shift from the BDCP to California WaterFix[4] and EcoRestore.[5] These two new parallel but separate programs were initiated to pursue water supply infrastructure and implement more focused restoration in the Delta respectively.

To maintain the momentum of conservation planning and implementation that had begun in the BDCP over the long term, the California Department of Fish and Wildlife started a new initiative called the *Delta Conservation Framework* in 2016. The Department held a series of meetings with its state partners to present the new initiative, gather feedback, and hear perspectives. The group collectively acknowledged two key points: 1) the need for a new approach to conservation planning after the BDCP and 2) the need to bring Delta stakeholders into the planning process early.

In June 2016, the California Department of Fish and Wildlife held an initial public workshop to have the same conversation with a wider stakeholder audience. In this meeting participants expressed many

Framework Goals

People: Communicating, engaging, educating

- GOAL A: Ensure that regular communication among stakeholders and socioeconomic considerations are integrated into all Delta conservation initiatives.
- GOAL B: Support and expand existing public outreach efforts advancing Delta conservation.
- GOAL C: Develop multi-benefit conservation and land management strategies and plans that balance environmental and human needs.

Ecosystem: Making science-based decisions

- GOAL D: Conserve Delta ecosystems and their ecological processes and functions to benefit society and wildlife, and to enhance resilience to climate change.
- GOAL E: Evaluate conservation progress and address climate change stressors and other drivers of change by implementing the science strategies and priorities of the Delta Science Program and Interagency Ecological Program, the adaptive management program for Biological Opinions related to state and federal water project operations, and adaptive management recommendations emerging from interagency integration teams.

Permits & Funds: Thinking ahead collectively

- GOAL F: Improve resource agency and regulatory capacity for permitting Delta conservation projects.
- GOAL G: Optimize use of existing short-term funding and support current and new mechanisms to secure long-term funding for continued conservation implementation and management.

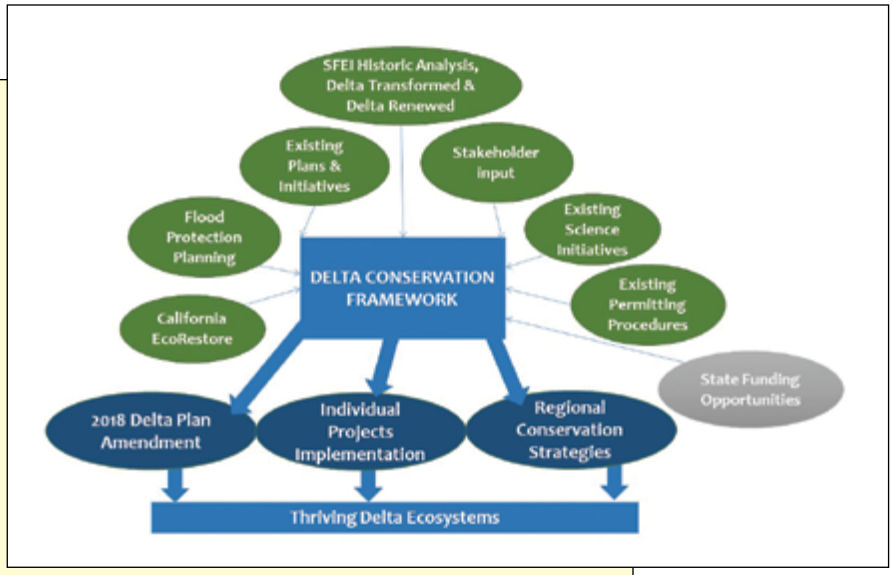


Figure 1.1: The Delta Conservation Framework offers a nexus and guide for diverse planning initiatives and perspectives in the Delta region.

concerns about the myriad past and present Delta conservation planning efforts. They also made some general, overarching suggestions for improvements:

- Bring together the confusing array of existing Delta planning efforts, instead of creating yet another plan to sit on the shelf.
- Focus conservation efforts on public lands first.
- Acknowledge agriculture as the primary land use and way of life in the Delta in any conversation about conservation planning.
- Include stakeholders in the conservation planning process early and often.
- Plan for conservation on a regional scale to better embrace the size and diversity of the Delta.

In response to this initial meeting, the California Department of Fish and Wildlife launched a series of six monthly public workshops. At these workshops, participants from diverse public and private interests reviewed and discussed draft portions of the document. The Department encouraged participants to offer new perspectives and suggest revisions, and then used this input to build the core components of the 2017 Public Draft *Delta Conservation Framework*. After releasing the 2017 Public Draft, the Department solicited more feedback through comment letters, individual stakeholder meetings, and two additional public workshops. The resulting public and final drafts offer an integrated vision and guide for regional conservation planning in the Delta.

Each section of the *Delta Conservation Framework* includes three parts: a description of goals and strategies; on-the-ground examples of regional-scale conservation planning efforts already underway; and reference guides introducing readers to the many existing plans and programs in the Delta, as well as to useful tools, checklists, and models. The Framework also provides the basics on Delta science enterprise[6,7,8,9,10,11] and adaptive management[12,13] efforts to help conservation practitioners learn about ongoing efforts and put them in a broader context.[14,15] As an example, a section on the San Francisco Estuary Institute's *A Delta Renewed* — which serves as the Framework's scientific foundation — summarizes the most current landscape-scale science on how to implement conservation to support ecosystem function. Other sections provide an invaluable counterpart, describing how farmfields, pastures, and working lands can contribute to ecosystem health and conservation. By pulling it all together in one place, and by identifying all the latest policy, regulatory, science, and management resources available, the document is much more than another plan on the shelf: it's a strategic, stakeholder-informed pathway to a healthy and prosperous Delta in 2050.

Although the *Delta Conservation Framework* was initiated as a conservation planning effort in response to the pivot away from the BDCP, what emerged at the end of the public participation and feedback process looks very different from the BDCP. For example, the Framework does not contain acreage targets. Nor does it provide detailed maps showing where conservation should occur. Instead, it is a guide for how best to plan and implement conservation.

In terms of the broader planning and policy context, the *Delta Conservation Framework* supports achieving the ecosystem goals of the Delta Reform Act and the Delta Stewardship Council's *Delta Plan*.[17] In June of 2015, the Delta Stewardship Council identified the need to amend the *Delta Plan* to address the shift from the BDCP to California Waterfix and EcoRestore. During the development of the *Delta Conservation Framework*, the Delta Stewardship Council initiated an amendment to Chapter 4 of the *Delta Plan*, Protect, Restore, and Enhance the Delta Ecosystem.

While the Council goes through the amendment process, and while many other plans and programs continue to evolve and adapt to changing circumstances, the Framework is intended to serve as a valuable reference and resource. If the Framework's conservation goals and strategies are pursued

by all Delta stakeholders, and if stakeholders embrace and champion the kind of multi-objective, regional scale projects that optimize benefits, the vision of a healthy Delta for all in 2050 could become reality.

Setting

The Delta, once a vast freshwater marsh, drains the watersheds of California's Sacramento and the San Joaquin Rivers. Combined with Suisun Marsh, this inland reach of the San Francisco Estuary spans six counties and 1,300 square miles of land and water.[17] Nearly half of California's surface water unites in the Delta, flowing through hundreds of miles of interconnected waterways west to San Francisco Bay. Ecologically rich and diverse prior to European settlement, the Delta is now largely a center for agricultural operations interspersed with small towns and communities.

The Delta plays a crucial role supporting California's economic vitality as a central component of the state's water supply infrastructure and contributor to the state's substantial agricultural productivity.[18] It is also home to a growing population of more than 550,000 people. Delta communities are primarily concentrated in the large cities around its fringes, but they are also expanding into the Delta's non-urban areas, such as Discovery Bay, the River Islands near Lathrop, and Hotchkiss tract in Oakley.[18,19] Statewide, more than three million acres of prime irrigated farmland and two-thirds of the state's population depend on the Delta watershed for some portion of their water supply.[20] Water flowing through the Delta provides a critical base for most of the state's economic output.[21] A vast levee system protects 400,600 acres of high-quality farmland, communities, and municipalities that occur within the historic Delta floodplain.

Although the California Water Code recognizes the Delta as "the most valuable ecosystem on the west coast of North and South America", the wildlife habitats and ecosystem services[21,22] that the Delta provides have been impacted by environmental degradation, land use conversions, and economic shifts. In the coming decades the Delta is expected to undergo substantial additional changes due to climate change. While California has long experienced droughts, floods, wildfires, and other climate-driven events, recent extremes and accelerated climate change derive from human activities such as the burning of fossil fuels.[23] As a result, the Delta must prepare for sea level rise, extreme droughts, and storms with associated flooding.[23] These events will influence the evolution of the Delta landscape far into the future.[3,14,17,18,20,23,24,25] Over the short and long term, these impending changes could impact land use and affect Delta ecosystems, agricultural operations, communities, and the Delta economy. [18,20,23,24]



Workers sort apples, part of the Delta's thriving agriculture related industries. Photo courtesy Delta Protection Commission

Planning History

Large-scale conservation of Delta aquatic and terrestrial habitats is called for in a wide variety of California state laws, mandates, plans, mitigation requirements, and initiatives, many of which are the result of decades-long debates, and efforts based on scientific research.[20,26,27,28,29,30,31,32,33,34]

Numerous government agencies, non-governmental organizations, academic institutions, private entities, policy-makers, landowners, and citizens are involved in these conservation, stewardship, and science activities.

> *"The Legislature finds and declares that the Sacramento-San Joaquin Delta, referred to as the Delta in this division, is a critically important natural resource for California and the nation. It serves Californians concurrently as both the hub of the California water system and the most valuable estuary and wetland ecosystem on the west coast of North and South America."(California Water Code, §85002).*

The strongest current state guidelines for overarching conservation and management of Delta aquatic and terrestrial ecosystems are the 2009 Delta Reform Act and subsequent 2013 *Delta Plan*, the 2014 *California Water Action Plan* (CWAP)[20] as well as the work that went into the 2006-2013 *Bay Delta Conservation Plan* (BDCP)[1] that in 2015 resulted in the separation of water supply management and resource conservation programs into California Water Fix[2] and California Eco-Restore.[3] The two recent state planning resources developed in parallel. Additionally, in 2016, the San Francisco Estuary Institute issued three important reports including *A Delta Renewed*, an important science basis for the Framework.[16,32,33]

The *Delta Conservation Framework* does not include conservation actions associated with changing flows into or through the Delta. Although the magnitude, timing, and pattern of flow through the Delta are vital factors driving ecosystem function, conservation actions to address flows are championed in parallel efforts to the Framework. These parallel efforts include the update to the *Bay Delta Water Quality Control Plan* by the State Water Resources Control Board, implementation of the current Biological Opinions[25] on the operations of the State Water Project and Central Valley Project, the re-initiation of consultation on these biological opinions, and incidental take authorizations for the operations of the state water project issued by the California Department of Fish and Wildlife. Collectively, they seek to understand the role of flow in the Delta in supporting ecosystem function and, if needed, place regulatory restrictions on water project operations to minimize the effects on listed species and their habitats.

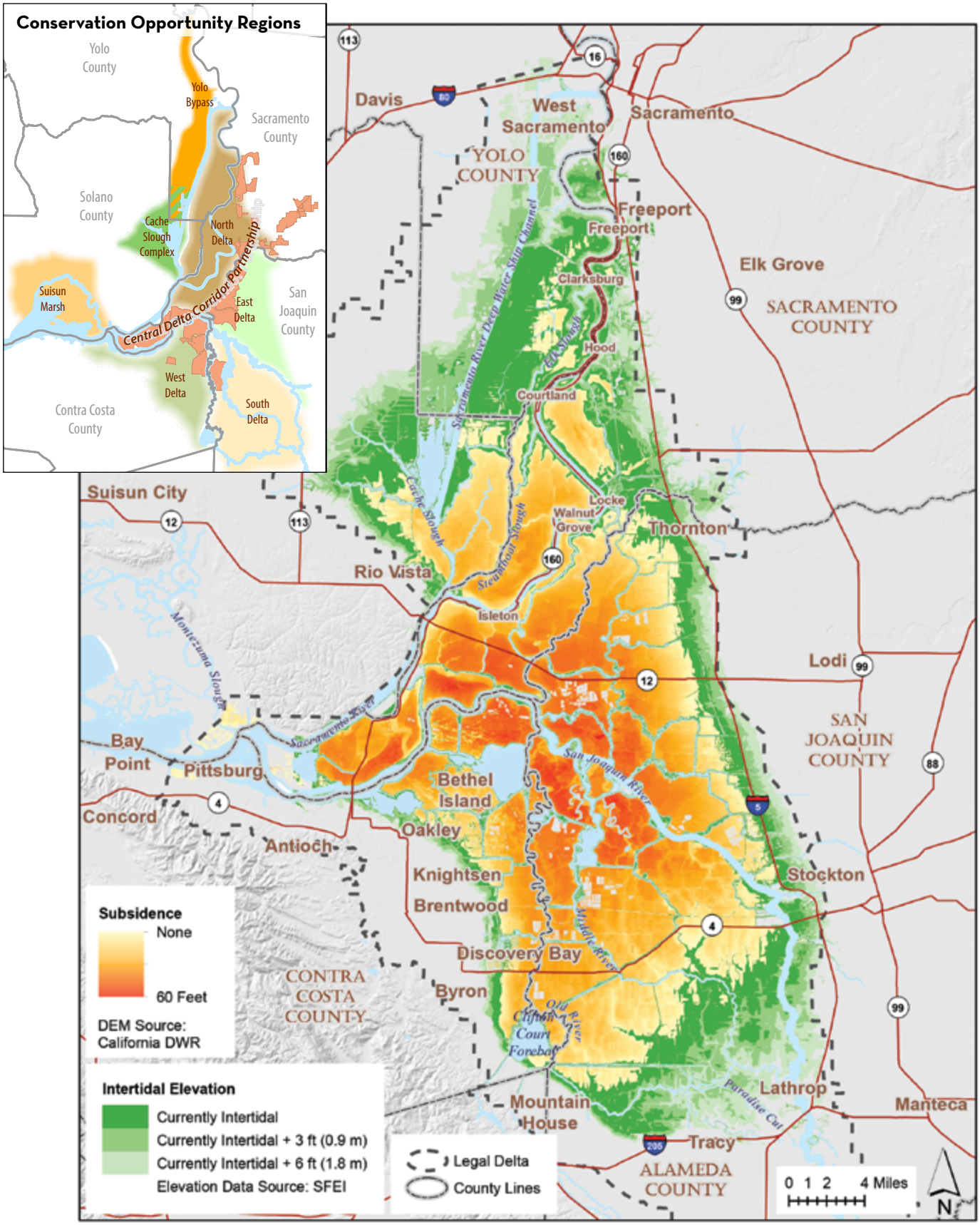
The information integrated and compiled in the *Delta Conservation Framework* is also needed to protect, restore, and improve the function of Delta ecosystems to support native communities of fish and wildlife, particularly populations of special status species.



Photo: Christina Sloop

Regulatory History Timeline

- 1992 – DELTA PROTECTION ACT states that "The Delta is a natural resource of statewide, national, and international significance, containing irreplaceable resources. It is the policy of the State to recognize, preserve, and protect those resources of the Delta for the use and enjoyment of current and future generations, in a manner that protects and enhances the unique values of the Delta as an evolving place (PRC §29701-2)."
- 1992 – DELTA PROTECTION COMMISSION was established by the Delta Protection Act as a forum for Delta residents to participate in decisions to recognize and enhance the unique cultural, recreational, and agricultural resources of the Delta (PRC §29703.5(a)).
- 1994 – CALFED BAY-DELTA COORDINATION PROGRAM (CALFED) was created to resolve some of the challenging issues affecting Delta ecosystems and wildlife, following a decade of disputes between the State of California, the federal government, agricultural interests, environmental groups, and municipal water services.
- 2006 – BAY DELTA CONSERVATION PLAN (BDCP) was initiated by the Department of Water Resources and the Bureau of Reclamation as a permitting framework for the construction of new Delta water conveyance through a combined 50-year Habitat Conservation Plan and Natural Community Conservation Plan spanning the Delta, Yolo Bypass, and Suisun Marsh.
- 2006 – DELTA VISION BLUE RIBBON TASK FORCE superseded CALFED, laying the groundwork for the Legislature to craft the 2009 Delta Reform Act.
- 2009 – DELTA REFORM ACT includes a package of bills that defined regulatory accountability in the Delta for implementation of conservation measures, as well as measures for water conservation, groundwater monitoring, enforcement to prevent illegal water diversions, and a bond measure to provide needed funding (California Water Code §85054).
- 2009 – DELTA STEWARDSHIP COUNCIL was established by the Delta Reform Act to advance the Delta Reform Act's coequal goals and to develop and oversee implementation of the Delta Plan, a long-term sustainable management plan for the region founded on those goals in the context of the "Delta as an evolving place." The Council is supported by the Delta Independent Science Board and the Delta Plan Interagency Implementation Committee.
- 2009 – SACRAMENTO-SAN JOAQUIN DELTA CONSERVANCY was established by the Delta Reform Act as the state agency responsible for implementing ecosystem restoration in the Delta and supporting efforts that advance both environmental protection and the economic well-being of Delta residents.
- 2013 – DELTA PLAN was unanimously adopted by the Delta Stewardship Council. It is guided by best available science and founded on cooperation and coordination among federal, state and local agencies.
- 2014 – CALIFORNIA WATER ACTION PLAN highlights overarching goals for "Reliability, Restoration, and Resilience," and outlines ten main actions that include: "Achieve the coequal goals for the Delta, protect and restore important ecosystems, increase flood protection, increase operational and regulatory efficiency, and identify sustainable and integrated financing opportunities."
- 2015 – CALIFORNIA WATERFIX was launched in lieu of the BDCP to realize new Delta water conveyance infrastructure under ESA Section 7 and the California Endangered Species Act.
- 2015 – CALIFORNIA ECORESTORE was launched in lieu of BDCP conservation measures as a new Natural Resources Agency led initiative to swiftly implement conservation projects in the Delta, Yolo Bypass, and Suisun Marsh.



Primary challenges to conservation in the Delta remain land subsidence behind levees, flood protection, and rising sea levels and extreme precipitation events related to climate change. Conservation lands offer important buffers for Delta communities and farmlands. INSET: The Delta Conservation Framework focuses on improving public lands first (Central Delta Corridor) to benefit the ecosystem and wildlife. The Framework also identifies conservation opportunity regions where it hopes to support regional partnerships and multi-benefit, public private collaborations for a healthier Delta.

Source: CDFW, 2018

Photo courtesy Delta Protection Commission.



Vision for Delta 2050

Despite substantial efforts to plan conservation in the Delta, many challenges to ecological resilience and function remain. Over the next three decades, efforts to restore the Delta ecosystem will occur in an ever-changing social, ecological, and regulatory environment influenced by economic shifts and climate change effects, such as sea level rise.[7,9,14,35,36] Human uses of, and impacts on, the Delta are central to considerations of how the landscape functions now and into the future.[19]

In 2050, the Delta is composed of resilient natural and managed ecosystems situated within a mosaic of towns and agricultural landscapes, where people prosper and healthy wildlife communities thrive.

As cornerstones for the success of Delta conservation and lasting multi-benefit solutions, Delta stakeholders developed a 30-year vision and set of guiding principles for collaboration and mutual respect during a series of Delta Conservation Framework public workshops in 2016. This vision will be achieved by all Delta stakeholders, local, state and federal, as they align future conservation efforts with the seven overarching goals established in the Framework.

What do stakeholders hope to see as the results of the framework and vision?

- MULTI-BENEFIT OUTCOMES: In 2050, the Delta is a network of multiple-use landscapes where agricultural productivity, economic vitality, and ecosystem conservation are achieved in a manner that mutually supports the needs of people and wildlife.
- CONSIDERATION OF LANDSCAPE DYNAMICS: In 2050, the Delta is recognized as part of a greater system that functions within the context of California's largest watersheds.
- HEALTHY, RESILIENT ECOSYSTEMS: In 2050, the Delta has healthy, resilient ecosystems with the capacity to adapt through time to impacts associated with climate change, sea level rise, and other environmental uncertainties.
- COLLABORATION: In 2050, state, federal, and local government agencies collaborate with each other and Delta stakeholders to achieve multi-benefit outcomes where possible.
- DECISIONS BASED ON SCIENCE: In 2050, policy decisions and desired conservation outcomes are informed and evaluated through coordinated Delta science endeavors.
- LOCAL SUPPORT: In 2050, Delta residents promote the management of healthy ecosystems as the basis of a healthy and economically thriving Delta region.
- LOCAL BENEFITS: In 2050, Delta residents and visitors actively enjoy the region's unique cultural and natural resource values through wildlife-friendly agricultural practices, tourism, low-impact outdoor recreation, and environmental education activities for all ages.
- RELIABLE LOCAL WATER: In 2050, effective integrated water management in the Delta promotes good water quality and a reliable water supply for users in the Delta.
- MULTI-BENEFIT FLOOD MANAGEMENT: In 2050, the Delta's flood management system provides both improved flood protection and increased habitat value for fish and wildlife, where possible.

Foundations of the Framework

The Framework is based on a 2050 vision, guiding principles, and a three-year effort to integrate public input, science, and existing plans into a cohesive framework for conservation planning.

Input from the Delta Stakeholder Community

Stakeholders from a variety of sectors and interests, including local Delta community members, play a key role in the successful planning and implementation of conservation-oriented programs and projects. Their involvement is especially important when reconciling the complex, often multi-dimensional, human and environmental uses of Delta landscapes and waterways.

During a series of six workshops in 2016, stakeholders from local, state, and federal agencies, water contractors, non-governmental organizations, environmental consulting firms, reclamation districts, universities, private businesses, and local residents raised important issues for consideration in developing a common vision and an integrated conservation approach for Delta ecosystems (see also Section II and Appendix 4).

Overall, workshop participants emphasized the importance of agriculture as the Delta's economic engine and the need to involve Delta community members when planning, implementing, and managing conservation actions.

The participation of Delta community members in the 2016 workshop series was limited until a local champion got involved to spread the word and share a sense of urgency. Reasons for the initial lack of local turn out included work demands, lack of trust in the process based on past experiences, an unfavorable attitude toward conservation, or insufficient outreach and communication about the workshops in local newspapers and at community gathering spots.

In general, participating stakeholders established that Delta conservation would move forward most successfully by focusing on lands currently under public ownership or on lands managed under specified conservation easements owned by non-governmental organizations, businesses, or private citizens. They also emphasized the importance of preserving local tax bases, adequately funding long-term management of public lands, and avoiding additional regulations and negative impacts on agriculture. Stakeholders supported a focus on multi-benefit solutions, including financial incentives for wildlife-friendly farming practices,[37,38] long-term agricultural conservation easements with willing Delta landowners,[37] or other incentives.

During the workshops, Delta local stakeholders also emphasized the importance of a "bottom-up" approach, where conservation projects are developed at a regional level with local support that ensures resident landowner participation in conservation planning and implementation. They agreed that applying good-neighbor practices to avoid negative impacts on agriculture and other neighboring land uses[37] would go a long way toward obtaining local support and



The California Department of Fish and Wildlife asked for early community feedback from residents of Bethel Island on a proposed design for a tidal marsh restoration project for Delta smelt habitat on Franks Tract. The community responded with their own counter proposal. Such exchanges, early in planning timelines, are critical to achieving conservation in collaboration with Delta communities. Photo: Christina Sloop

successfully implementing Delta conservation. Stakeholders also called for a balance of publicly accessible and "wild" conservation lands, to allow restricted or seasonal recreational access to some areas, while protecting sensitive wildlife areas from disturbance. There was also overall recognition that strong levees are beneficial to everyone.

In terms of conservation goals, workshop participants supported a greater focus on improving ecological processes to restore ecosystem function[16] and going beyond emphasis on single species conservation under federal and state endangered species laws and regulations (Federal Endangered Species Act (ESA)/California ESA (CESA)), to improve wildlife habitat and connectivity. This expanded approach would benefit wildlife and help recover declining populations of special status species. Specifically, participants favored a landscape conservation approach tied to locally driven project planning and implementation that builds on, or integrates, existing regional planning efforts. Stakeholders also recognized the need to make the conservation permitting process more efficient to expedite implementation and reduce costs.

One take home was the need for conservation proponents to take responsibility over the long term for achieving desired conservation outcomes. To be effective, such efforts will require not only regular evaluations of conservation performance on the basis of predefined goals, but also regular communication of successes and failures to stakeholders.

The *Delta Conservation Framework* integrates many of these stakeholder concerns and suggestions into its goals and strategies (see Section II).

Considering Existing Plans

Any evaluation of conservation opportunities in the Delta requires consideration of the many existing planning documents and programs. Those plans and programs considered in the development of this *Delta Conservation Framework*, and descriptions of how they align with the Framework, are detailed in the Guide to Related and Aligned Plans and Programs at the end of this section (see pp. 30-37). The *Delta Conservation Framework* does not supersede these individual planning efforts, but instead connects and integrates them into the larger landscape-scale perspective. It suggests them as important references for consideration as part of ongoing or future regional conservation strategies and individual projects. In particular, in locations where regional conservation strategies overlap with regionally-focused planning efforts, such as Habitat Conservation Plans and Natural Community Conservation Plans (HCPs and NCCPs), regional goals, strategies, and objectives should tie in with those in the pre-existing plans. Appendix 6 provides summaries of the existing plans that should be considered by regional conservation partnerships in regional conservation strategy planning, and by individual conservation practitioners in project planning, and it offers further insight into how these plans relate to the *Delta Conservation Framework* (see also p. 45 for a discussion of the various "regional" strategies, partnerships, and plans terminology).

Framing Conservation Goals

The *Delta Conservation Framework*'s goals and strategies, used collaboratively, offer pathways to realizing the vision of the Delta as a place where people prosper and healthy wildlife communities thrive by 2050. In sections II-V the Framework suggests strategies for communication, planning, funding, and permitting conservation that could be used to achieve each goal over the coming decades. Some of the goals and strategies, such as Goal E, highlight pre-existing and ongoing efforts to successfully implement conservation in the Delta that should be used as resources moving forward. Other goals, such as Goals F and G, highlight the need to consider new approaches to implementing conservation. Still others, such as Goals A-C, underscore a growing recognition of the role people and communities must play as partners in conservation.

Delta Conservation Framework at a Glance

SHARED VISION AND OVERARCHING GOALS ON HOW TO ACHIEVE DELTA CONSERVATION

- Serves as a high-level Delta conservation guidance document for all stakeholders engaged in conservation planning, and for the collaborative development of focused regional conservation strategies that link to the system-wide goals outlined in this document.

SUPPORT FOR GOALS OF THE DELTA REFORM ACT AND CALIFORNIA WATER ACTION PLAN

- Encourages collaborative approaches through stakeholder partnerships and development of regional conservation strategies to inform the amendment of the ecosystem elements of the *Delta Plan* and implement *California Water Action Plan* Action 3. Recommends goal-based strategies to improve integrative conservation planning by Delta stakeholders that emphasize multi-benefit outcomes where possible.

PARTNERSHIP APPROACH FOR COLLABORATIVE ENGAGEMENT

- Establishes a goal and strategies for actively engaging landowners, federal, state, and local government agencies, regional partnerships, non-governmental organizations, and other relevant stakeholders to advance ecosystem conservation goals and strategies collaboratively on both landscape and regional scales, while ensuring consistency with existing conservation initiatives.

EDUCATION AND OUTREACH ABOUT THE IMPORTANCE OF A HEALTHY DELTA AT LOCAL, STATE, AND NATIONAL LEVELS

- Offers strategies for promoting public education and outreach about the Delta to improve public understanding of its economic, cultural, and environmental importance and to garner far-reaching support for its health and related socioeconomic sustainability. This is in direct alignment with the public trust doctrine outlined in the Delta Reform Act.

STRATEGIES AND OBJECTIVES FOR POTENTIAL SOLUTIONS TO KNOWN DELTA CONSERVATION CHALLENGES

- Offers strategies to address challenges, including the effective integration of community and conservation goals; regulatory conflicts, permitting, and funding barriers hindering conservation project implementation; and needed resources for the long-term maintenance and management of Delta projects.

FLOOD PROTECTION PLANNING LINKS

- Connects with flood protection planning through the emphasis on approaches for conservation that consider multi-benefit outcomes, as outlined in the 2016 *Central Valley Flood Protection Plan Conservation Strategy* and North Delta Program.

PRIORITIES FOR STATE AND OTHER FUNDING

- Directly informs grant solicitation language for some state funding programs, helps guide distribution of other available conservation support, and serves as a basis for future funding for long-term Delta conservation, including national, state, regional, and private sources.

GUIDANCE FOR THE COORDINATION OF COLLABORATIVE REGIONAL CONSERVATION STRATEGIES

- Provides a framework for coordinated implementation and management to build on early conservation successes and to guide collaborative future planning, implementation, and long-term management activities.



Photo: Rick Lewis



NATIONAL MODEL

Restoration Plan for Florida Everglades Mirrors Delta Approach

Everglades. Photo courtesy National Park Service.

Although located 2,500 miles away and in a markedly different ecosystem, Florida's Everglades nevertheless face similar challenges, and offer a useful parallel, to the Delta.

The Everglades — a wide, slow-moving swath of wetland dubbed "the river of grass" — is one of the largest wetland ecosystems in the world, covering nearly 18,000 square miles in southern Florida. It is now the focus of an extensive and historically significant watershed restoration program to mitigate the damage done by more than two centuries of redirecting estuarine water for flood control and other human uses. This ongoing and largely successful restoration program is tackling many of the same problems, and coming to many similar conclusions about best solutions, as California's *Delta Conservation Framework.*

"Success for the human systems will be to maintain or improve current levels of water supply and flood protection in a rapidly growing human population in south Florida, consistent with the goals of the Plan for the natural system."

"Success for the natural system will be to recover and sustain those essential hydrological and biological characteristics that both defined the original pre-drainage greater Everglades and made it unique among the world's wetlands. These defining characteristics include the great extent of naturally interconnected and interrelated wetlands, sheet flow, extremely low levels of nutrients in freshwater wetlands, high levels of estuarine productivity, and the great resilience of the plant community mosaics and abundance of many of the native wetland animals."

Vision, Comprehensive Everglades Restoration Plan, USACE 2003

NATIONAL MODEL CONTINUED

Plan Overview

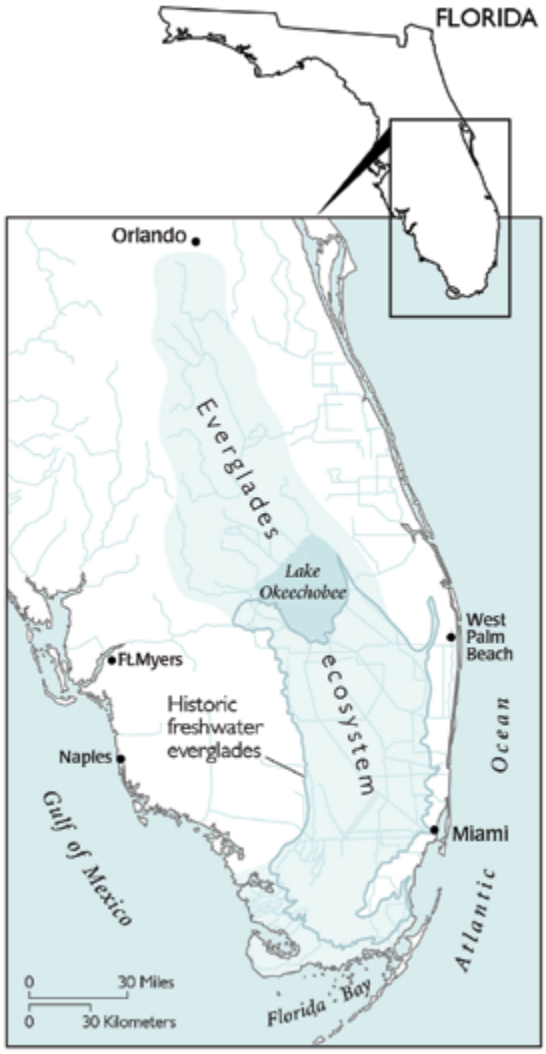
Similar to the *Delta Plan*'s coequal goals, the main objectives of the *Comprehensive Everglades Restoration Plan* (CERP) are "getting the right amount of water of the right quality to the right places at the right time" and "to find the correct balance among the flow types throughout all regions to ensure a healthy and sustainable natural and human environment." Everglades restoration goals include recovery of freshwater flows into the estuaries, restoring the ecosystem processes that once supported diverse wetland habitats, and providing resiliency to changing conditions.[1,2,3] This focus further includes making recommendations for structural or operational modifications to the existing water project to restore important functions and services of the Everglades and south Florida ecosystem while also planning for agricultural and urban water needs and flood protection for the next 50 years.

The Plan is founded on an adaptive management program as a basis for continually improving the design, operation, and performance over time. Maximizing operational flexibility is considered to be an essential strategy for meeting the natural and human system performance goals of the Plan.

Human and Natural System Integration

The CERP's greatest strength is that it integrates natural and human objectives into a single design, and brings together an array of public interests into a common strategy for the future of south Florida.

Although the future Everglades ecosystem will not recreate historic conditions, because it will be smaller than the pre-drainage system, planned restoration is intended to recover these defining characteristics and create a new Everglades that behaves functionally as a wild



Source: CERP

Everglades system rather than as a set of managed, disconnected wetlands.

Like the *Delta Conservation Framework*, the CERP acknowledges both human and natural demands on a rich estuarine system, and the need to sustain both as functional systems far into the future. In the Delta Framework's case however, (the DCF has no flow- or water supply- management actions), the human dimension is more related to the Delta's agricultural legacy.

Direct Community Involvement

In both the Delta and Everglades, planning is based on an open collaborative process with interdisciplinary, cross-sector, and public outreach and engagement. The lead agencies of the CERP—the U.S. Army Corps of Engineers (USACE) and the South Florida Water Management District (SFWMD)—are leading one of the largest conservation partnerships in the world. This multi-stakeholder partnership is composed of tribes and federal, state, and local government agencies, as well as private and environmental interests including the fishing community; business organizations; local community groups; environmental organizations; the agricultural community; homeowners; and other members of the public who are concerned about the health of the Everglades, including recreation groups and the sugar industry.[1,4,5]

Community participation has been an important component of restoration in the Everglades. Community members have been engaged in the planning and ecosystem restoration process through public workshops and volunteer opportunities, in part as a result of a 2010 Clean Water Fund survey that resulted in recommendations to improve public outreach and participation.

Development of the *Delta Conservation Framework* has involved similar community surveys, stakeholder outreach, and resulting emphasis on collaborative planning.

Multiple-Benefit Management and Public Lands

Both the Delta and the Everglades are made up of a patchwork of public and private lands owned by various entities and managed to achieve a variety of goals (though there may be more public land in the Everglades system). The greater Everglades ecosystem contains four national park units, 16 national wildlife refuges, and over one million acres of public lands managed by the water district. These lands support recreation, public use, and conservation of natural resources. As such, individual CERP projects may have one or more multi-benefit objectives, including:

1. Restoring wetlands and watersheds and reestablishing flows to maintain ecosystem connectivity
2. Improving flood protection
3. Sustaining existing and future water supply, while increasing water storage capacity
4. Improving the water quality and timing of discharges into estuaries, lakes, wild and scenic rivers and managing water conservation areas for municipal, agricultural, and recreational uses.



Electrofishing research in the Everglades. Photo: Larry Perez, courtesy National Park Service

NATIONAL MODEL CONTINUED

Examples of multi-benefit approaches to the Everglades restoration efforts with characteristics similar to some of those referenced in the *Delta Conservation Framework* include:

- A Master Recreation Plan, included in CERP, under which regional plans and projects evaluate and address compatibility between recreation and restoration and incorporate workshop participants' feedback on recreation needs into the regional plans.[5]
- A community outreach program, developed by USACE, including a quarterly newsletter, to inform the public of project planning meetings and to educate and engage young adults and children.[6]
- The *Invasive Exotic Species Strategic Action Framework* (South Florida Ecosystem Restoration Task Force 2015), which engages partner agencies and the public in managing the impacts of invasive species on ecosystems, native and special status species, cultural values, recreational opportunities, and economic interests that affect the entire state of Florida.[7]

Environmental Overview

As in the Sacramento-San Joaquin River Delta in California, humans reclaimed a large acreage of the Everglades wetlands for farming and development starting before 1900. Infrastructure changes to support urban development and agriculture reduced freshwater flow through the estuaries, and the vast Everglades wetland ecosystem ultimately shrank to half its original size as a result. Encompassing Lake Okeechobee and its tributary areas, the Everglades ecosystem includes the roughly 40- to 50-mile-wide, 130-mile-long wetland mosaic that once extended continuously from Lake Okeechobee to the southern tip of the Florida peninsula at Florida Bay.[8] A large canal developed for flood control transformed the meandering Kissimmee River into a straight, deep channel that caused catastrophic damage to floodplain habitats and water quality, severely affecting several fish and wildlife species and reducing ecosystem services to humans.

Conservation Focused on Restoring Ecosystem Function

Even in their diminished states, the ecosystems on both coasts provide innumerable ecological services. The Everglades contains a mosaic of wetlands, freshwater ponds, prairies, and forested uplands that support rich communities of plants and wildlife. In 1994, Congress passed the Everglades Forever Act to reverse the decline in water quality and ecosystem health which led to the development of the CERP, an overarching framework for restoration projects with objectives to recover freshwater flows into the estuaries; restore the ecosystem processes that once supported diverse wetland habitats; improve water quality; and provide resiliency to changing conditions.

Florida panther. Photo courtesy Everglades National Park Service



Estuaries and coastal areas in the Everglades receive either too little or too much water, causing fluctuations in salinity that affect the health of ecosystems. By capturing, storing, cleaning, and redistributing water, the CERP addresses this challenge to restore freshwater flows to the estuary while still providing for the needs of the public. CERP projects are:

- rehydrating coastal wetlands by distributing freshwater to the estuary over a broad area, instead of through individual drainage canals
- capturing runoff and excess water to reduce harmful discharges to the estuary during wet periods and provide water during dry periods
- improving water quality to reduce salinity and nutrient impacts on the estuary; removing flow and connectivity barriers
- reestablishing underground aquifers

These landscape-scale projects are already restoring habitats for native plants, fish, wading birds, shorebirds, and waterfowl. Although invasive species, heavy rains, drought, and other challenges continue to degrade the ecosystems in the Everglades, restoration has helped with recovery. Imperiled Everglades species, such as the federally endangered Florida panther, and declining native fish populations, including largemouth bass, Everglades pygmy sunfish, and other species of sunfish, have benefitted from CERP actions.

Science Informing Everglades Restoration Efforts

Restoration efforts in the Everglades combine the best available scientific and technical information with policy, management, and public opinion. Congress established the South Florida Ecosystem Restoration Task Force to coordinate the development of policies, strategies, plans, programs, and projects that address restoration and protection of the South Florida ecosystem. One of the Task Force advisory bodies is the Science Coordination Group, including senior managers and scientists, which supports efforts to coordinate the scientific aspects of restoration with management decisions. A multiagency collaboration of scientists and resource specialists (The Restoration Coordination and Verification program, or RECOVER) provides scientific and technical information to incorporate into the CERP effort.

RECOVER develops five-year plans to ensure project design, construction, operations, and adaptive management incorporate the latest updates in science. The five-year plans establish tasks and make recommendations for changes to goals or targets, decision-making processes, and communication. Regular RECOVER meetings evaluate and refine conceptual models.

The *Delta Conservation Framework* is also based on best available science, science-based adaptive management, and monitoring and tracking of conservation outcomes based on goals and objectives. Many layers of multiagency science, research, and collaboration underly the Framework.

QUICK LINKS

Comprehensive Everglades Restoration Plan[3]
https://www.saj.usace.army.mil/Portals/44/docs/Environmental/Report%20to%20Congress/2015CERPReportCongressDRAFT.pdf

Kissimmee River[7]
www.sfwmd.gov/our-work/kissimmee-river

Comprehensive Everglades Restoration Plan (CERP)[3]
http://141.232.10.32/pm/recover/recover.aspx

Everglades Restoration[1]
www.evergladesrestoration.gov

Restoration Coordination and Verification five-year plan[9]
https://evergladesrestoration.gov/content/scg/minutes/2017meetings/012317/RECOVER_5-yr.pdf

Western Everglades Restoration Project [10]
www.sfwmd.gov/sites/default/files/documents/jtf_western_glades_planning.pdf

United States Geological Survey [8]
https://pubs.usgs.gov/circ/circ1182/pdf/12Everglades.pdf

GUIDE TO RELATED & ALIGNED PLANS & PROGRAMS

Bay Delta Conservation Plan Public Draft

This plan was initiated in 2006 as a permitting framework for the construction of proposed Delta water conveyance improvements through a combined 50-year habitat conservation plan (HCP/NCCP) spanning the Delta, Yolo Bypass, and Suisun Marsh. A draft was completed in 2013, but in April 2015, the Brown administration announced a change in the permitting approach for new Delta water conveyance infrastructure, shifting state efforts away from the BDCP. Conservation measures presented in the 2013 Public Draft of the BDCP were intended to restore a more naturally functioning Delta ecosystem, contribute to the recovery of covered species through establishing a large Delta reserve system, and establish a secure and reliable Delta water supply for human use while managing flows to protect and support life history requirements of special status fish. The draft BDCP offers a wealth of information useful to inform future planning and development of Regional Conservation Strategies. The *Delta Conservation Framework* goals and strategies reflect many of the BDCP conservation measures targeted to improve Delta ecosystem function to benefit fish, wildlife, and natural communities. However, the *Delta Conservation Framework* does not offer direct acreage targets beyond those already established through existing planning documents, nor does it address the issue of providing a secure and reliable water supply for human use. For more details of how the *Delta Conservation Framework* incorporates elements of the BDCP, please refer to Table III.1 in Appendix 3.



Endangered Delta smelt. Photo: DWR

California State Parks Recreation Proposal for the Sacramento-San Joaquin Delta

This 2011 proposal provides recommendations for the improvement or expansion of California State Parks' four Delta recreation areas and six other state parks on the edge of the Delta and Suisun Marsh, and for connecting them with destinations inside the Delta and Suisun Marsh region. It outlines opportunities to create four new state parks for the region, and suggests ways to improve recreational use of wildlife habitat areas, publicly owned levees, scenic highways, state recreational trails, and other public lands. It also includes suggestions for coordination of recreation and tourism efforts. The proposal suggests a network of recreation areas — including parks, resorts, boating facilities, historic communities, agricultural-tourism attractions, and other visitor-oriented places that are connected by scenic driving routes, boating trails, or bicycling and hiking trails. The proposal highlights existing recreation assets as well as new recreation opportunities. These may include flood-control efforts, pipelines and canals, and restoring large wildlife habitat areas, especially at the six potential "restoration opportunity areas" mapped in the recreation proposal.

Partnerships among agencies, businesses, and nonprofit groups would help advance such multi-benefit outcomes and reveal the region to more visitors under this proposal. Co-benefit recreation opportunities are integrated into *Delta Conservation Framework* Goal C, "Develop multi-benefit focused conservation and land management solutions to balance environmental and human needs."

California State Wildlife Action Plan

The 2015 update to this strategic conservation plan (the "SWAP") developed by California Department of Fish and Wildlife provides a blueprint for sustaining the integrity of California ecosystems.

SWAP 2015 articulates conservation priorities for implementation by 2025, with a goal of desired conditions to be attained and sustainability improved within 50 years. The following goals summarize the SWAP priorities and provide a framework for complementary tier-down regional goals and objectives aimed at: 1) enhancing the abundance and richness of species and ecosystems, 2) enhancing the quality of ecosystem conditions; and 3) enhancing ecosystem functions and processes. Supported by 12 subgoals, these statewide goals represent the overarching desired outcomes of integrated implementation.

SWAP 2015 highlights the Delta as part of the Bay Delta Conservation Unit, within the Bay Delta and Central Coast Province, and identifies target ecosystems and species of greatest conservation need.

The SWAP also highlights pressures in the Delta that make it a prime region for conservation. Targets and conservation strategies were developed by reviewing and synthesizing other planning efforts for more specific guidance, including the BDCP, *Delta Plan*, and other planning documents described in this appendix. However, regional conservation partnerships and project proponents should consult the SWAP when planning projects for or within target ecosystems and are strongly advised to consult the SWAP if applying for federal funding through the State Wildlife Grant or Endangered Species Act Section 6 program.

Species Recovery Briefs can be found in Appendix 5 online.

See Quick Links p.37 to access above plans and programs.

California Water Action Plan

Concerns regarding declines in the Delta's wildlife species, the resilience of Delta levees to significant seismic events, and the Delta's vulnerability to floods and the effects of sea level rise are the focus of the 2014 *California Water Action Plan* (CWAP). This plan outlines ten main actions for achieving reliable and resilient water systems and restoring the most important California ecosystems. The CWAP recognizes the social and political complexities around Delta issues yet states that "the status quo in the Delta is unacceptable and it would be irresponsible to wait for further degradation or a natural disaster before taking action".

Relevant CWAP actions include:

- Action 3: Achieve the coequal goals for the Delta
- Action 4: Protect and restore important ecosystems
- Action 8: Increase flood protection
- Action 9: Increase operational and regulatory efficiency

Implementation of the *Delta Conservation Framework* will serve to further the above actions in the future, with several overarching long-term goals with strategies that address these CWAP actions. These include strategies aimed at:

- Reestablishing or improving Delta ecosystem function (GOAL D; Section III);
- Optimizing connectivity, functional food webs, management of harmful invasive species, and low-impact human use of conservation areas to reduce negative effects on sensitive wildlife (GOAL D; Section III);
- Levee maintenance and flood management practices that also afford additional or improved habitat, and advancing agency land management processes and procedures (GOAL C; Section II);
- Climate adaptation and adaptive management in Delta conservation and community planning going forward (GOAL E; Section III);
- Improving permitting procedures (GOAL F, Section V);
- Securing funding support (GOAL G, Section V).

Central Valley Flood Protection Plan and Conservation Strategy 2017

This plan (the CVFPP) serves as a guide to the state's participation in managing flood risk and prioritizing investments in areas protected by the State Plan of Flood Control (SPFC). The CVFPP recognizes that flood risks, water supplies, and functioning Central Valley ecosystems are interconnected, with actions in one area influencing the other areas.

The 2017 update contributes to a programmatic vision for flood system improvements over time in accordance with the requirements of the Flood Protection Act of 2008. The non-regulatory companion, CVFPP Conservation Strategy, is an integral part of the CVFPP that focuses on the improvement of ecosystem functions. The CVFPP planning area includes the *Delta Conservation Framework* Conservation Opportunity Regions; see section VI and Appendix 2. Planning partnerships and individual project proponents should look to the CVFPP for specific guidance on conservation of fluvial, riparian, and floodplain ecosystems in the context of flood protection activities.

The CVFPP Conservation Strategy goals directly overlap with Goal C, Strategy C1 of the *Delta Conservation Framework*. Other goals and strategies also overlap regarding river and floodplain conservation with a focus on:

- Multi-benefit projects that combine flood risk reduction with ecological benefits, environmental improvements, and agricultural stewardship (*Delta Conservation Framework* Goal C, Strategies C1, C2, C4, C5, C6);
- Promoting natural dynamic hydrologic and geomorphic processes underlying ecosystem function (*Delta Conservation Framework* Goal D, Strategy D1);
- Contributing to the recovery of special status species in riverine and floodplain habitats (*Delta Conservation Framework* Goal D, Strategies D1, D2, D3, D4, D5);
- Increased predictability and cost effectiveness of permitting processes as related to multi-benefit projects (*Delta Conservation Framework* Goal F); and
- Goals and measurable objectives for progress evaluation within an adaptive management framework (*Delta Conservation Framework* Goal E).

Delta Economic Sustainability Plan

To inform the Delta Stewardship Council's policies concerning the socioeconomic sustainability of the Delta region, the 2009 Delta Reform Act required the Delta Protection Commission to prepare an *Economic Sustainability Plan* (ESP) for the Delta region. The ESP, adopted in January 2012 (Public Resources Code §29759), includes recommendations on levees, public safety, and updates to the Department of Water Resources flood management plan, to inform local government general plans and economic efforts affecting Delta agriculture and infrastructure. It also provides options for Delta Legacy Communities to encourage recreation and tourism investments in the Delta to maintain and enhance economic prosperity, particularly if there are declines in agriculture. As a key finding, the ESP emphasizes water quality, water supply, and the ability to divert water in the Delta as essential drivers for the sustainability of habitat and ecosystem improvement, agriculture, tourism, and recreation in the Delta. The ESP is being updated with the most current information on recreation, agriculture, tourism, business development, and more. This ESP update and available Community Action Plans will be critical resources to inform regional conservation partnership planning processes and help integrate Delta conservation practices with the human dimension going forward. Planning partner-

To skip these references go to p. 39

GUIDE TO RELATED & ALIGNED PLANS & PROGRAMS - CONTINUED

ships and individual project proponents should look to the updated ESP and Community Action Plans for specific guidance on how Delta socioeconomic aspects relate to conservation in a given region.

The Delta Plan

First released in 2013 when state and federal agencies were working toward a habitat conservation planning approach with the 50-year *Bay-Delta Conservation Plan* (see p.30 and Appendix 3), the *Delta Plan* outlines policies and recommendations to provide a more reliable water supply for California; preserve and improve Delta ecosystems; protect and enhance "Delta as an evolving place"; improve water quality; and reduce risk to people, property, and state interests. It further highlights funding needs and options for *Delta Plan* implementation. Associated white paper publications also provide guidance on adaptive management, performance measures, a levee investment strategy, and a long-term strategy for dredged sediment reuse.

Delta Landscapes Project Report Series, SFEI

This series of reports (2012-2016) informs landscape-scale conservation of the Sacramento-San Joaquin Delta ecosystem. Funded by the California Department of Fish and Wildlife Ecosystem Restoration Grants Program, the project includes the Delta historical ecology investigation outlining how Delta ecosystems functioned prior to the California Gold Rush and subsequent landscape-level changes in the early 1800s. Two successive reports utilized the resulting historical baseline to evaluate and describe how the Delta was altered over time (*A Delta Transformed*) and how it might be improved in the future to better support resilient populations of native wildlife (*A Delta Renewed: A Guide to Science-Based Ecological Restoration in the Sacramento-San Joaquin Delta*).

The *Delta Conservation Framework* goals and strategies related to ecosystem function as part of a landscape-level perspective (in particular for Goal D) are directly based on information provided in the Delta Landscapes Project report series (see Section IV for more information). Regional conservation partnerships and individual project proponents should look to the Delta Landscapes Project report series for detailed maps, historical context and how Delta function has changed, and for recommendations on conservation practices to support ecological functions in the Delta going forward (see also SFEI p. 132).

Ecosystem and Species Recovery Plans and Conservation Strategies

Recovery plans have been drafted by a variety of agencies and organizations for state and federally listed species and habitats; these are summarized below. For federally listed species, the National Marine Fisheries Service and US Fish and Wildlife Service have developed ecosystem-level recovery plans for tidal marsh, vernal pool, and Antioch Dunes ecosystems, and for upland species of the San Joaquin Valley. Plans for individual species include those for California tiger salamander (draft), giant garter snake, California red-legged frog, Least Bell's vireo (draft), California least tern, Central Valley salmon/steelhead, Delta smelt, Sacramento splittail, longfin smelt, green sturgeon, Chinook salmon, and Sacramento perch. State-listed species' plans are generally written by experts—examples include plans prepared for bank swallow, Swainson's hawk, and tricolored blackbird. A draft conservation strategy for greater sandhill crane is in process, but has not yet been released. Some recovery strategies are incorporated in conservation plans for specific ecosystems, such as for riparian bird.

Goal D, Strategy D3 of the *Delta Conservation Framework*, "Create conditions conducive to meeting the goals in existing species recovery plans to maintain or improve the distribution and abundance of listed species supported by Delta ecosystems," refers to the existing recovery goals described above. Other strategies under Goal D focus on optimizing connectivity, ecosystem function to support food webs, control and management of harmful invasive species, and minimizing adverse effects from human disturbance.



Photo: Amber Manfree

See Quick Links p.37 to access above plans and programs.

ERP Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta, Sacramento Valley and San Joaquin Valley Regions

This serves as the conceptual framework to guide the multi-agency Environmental Restoration Program (ERP), including development of conservation priorities and processes to identify and implement restoration opportunities and monitoring to guide and improve their success, in the Sacramento-San Joaquin Delta, the Sacramento Valley, and San Joaquin Valley regions. The ERP approach for ecosystem restoration is focused mainly on aquatic habitats and species in the Delta and the Sacramento and San Joaquin Valley regions.

The ERP Conservation Strategy describes goals and conservation priorities for Stage 2 of the CALFED Bay-Delta Program. The ERP implementing agencies — consisting of CDFW, USFWS, and National Oceanic and Atmospheric Administration Fisheries Service — will use the ERP Conservation Strategy as a guide until 2030.

The vision and goals of the *Delta Conservation Framework* directly integrate what is presented in the ERP Conservation Strategy, while providing an additional link to the Delta community and specific focus on implementation of Delta conservation. regional conservation partnerships and individual project proponents should look to the ERP Conservation Strategy for details on aquatic habitat descriptions, stressors, and related goals and conservation priorities.

Habitat Conservation Plans/ Natural Community Conservation Plans

The *Delta Conservation Framework* defers to the species and acreage targets outlined in Habitat Conservation Plans (HCPs), Natural Community Conservation Plans (NCCPs), or relevant Conservation Strategies, where they overlap with the Delta planning region. Here, we provide short overviews of HCP or NCCP initiatives within the Delta primary or secondary planning zones. The *Delta Conservation Framework* recommends that regional conservation partnerships integrate these goals and targets in conservation plans.

EAST ALAMEDA COUNTY CONSERVATION STRATEGY (EACCS)

The EACCS is not an HCP or NCCP; however, it is a framework intended to protect, enhance, and restore natural resources. A final draft was released in October 2010. The purpose of the EACCS is to preserve endangered and other special-status species and their habitats through a shared vision for long-term habitat protection in East Alameda County. The EACCS establishes guiding biological principles for conducting conservation in the county by assessing East Alameda County areas for their conservation value. Recommendations include working with willing landowners to implement long-term conservation stewardship efforts that will offset impacts from local land use, transportation, or other infrastructure projects. Only the most northeastern tip of Alameda County overlaps with the legal Delta, which is conservation zone 7 (CZ7) in the EACCS. This area contains a small amount of grassland and alkali meadows with ponds, while the remainder is agricultural. Special-status species that occur or historically occurred in CZ7 include San Joaquin kit fox, California red-legged frog, and California tiger salamander.

EAST CONTRA COSTA COUNTY HCP/NCCP

This is an approved 30-year HCP/NCCP, released in 2006 and developed, in part, to address indirect and cumulative impacts to terrestrial species from development supported by increases in water supply provided by the Contra Costa Water District. While the HCP/NCCP plan area includes land within the legal Delta, the focus of the plan is primarily on grasslands, riparian, and other upland habitats and the terrestrial species dependent on these ecosystems. However, some natural community level goals include preserving and restoring wetlands. Most of the investments in land acquisition and habitat improvements are focused outside of the legal Delta. Key restoration priorities in the Delta include the Dutch Slough/Big Break area, lower Marsh Creek, and lower Kellogg Creek. Projects within the Delta would help to achieve the plan's species-level goals for giant garter snake, tricolored blackbird, Swainson's hawk, and western pond turtle. The HCP/NCCP does not cover fish species, including salmonids, and the impact on fish is addressed through separate consultation and permitting.

SOUTH SACRAMENTO HCP

Currently under development, with a working draft released in 2010, the primary focus of the South Sacramento HCP is to protect vernal pool and other upland habitats that are being diminished by vineyards and development, but it also protects wetland and riparian habitats and agriculture. The plan covers several special status terrestrial species that also inhabit the Delta, such as Swainson's hawk, tricolored blackbird, sandhill crane, giant garter snake, Valley elderberry longhorn beetle, western pond turtle, white-tailed kite, California tiger salamander, and western burrowing owl. The geographic scope of this HCP includes a small portion of the Sacramento-San Joaquin Delta in Sacramento County, extending from about the Stone Lakes National Wildlife Refuge in the north (and up to Florin Road in Sacramento) to Tyler Island in the south. The westernmost boundary of the plan

To skip these references go to p. 39

GUIDE TO RELATED & ALIGNED PLANS & PROGRAMS - CONTINUED

area is the Sacramento River. Portions of the Plan Area are included in the *Delta Conservation Framework*'s secondary planning zone, where habitat could become important for species such as sandhill crane and giant garter snake as sea levels rise and other future conditions render legal Delta habitat less suitable. Reserve areas adjacent to the Delta could also provide stepping-stone connectivity between Delta wildlife populations and populations to the east. This HCP does not address aquatic species, as they have historically been covered by U.S. Army Corps of Engineers' (USACE) 404 permits and CDFW Streambed Alteration Agreements. Programmatic permits that may be incorporated into the HCP are developed by Sacramento County in collaboration with the USACE, U.S. Environmental Protection Agency, and CDFW.

SOLANO MULTISPECIES HCP (MSHCP)

The Solano MSHCP is still in development, with a final administrative draft updated in October 2012. This HCP will promote conservation of biodiversity and preservation of covered species and their habitats in relation to urban development, flood control, and infrastructure improvement activities. Federally- and state-listed fish species and other species of concern on lands within the Delta will be included in the HCP as covered species. These include many of the species also covered by the *Bay Delta Conservation Plan.* Natural communities to be protected include grasslands and vernal pools, riparian and stream habitats, and marshes. The plan area includes all of Solano County and a small portion of Yolo County, overlapping the Delta primarily in Suisun Marsh and the vicinity of Cache and Lindsey sloughs.

SAN JOAQUIN COUNTY MULTI-SPECIES HABITAT CONSERVATION AND OPEN SPACE PLAN (SJMSCP)

Approved in 2001, this HCP was developed to provide guidelines for preserving agriculture and protecting species in the context of conserving open space and protecting it from conversion to other land uses. The geographic scope includes all lands within the legal Delta that overlap with San Joaquin County, as well as secondary zones to the east and southwest of the Delta. The purpose of the plan is to balance the need to conserve open space and special status species with the region's agricultural economy and landowner property rights. The SJMSCP is a 50-year plan covering 97 special status plant, fish, and wildlife species in 52 vegetative communities. The covered species in the Delta are mostly the same species covered by the BDCP and some species not included in the BDCP, such as bank swallow.

YOLO HCP/NCCP

A second administrative draft of the Yolo county-wide HCP/NCCP, which is under development, was released in 2015. This plan will address the conservation of 70-80 species in five habitat types: wetland, riparian, oak woodland, grassland, and agricultural lands. It will not address aquatic species; however, project-specific mitigation will be developed for projects affecting aquatic resources. Yolo County only overlaps the Delta in the Yolo Bypass and the area between the Sacramento Deep Water Ship Channel and the Sacramento River. However, there are numerous special status species that inhabit this area, including valley elderberry longhorn beetle, giant garter snake, Swainson's hawk, western burrowing owl, and tricolored blackbird; there was even a sighting of least Bell's vireo.

Human Use of Restored and Naturalized Delta Landscapes

This one-year study explored the California Delta from an integrative human-environment perspective. It offers a holistic integration of multiple goals and land use agendas using a landscape planning approach. Released in 2016, the report advances a reconciliation approach, which seeks synergies between ecosystem needs and the desires of those who live, work, and play in the Delta, both now and in the future. Recommendations include the need for a significant shift in the way restored Delta landscapes are conceptualized and considered in planning, policy, and design efforts and advocating for an approach in which human presence is understood as integral to these landscapes. This will require integration of a multitude of values — economic, ecological, scientific, and recreational — and will make restorative efforts more realistic and effective. However, reconciling human uses with restoration objectives will also require a more holistic type of stewardship. Implementing adaptive management efforts is therefore a further recommendation, combined with adequate resources for support.

Many of the recommendations in this report are also integrated into the *Delta Conservation Framework* overarching goals, and they were also voiced and captured during the 2016 stakeholder workshop process (see Appendix 4). In particular, Goals A-C address human integration into Delta conservation processes and the heightening of national, state, and even local awareness of Delta values and culture.

See Quick Links p.37 to access above plans and programs.

San Francisco Estuary Comprehensive Conservation and Management Plan

Known as the CCMP or *Estuary Blueprint*, this 2016 plan incorporates input from more than 70 organizations that reached collaborative agreement on four long-term goals to be achieved by 2050, plus 32 actions to be taken prior to 2021. The aim is to protect, restore, and sustain the San Francisco Estuary including the Delta and San Francisco Bay.

The overarching goals of the *Delta Conservation Framework* entirely or in part align with the four long-term CCMP goals to: 1) Sustain and improve the Estuary's habitats and living resources (Goals C-D); 2) Bolster the resilience of Estuary ecosystems, shorelines, and communities to climate change (Goals D-E); 3) Improve water quality and increase the quantity of fresh water available to the Estuary (Goal C - water quality; overall freshwater flow quantities are not addressed by the *Delta Conservation Framework*); and 4) Champion the Estuary (Goals A-B, and F-G).



In the lower Estuary, biologists and shoreline planners are experimenting with human-engineered oyster reefs that can improve water quality, enhance habitats for estuarine species, and protect nearby communities from storm surge and sea level rise. Such living shorelines are an important element in the Estuary Blueprint. Photo: Kathy Boyer

The *Delta Conservation Framework* goals also align with the CCMP action priorities to: improve our understanding and monitoring of how watersheds support aquatic resources and to connect the management of streams, rivers, and downstream habitats; to protect and grow a healthy mosaic of habitat types along shorelines and riparian banks; maintain ecosystem function and bolster food webs, connections between habitats, and the movement of fresh water and sediments through the Estuary; support ecological adaptations to rising sea levels through natural infrastructure (wetlands, horizontal levees, buffering habitats); encouraging water conservation, recycling, and regional planning to increase supply without diverting more from fish to cities; keep addressing pollution challenges; persist in finding solutions to climate challenges, including wetland related carbon sequestration and other solutions for improved and resilient land use practices; and make strides in informing and integrating the public in planning and implementation activities.

While the *Delta Conservation Framework* only addresses the CCMP goals and priority actions within the upstream portion of the Estuary, the short- and long-term effects of implementation through regional conservation partnerships will extend downstream and out into the Pacific ocean; and perhaps will address upstream conditions as sea level rises and salinity and other effects felt in the Bay reach further into the Delta. Therefore, a sustained and improved connection among efforts in the upstream (Delta) and downstream (Bay) regions of the Estuary will become increasingly important.

The Suisun Marsh Habitat Management, Preservation, and Restoration Plan

This comprehensive, 30-year plan (the SMP) addresses habitats and ecological processes, public and private land use, levee system integrity, and water quality through tidal restoration and managed wetland activities. The SMP's purpose is to create an acceptable balance between protection and enhancement of managed wetlands and the restoration and protection of tidal wetlands. The SMP was developed by and is overseen by the Suisun principal agencies: the U.S. Fish and Wildlife Service; U.S. Department of Interior, Bureau of Reclamation; California Department of Fish and Wildlife; Department of Water Resources; National Marine Fisheries Services; Suisun Resource Conservation District; and the Delta Stewardship Council (successor to the CALFED Bay-Delta Program).

The objectives of the SMP are to preserve and enhance the quality and diversity of the Suisun Marsh aquatic and wildlife habitats and to assure retention of upland areas adjacent to the marsh in uses compatible with its protection.

These objectives are integrated within *Delta Conservation Framework* Goal C, Strategy C2 "Support sustainable wildlife-friendly agriculture to provide additional wildlife and migratory bird habitats," and Goal D, strategies D1-D2, "Restore, enhance, and manage ecosystem processes Delta-wide to improve function and life history support for native and migratory wildlife, and to build ecological resilience," and "Conduct technical analyses within groups such as regional conservation partnerships to coordinate, identify, and prioritize available geographic areas for conservation and climate adaptation."

For implementation of projects in Suisun Marsh, individual project proponents should work closely with the Suisun Resource Conservation District and the San Francisco Bay Conservation and Development Commission.

To skip these references go to p. 39

GUIDE TO RELATED & ALIGNED PLANS & PROGRAMS - CONTINUED

Water Quality Control Plan for the San Francisco Bay/ Sacramento-San Joaquin Delta Estuary

The California State Water Resources Control Board (State Water Board) put out this plan in 2006 (the *Bay-Delta Plan*), which focuses on beneficial uses to be protected and water quality control measures needed to afford sound protection of these uses in the watershed. The plan is implemented through water rights and other measures. The State Water Board administers water rights in the Bay-Delta watershed and is currently in the process of updating the *Bay-Delta Plan* and flow objectives for priority tributaries to the Delta to protect watershed beneficial uses. The first phase updates San Joaquin River flow and southern Delta water quality requirements, followed by other comprehensive changes to protect beneficial uses not addressed in Phase 1 (e.g., Delta outflows, Sacramento River inflows, Suisun Marsh salinity, Delta Cross Channel gate closure, export limits, reverse flows). Additional phases involve changes to water rights and other measures to implement changes to Phases 1 and 2, as well as developing and implementing flow objectives for priority Delta tributaries outside of the *Bay-Delta Plan* updates.

The *Delta Conservation Framework* addresses water quality challenges and solutions only in the context of conservation project planning and implementation and so defers to the *Bay-Delta Plan* for addressing the more comprehensive requirements for Delta-wide water quality improvements.

Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan

Prepared jointly by the Department of Water Resources and Bureau of Reclamation in 2012, the *Yolo Bypass Salmonid Habitat Restoration and Fish Passage Draft Implementation Plan* addresses two specific Reasonable and Prudent Alternative (RPA) actions in the National Marine Fisheries Service state and federal water project Biological Opinion for the recovery of endangered salmonid species, focused on increased seasonal inundation and fish passage in the Yolo Bypass:

RPA Action I.6.1: Restoration of floodplain rearing habitat, through the increase of seasonal inundation within the lower Sacramento River basin; and

RPA Action I.7: Reduce migratory delays and loss of salmon, steelhead, and sturgeon, through the modification of Fremont Weir and other structures of the Yolo Bypass.

Flooding in approximately 80 percent of years, the Yolo Bypass offers many characteristics of historic floodplain habitat favorable to various fish species. Flood protection is the primary function of the Yolo Bypass, with managed agricultural activities in most of the area during the dry season. At present, a number of Yolo Bypass focused restoration projects are being planned and implemented through the California EcoRestore initiative.

The associated Yolo Bypass Cache Slough Partnership, convened in 2016, also provides a vehicle for local governments to be involved in planning and decision making. Made up of 15 local, state, and federal agencies, the Partnership's purpose is to improve executive-level interagency coordination. The policy-level Partnership emphasizes the importance of achieving across-the-board improvements in habitat, flood protection, agricultural sustainability, recreation, and other public values. This foundational acknowledgement has set the stage for improved trust between stakeholders, a key ingredient in successful efforts of this scale.

See Quick Links p.37 to access above plans and programs.

QUICK LINKS

See Appendix I for full references and end notes

Bank Swallow Technical Advisory Committee (2013)
https://www.sacramentoriver.org/bans/index.php?id=recovery

Bay Delta Conservation Plan Public Draft (BDCP 2013)
http://baydeltaconservationplan.com/EnvironmentalReview/EnvironmentalReview/2013-2014PublicReview/2013PublicReview-DraftBDCP.aspx Accessed 6/2/16.

California EcoRestore projects (CNRA 2017)
http://resources.ca.gov/ecorestore/california-ecorestore-projects/
Accessed: August 24, 2017.

California State Parks Recreation Proposal for the Sacramento-San Joaquin Delta
www.parks.ca.gov/?page_id=26677

California State Wildlife Action Plan (CDFW 2015 update)
www.wildlife.ca.gov/swap/final

California Water Action Plan (CDFA and CalEPA 2014)
http://resources.ca.gov/docs/california_water_action_plan/Final_California_Water_Action_Plan.pdf

California Water Action Plan Update (CNRA, CDFA and CalEPA 2016)
http://resources.ca.gov/docs/california_water_action_plan/Final_California_Water_Action_Plan.pdf

Central Valley Flood Protection Plan: Public Draft (DWR 2011, 2012)
www.water.ca.gov/cvfmp/docs/2012_CVFPP_FullDocumentHighRes_20111230.pdf

Central Valley Flood Protection Plan Conservation Strategy (DWR 2016), Sacramento, CA
https://water.ca.gov/Programs/Flood-Management/Flood-Planning-and-Studies/Conservation-Strategy
Accessed: August 24, 2017

ERP Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta, Sacramento Valley and San Joquin Valley Regions (CDFW2014)
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=31232&inline
Accessed December 29, 2015

The Delta Plan: Ensuring a reliable water supply for California, a healthy Delta ecosystem, and a place of enduring value (Delta Stewardship Council 2013)
http://deltacouncil.ca.gov/delta-plan-0
Accessed: June 23, 2016

Conservation Plan for the Tricolored Blackbird (Kester 2007)
www.fws.gov/migratorybirds/pdf/management/focal-species/TricoloredBlackbird.pdf

Conservation Strategy for Swainson's Hawks in California
www.swainsonshawk.org/Images/Conservation%20Plan%2009%20final.pdf

Delta Economic Sustainability Plan
http://delta.ca.gov/regional_economy/economic_sustainability/

A Delta Renewed: A guide to science-based ecological restoration in the Sacramento-San Joaquin Delta (SFEI 2016)
www.sfei.org/sites/default/files/project/SFEI_DeltaRenewed_102616_lowres.pdf
Accessed January 25, 2017

A Delta Transformed: ecological functions, spatial metrics, and landscape change in the Sacramento-San Joaquin Delta (SFEI 2014)
www.sfei.org/documents/delta-transformed-ecological-functions-spatial-metrics-and-landscape-change-sacramento-san
Accessed: January 26, 2016

East Alameda County Conservation Strategy (EACCS 2010)
www.eastalco-conservation.org/documents.html
Accessed: June 29, 2016

East Contra Costa County Habitat Conservation Plan and Natural Community Conservation Plan (ECCCHC 2006)
www.co.contra-costa.ca.us/depart/cd/water/HCP/documents.html
Accessed: December 22, 2011

Estuary Blueprint, San Francisco Estuary Comprehensive Conservation and Management Plan (SFEP 2016)
www.sfestuary.org/ccmp/

Human Use of Restored and Naturalized Delta Landscapes (Milligan-Kraus-Polk 2016)
https://watershed.ucdavis.edu/files/biblio/Human%20Use%20Report_for%20screen%20viewing%20%28spreads%29.compressed.pdf

Restoring the Sacramento-San Joaquin Delta Ecosystem (CNRA 2015)
http://resources.ca.gov/docs/ecorestore/ECO_FS_Overview.pdf

Recovery Plan for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon and California Central Valley steelhead (NMFS 2014)
www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/recovery_planning_and_implementation/california_central_valley/california_central_valley_recovery_plan_documents.html

Suisun Marsh Habitat Management, Preservation, and Restoration Plan (USBR, USFWS and CDFG 2013)
www.wildlife.ca.gov/Regions/3/Suisun-Marsh

The Riparian Bird Conservation Plan (Point Blue, California Chapter of Partners in Flight 2016)
www.prbo.org/calpif/pdfs/riparian_v-2.pdf

San Joaquin Multispecies Habitat Conservation and Open Space Plan (SJMSCP 2000)
www.sjcog.org/DocumentCenter/View/5

Solano Multispecies Habitat Conservation Plan (draft Solano County Water Agency 2012)
www.scwa2.com/water-supply/habitat/solano-multispecies-habitat-conservation-plan

South Sacramento Habitat Conservation Plan
www.southsachcp.com

Water quality control plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 2006)
www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/2006wqcp/

Yolo Bypass salmonid habitat restoration and fish passage implementation plan (DWR and Reclamation (2012)
www.water.ca.gov/fishpassage/docs/yolo2.pdf
Accessed: 6/3/16.

Yolo Habitat Conservation Plan and Natural Community Conservation Plan (draft 2015)
www.yolohabitatconservancy.org/documents

Your Project, Your Ideas, Your Partners?

SECTION II

Integrating Delta Community with Conservation



Illustration: Alison Kazovi

The Delta as an Evolving Place 43

A Regional Approach to Conservation 45

Framework in Depth:

- Goal A: Incorporating Regular Stakeholder Communication into Conservation Practice 46
- Goal B: Delta Promotion at Local, State, and National Levels 49
- Goal C: Floating all Boats 51

Central Delta Corridor Parcels Conservation Opportunity Region 63

Guide to Supporting Partnerships 70

KEY TERMS

- **DELTA AS PLACE** - The concept of "Delta as Place" emerged from the 2007 Delta Vision Blue Ribbon Task Force process[1] and connects to the language in the Delta Reform Act of achieving the coequal goals "in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place" (California Water Code §85054).[2]
- **LANDSCAPE-SCALE BENEFITS** – The larger the scale of the planning context for conservation, the greater the potential benefits for the ecosystem. Projects planned on a "landscape scale," beyond individual parcels, can multiply benefits for fish and wildlife. Connecting individual projects across a landscape over the long term can yield bigger returns.
- **MULTI-BENEFIT PROJECTS** – Multiple benefits projects balance environmental and human needs either at the project scale, or the landscape scale to result in a variety of beneficial outcomes. As long as projects contribute to multiple benefits in the larger landscape context, not all have to result in multiple benefits at the project scale. Examples include: wildlife-friendly farming, multi-use floodplains that provide flood protection and agricultural fields with annual crops that provide habitat, and low-impact outdoor recreation in conservation areas.
- **WILDLIFE-FRIENDLY FARMING** endeavors to integrate conservation and agricultural production to benefit wildlife and conserve biodiversity on land that is used to produce food, crops, livestock, and other commodities.
- **HABITAT EXCHANGES** are voluntary programs that use habitat credit markets and financial returns for landowners to encourage willing landowners to provide wildlife habitat. The Central Valley Habitat Exchange aims to generate a future where landowners are rewarded for sustainable management and restoration activities that result in measurable environmental improvements. Improvements include healthier streams, resilient floodplains and riparian corridors that translate into more jobs and support benefits for farmers who "grow" habitat.

The Delta Conservation Framework footnote and endnote references can all be found in Appendix 1 online by section.

Introduction

There is growing recognition that for conservation practices to be successful they must be reconciled with the needs of Delta community members, tribes, and all Californians.[1]

Looking back, early examples show that this is possible.[2] Native Californians have lived in the Delta region sustainably for at least 6,000 years. Traditional resource management, such as fire management in the Great Valley, has been shown to increase habitat quality and species diversity, reduce evapotranspiration losses, attenuate peak flood flows, prolong stream flows, and increase production of culturally significant resources.

Over time, use of the Delta has intensified, however. As the Delta's population grows, as demand for fresh water and agricultural products continues, and as habitat for birds, fish, and wildlife shrinks, finding ways to do more with less for the benefit of all is becoming an urgent priority for residents and resource managers alike.

Today, the Delta is at a crossroads. In the last two hundred years, reclamation and agricultural development rapidly transformed the Delta from a natural landscape laced with rivers and marshes into a highly developed patchwork of levees, channels, farms, fields, towns and water conveyance systems. Over the next hundred years — faced with pressure to change the water conveyance system,[3] subsidence, weakening levees, endangered species, rising sea levels, and new climate extremes — the Delta must change rapidly again.

Restoring ecological processes will nurture ecosystem resilience in the face of future changes and will ensure continued and improved ecosystem services to local Delta communities and agriculture. This includes, but is not limited to open space; opportunities for hunting, fishing, boating, and other recreation that also promote tourism; clean water and fertile soils; subsidence reversal; carbon sequestration; crop pollination; biodiversity; and flood control. (See also Key Terms p.14)

This section of the *Delta Conservation Framework* highlights the need for a more comprehensive, public facing approach to conservation. It explores three specific goals designed to ensure that all stakeholder perspectives – whether business, community, recreational or resource management — are included when planning and implementing conservation in the Delta.

Goal A focuses on stakeholder communication and integration with regional planning partnerships.

Goal B focuses on outreach campaigns to local, statewide, and national audiences.

Goal C focuses on how the integration of conservation goals and existing science and planning can help achieve multi-benefit outcomes for Delta ecosystems and local communities.

While these are important foundational goals for the *Delta Conservation Framework*, it is important to acknowledge that solutions intended to benefit both the Delta ecosystem and local communities may not always result in equal benefits. Solutions, at one point or another, will inevitably include disadvantages, or even losses, for some stakeholders.[4,5,6,7] Recognizing the potential for unequal benefits must be a first step in any effort to gain the trust and cooperation of stakeholders.



Riverfront agricultural facility near Clarksburg in the heart of the Delta. Photo courtesy Delta Protection Commission

Public Feedback from 2016 Workshops

As described in Section I, efforts to engage stakeholders early in the *Delta Conservation Framework* planning process, and to start to develop a mutual understanding of common goals, included a series of public workshops in 2016. The workshops revealed that many Delta farmers, business owners, and residents feel that they have gotten the "short end of the stick" in the past, in terms of being given meaningful opportunities to share their views and contribute to the conservation and water planning going on all around them. In some cases, participants attended the 2016 workshops to avoid a potential negative effect on their lands or livelihoods. In other cases, participants were motivated by their desire to undo some of the degradation of Delta ecosystems caused by humans over the past century.

Participants in the 2016 workshops expressed particular concern about the possible impact of conservation on agriculture and Delta counties and communities. Many of these concerns pertain to the economic impacts of converting productive agricultural farmlands to wildlife habitats, floodplains, or other landscapes with benefits to ecosystem health. Concerns expressed about such conversions included the loss of a local tax base for Delta counties, and associated decreases in agricultural processing, labor, and equipment sales.

Workshop participants also expressed concerns about being subject to constraints on agricultural operations that might result from the presence of sensitive species on or near private property; the spread of invasive species onto their properties from nearby conservation areas, or vice versa; drainage and seepage from restoration or levee setback sites onto agricultural lands, or vice versa; and other unintended but potential impacts associated with implementation and management of conservation lands, and, in some instances, with public access to conservation lands.

Although it is possible to plan conservation projects with minimal impacts and multiple benefits, the degree of agricultural and community benefit from conservation will likely vary within the Delta and over time. Partnerships, projects and strategies developed through the *Delta Conservation Framework* will emphasize appropriate solutions with long term benefits for all stakeholders whenever possible. They will also focus conservation efforts on public lands first, and on providing lasting support and incentives for private landowners willing to engage in conservation.

Delta communities clearly also recognize that conservation can have positive impacts on their environment and the fish, wildlife, and waterways many rely on for tourism, hunting, fishing, boating, and quality of life. The way of life, and the quality of life, in the Delta are fundamentally supported by functional ecosystems. The ecosystem services provided by conservation efforts benefit all those that are part of the ecosystem, not just salmon, smelt, cranes and otters, but also women, men and children. As such, conservation projects that have small-scale impacts on agriculture should be considered in light of the potential direct and indirect larger, landscape-scale, benefits of ecosystem conservation to society. Ultimately restoring ecosystem processes via conservation may contribute more to local and statewide economies than maintaining marginal agricultural lands in perpetuity. The *Delta Conservation Framework* seeks to provide a framework for making these kinds of decisions with real consideration for the rich context of the Delta – people, place, and wildlife. It is imperative that all stakeholders get a chance to collaborate in conservation planning efforts and help make "all boats float" in the Delta in the long term.



Walnut Grove ice cream joint. Photo: Amber Manfree



Pear festival in Courtland. Farm festivals in the Delta offer a nexus between tourism, community, and stewardship. Photo courtesy Delta Protection Commission

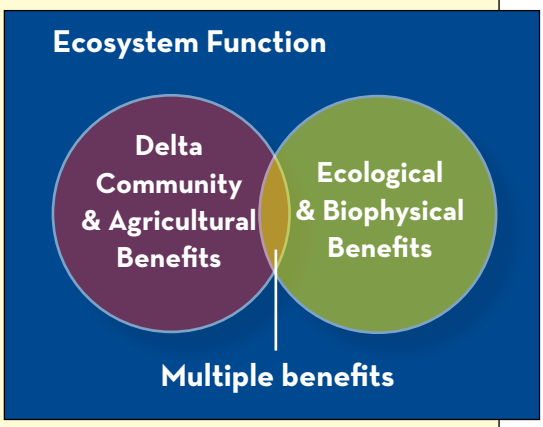
Delta as an Evolving Place

As mentioned above, in order for conservation to succeed it must occur in a context – such as the *Delta Conservation Framework* — that acknowledges the importance of an evolving place and the people who live there.

The phrase "Delta as Place" emerged from the 2007 Delta Vision Blue Ribbon Task Force process.[8,9] "Delta as Place" acknowledges that the Delta is a place for people, homes, and businesses, filled with history, cultural richness and diversity, as well as that the Delta is a critical hub for water distribution in California and an important ecosystem.[10]

The phrase connects to language in the Delta Reform Act directing that the state's co-equal goals of a reliable water supply and healthy ecosystem be achieved "in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place" (California Water Code §85054). This language calls for consideration of the human dimension in ecosystem conservation. The *Delta Plan*, in turn, articulates a number of ways to achieve this reconciliation of human uses and protection of the Delta ecosystem in the future.[10,11] The Plan also outlines regulatory policies, recommendations, and performance measures that track progress toward this end.[10]

Participants in the 2016 *Delta Conservation Framework* workshops described "Delta as Place" as a local feeling and great love for the Delta as a home, rooted in a multi-generational linkage to the land and in a way of life founded on farming and land management. They also recognized, however, that these strong ties to the landscape and its history may impart a reluctance to embrace change, especially if change is initiated from outside of local communities. Those Delta community members who participated in the 2016 workshops expressed concern that their lifestyle could cease to exist, or drastically change, if state agencies manage more land in the Delta and displace farms, orchards, pastures, and people. Participants also expressed concern that conversion and restoration of agricultural lands to habitat, or other state purposes, could adversely affect water quality and availability and also increase regulatory restrictions on their agricultural activities.



Stakeholder input suggests that research into potential socioeconomic effects, and acknowledgement of local concerns, needs to inform ongoing planning and implementation of conservation projects to be successful. Addressing local concerns may also help to achieve buy-in for long-term solutions.[12,13,14,15,16]

For example, as Delta conditions evolve over time due to climate change or changes in markets, which could both affect which crops are grown, some loss of agriculture could be balanced by improved long-term economic sustainability or other benefits.

Other entities and initiatives are now furthering the preservation of "Delta as place," and inform the *Delta Conservation Framework*. For example, Chapter 5 of the *Delta Plan*, Protect and Enhance the Unique Cultural, Recreational, Natural Resource, and Agricultural Values of the California Delta as an Evolving Place, describes the cultural values that make the Delta a unique place and outlines a series of five core strategies to protect and enhance those values. These core strategies include designating the Delta as a special place in state and national registries, maintaining Delta agriculture, encouraging recreation and tourism, sustaining a healthy and diverse Delta economy, and developing plans to protect Delta lands communities.

In addition to the strategies outlined in Chapter 5 of the *Delta Plan*, the Delta as Place Interagency work group was established by the Delta Protection Commission to implement related *Delta Plan* policies and recommendations and to advance Delta values. Some of this work involves coordinating activities across federal, state, and local agencies to promote Delta agricultural sustainability, culture, economic development, energy and transportation infrastructure, recreation, and subsidence reversal/carbon markets.[9] Recent work group actions include several initiatives: Community Action Planning, Delta Narratives, a Delta Awareness Campaign, a Delta Leadership Program, and a proposal for a federal designation of the Delta as a National Heritage Area.[9] This kind of heritage area is defined as "a region designated by the United States Congress, where natural, cultural, historical, and recreational resources combine to form a cohesive, nationally-distinctive landscape arising from patterns of human activity shaped by geography."[9]

If community attitudes and conservation planning are to evolve as the Delta evolves, and as what defines the "Delta as place" evolves, the region requires a more inclusive and adaptive long-term planning process. Many stakeholders, including government agencies, are rooted in the status quo. With so much change ahead, however, preparing for the future now, using the forward-thinking collaborative effort including representation of the various interests proposed by the *Delta Conservation Framework*, is in everyone's best interest.

"If there isn't community buy-in on restoration projects then they're often seen as an imposition rather than a type of amenity for the community. Those projects that have a good connection with the local community really increase their rate of success, because you have those communities looking out for those projects. If restoration is imposed, it plays itself out where it can get sabotaged, and there isn't support for it. I think most of the scientific community is aware of this now. I'm not sure we have a set of best practices yet. But I think they will have to come to light through trial and error."

BRETT MILLIGAN, UC DAVIS [1]

BENEFITS OF CONSERVATION TO DELTA COMMUNITIES

- Control of invasive aquatic vegetation in both conservation areas and adjacent agricultural and recreational waterways and marinas
- Climate change mitigation, adaptation, resiliency
- Removal of submerged debris and abandoned vessels in or near conservation sites
- Discouragement of unsanctioned activities, such as illegal dumping, poaching, unauthorized camping
- Installation and management of water gates, screens, and barriers for the benefit of fisheries and irrigation systems
- Improvement of water quality
- Beneficial reuse of dredge material in restoration of tidal wetlands (e.g., subsided lands or flooded islands or land-side of levees)
- Improvement of fishing access from levees and public conservation staging areas; enhanced wildlife viewing destinations accessible from boats (e.g., Calhoun Cut Ecological Reserve)
- Direct public access in certain conservation areas
- Enhanced tourism subsidizing local Delta businesses
- Improvement of air quality and scenic value from the planting of trees
- Public stewardship

A Regional Approach to Conservation

A strong thread throughout the *Delta Conservation Framework* is to focus on "regions" that make sense in terms of landscapes, watersheds, ecosystems, human history, or communities as an organizing principle for conservation work in the future.

The Framework references a number of different kinds of "regional" approaches:

- **Regional Conservation Partnerships** made up of diverse interests, public and private, that work together to achieve landscape level goals;
- **Regional Conservation Strategies** developed by regional partnerships that map out how conservation goals might be achieved in the regions with an eye toward fitting the regional pieces together across a larger landscape picture;
- **Conservation Opportunity Regions** roughly identified by Delta stakeholders where promising opportunities for major conservation and restoration successes exist (see maps pp. 20 & 170);
- **Regional Conservation Investment Strategy** (RCIS), a California Department of Fish and Wildlife program offering a structure for analysis, assessment, scenario-planning, investment and mitigation to regions interested in developing nonbinding, voluntary conservation and habitat enhancement actions around focal species and habitats (see also Section V).*

Of the above, the "regional conservation strategy" is a central organizing idea for implementation of the *Delta Conservation Framework*. A regional strategy might be an existing plan, such as the *Suisun Marsh Habitat Restoration and Management Plan*, or a new plan. The main idea is to develop non-regulatory, long-term, broadly supported regional conservation action plans. These would be developed collaboratively by a regional planning partnership comprised of public agencies.

Each regional conservation strategy would be aligned with the overarching goals and strategies of the *Delta Conservation Framework* while tailoring a set of conservation objectives, specific actions, and an adaptive management framework to the needs of a given region.

The Framework also suggests a process for integrated scenario planning to support existing and new regional partnerships in the development of regional conservation strategies. Through this process, regions can select a priority scenario representing the most favorable multiple benefit outcomes for implementation (see Section VI).

** While the core ideas of regional partnerships, strategies, and conservation opportunity regions presented here are the foundation of the Framework, they appear largely without capitalization throughout these pages to underscore an intent of inclusivity and collaboration.*



Regional scale planning enables the Yolo Bypass to be used for multiple benefits, including farming and habitat, and protects nearby Sacramento from flooding (such as this January 2017 event). Photo: Carson Jeffres

Framework in Depth: Goal A

Integrate Stakeholder Communication in Conservation Practice

Public agencies, restoration practitioners, and scientists can all benefit from working in collaborative partnerships with Delta residents, landowners, farmers, tribes and nongovernmental organizations, at the local and regional levels, to plan conservation projects.[1,10,11,13,14] The intention of these partnerships is to overcome the current climate of guardedness and move toward sustained communication and collaboration. Mutual respect for, and a commitment to, evaluating challenges and opportunities together is essential to the success of conservation. Delta ecosystem function could be greatly improved through support for multi-benefit projects.[1,8,10]

Collaborative Regional Partnerships

Strategy A1 under Goal A of the *Delta Conservation Framework* encourages the development of collaborative regional partnerships among public and private stakeholders to inform conservation planning. The work of such partnerships is to develop and implement regional conservation strategies within subregions of the Delta, using scenario-planning and decision-making approaches like those outlined in Section VI. These strategies should explore the most appropriate conservation scenario solutions for their sub-region, and consider local ecosystems, land uses, and needs of Delta communities in the process. As regional conservation strategies are developed, they should they not focus on adopting specific conservation measures from the *Bay Delta Conservation Plan* (see p. 30); they should, however, consider existing acreage targets detailed in regulatory and compliance plans.

As described above, stakeholder input from the 2016 workshops identified both existing regional partnerships and subregions of the Delta (subsequently referred to as conservation opportunity regions) where it makes sense to expand conservation efforts, support existing and new collaborative partnerships, and undertake strategic conservation planning.

The Framework also emphasizes the importance of executive level coordination and facilitation of habitat restoration in the Delta. A combination of such support and independent advisors can help overcome institutional hurdles related to project permitting, long-term management, and project implementation.

Local entities with strong ties to agriculture, such as farm bureaus or leaders within local agricultural communities, could also serve as liaisons to ensure the use of good-neighbor practices consistent with Department of Water Resources' (DWR) Agricultural and Land Stewardship Workgroup strategies[17] (see pp. 48 & 75). These regional liaisons would also ensure that any new priorities emerging from socio-economic studies supporting project planning and implementation be addressed. Regional conservation opportunity areas are featured within each Framework section and include the Suisun Marsh, Yolo Bypass, Cache Slough Complex, Central Delta Corridor, West Delta, South Delta, and North Delta (see pp. 63, 90, 121, 149, & 175).

The *Delta Conservation Framework* also suggests that easily accessible web tools and content be made available to support regional conservation partnerships. These resources could include existing conservation planning tools such as the Open Standards of the Practice of Conservation[18] and web links to current agency webpages, including CDFW, DWR, the Delta Conservancy, the Delta Protection Commission, the Delta Stewardship Council, and the Good Neighbor Checklist prepared by DWR[17] (see Table 2.2, p. 75). Websites and online forums (e.g., blogs, email list serves) should be designed to facilitate early and consistent communication among all Delta stakeholders. Physical mailings, published announcements, and posted flyers could also be used to inform potentially interested Delta community stakeholders about conservation-related meetings within each Delta region.

Major existing and emerging conservation efforts that are building blocks within the *Delta Conservation Framework* include:

- The *Suisun Marsh Habitat Management, Preservation and Restoration Plan*, established in 2013 to provide a structure for conservation planning and implementation in the Suisun Marsh region.
- The *Central Valley Joint Venture Implementation Plan* that outlines objectives for Central Valley habitats that support waterfowl, shorebirds, waterbirds, and riparian songbirds.[19]
- The Yolo Bypass-Cache Slough Complex Planning effort, which includes the Yolo Bypass-Cache Slough Partnership, the Corridor Management Framework, and the Yolo Bypass Working Group, that serve as a conduit for successful conservation planning and management in the Yolo Bypass-Cache Slough region.


Illustration: Afsoon Razavi

GOAL A

Ensure that regular communication among stakeholders and socioeconomic considerations are integrated into all Delta conservation initiatives.

STRATEGY A1

Maintain and expand communication among diverse individuals, organizations, and agencies with a stake in conservation planning.

- Use existing collaborative regional partnerships and regular coordinated forums to plan, implement, and manage conservation; evaluate progress; and engage in adaptive management.
- Foster new regional partnerships in areas without existing partnerships.
- Support the use of existing tools (such as best practice checklists, science based project design recommendations, and online scenario-building and decision-making methods) to engage stakeholders when planning or developing regional conservation strategies.

STRATEGY A2

Align conservation practices with best practices that support Delta agriculture and communities.

- Consider the Department of Water Resources' Agricultural and Land Stewardship Workgroup strategies, as well as socioeconomic and natural resource management. research (existing, ongoing, or new), in the planning of regional conservation strategies.
- Identify local experts in land use and agriculture as points of contact for individual projects and regional planning efforts.
- Consider relevant findings from socioeconomic research in conversation planning.
- Update conservation practices as ecosystem and stakeholder needs evolve and change.

- The Central Corridor Partnership, which is a regionally focused effort of public landowners and owners of publicly funded lands along the Central Delta Corridor with the goal to develop a regional strategy with coordinated conservation efforts.
- The North Delta Habitat Arc, a reconciled ecosystem strategy that creates an arc of habitats connected by the Sacramento River to benefit native fish and other wildlife.
- The Migratory Bird Conservation Partnership, comprised of three of California's top organizations for bird conservation: Audubon California, Point Blue Conservation Science, and The Nature Conservancy, working with a broad array of partners to develop multi-benefit conservation solutions for birds, wildlife, and human communities to address issues concerning birds' habitat and biological needs.
- The Nature Conservancy's BirdReturns, a pilot project combining crowd-sourced data, hard science and economic incentives to provide pop-up habitats for birds on rice fields in the Sacramento Valley. There is interest and potential to expand this effort to the Delta.
- The Delta Working Landscapes Program, coordinated through the Delta Protection Commission, is providing examples of what wildlife friendly agriculture and wetland restoration measures private landowners could adopt on larger scales throughout the Delta.[23,24]

See Guide to Supporting Partnerships and Programs on p. 70.

FRAMEWORK IN DEPTH: GOAL A CONTINUED

Agriculture, Land Stewardship and Conservation

Strategy A2 under Goal A of the *Delta Conservation Framework* suggests ways to align conservation practices with agriculture and land stewardship. Local landowners are concerned that conservation projects will take valuable agricultural land out of production, as well as spread invasive species, provide mosquito habitat, impact water supply, increase the risks of drainage and seepage problems, and draw scrutiny from regulatory agencies if listed species move onto their lands. Some participants in the 2016 stakeholder workshops felt that public agencies generally do not manage their lands well, and have insufficient staffing and funding for long-term monitoring and maintenance. They suggested that public agencies focus on finding solutions to improve land management and consider stewardship practices that incorporate agriculture (see also Goal C, Strategy C4).

Several solutions were proposed to address potential conflicts between conservation projects and local community goals. These included incorporating stakeholders' perspectives in conservation planning and implementation processes; using good- neighbor practices when managing conservation lands over the long term; and offering financial, regulatory, or other incentives to compensate landowners for their participation in conservation.

As described under Strategy A1, the *Delta Conservation Framework* suggests that conservation partnerships, state agencies, local agencies, and project proponents should consider the 2014 Department of Water Resources Agricultural and Land Stewardship Workgroup strategies (DWR-ALS)[17] to minimize potential impacts of conservation projects on agricultural lands. The DWR-ALS strategies contain specific tools that balance the needs of agriculture and conservation. They also provide an outline for assessing the ecosystem benefits of a given project, while ensuring that local landowners can achieve or maintain agricultural and economic viability in the surrounding region.

During conservation planning efforts, effective coordination among agricultural practitioners (or their local representatives), local planners, conservation planners, and other stakeholders is essential to ensure that potential impacts to agricultural lands and the environment can be recognized promptly and evaluated.[20,21] Farmers and landowners should be involved in planning from the start. Assistance and incentives for farmers and landowners to engage in conservation partnerships are also essential. Because landowners and farmers are often busy managing their own lands, the DWR-ALS strategies[17] suggest the use of public advisors for government projects aimed at conservation. The advisor could serve as a point of contact for agricultural interests in a region, help inform farmers and landowners about ongoing conservation planning processes and advocate for funding to provide incentives to farmers willing to use wildlife-friendly farming practices.

More information on DWR-ALS and Delta Working Landscapes can be found in the Guide to Related Partnerships and Programs on pp. 74-75.



Workers in a Delta field. Photo courtesy DWR-PJH

CONSERVATION ACTIONS WITH SOCIOECONOMIC BENEFITS

- Encourage more farms to adopt wildlife-friendly agricultural practices based on successful examples in the Delta, such as sandhill crane habitat on Staten Island.
- Construct new flood bypasses, or improve existing bypasses, to provide habitat and improve flood protections; for example, in Yolo Bypass and McCormack-Williamson Tract-Cosumnes (north and central Delta) and Paradise Cut (south Delta).
- Conduct restoration on already flooded islands like Frank's Tract to reestablish habitat for listed species, according to the Delta Smelt Resiliency Strategy, before converting productive agricultural land.[37,38]
- Focus restoration efforts on the mid-channel berms or islands that are in danger of being lost, before converting productive agricultural land, as a wide variety of species are dependent on those types of habitats, including Delta smelt, Chinook salmon, Sacramento splittail, western pond turtle, and Mason's lilaeopsis.
- Encourage the growth of native vegetation on the waterside of Delta levees, where appropriate, to provide habitat for aquatic and semi-aquatic species and provide recreational and tourism benefits.[40]
- In some areas, instead of planning restoration across large swaths of land, enhance existing habitat in smaller restoration areas by improving natural slough structure using dredge and fill material in strategic locations, increasing the variability of flows and water residence times, and creating more natural channel margins along existing sloughs and waterways by establishing native plants. Examples include Twitchell Island and Southport.
- Restore historic floodplains to provide ecosystem benefits onsite and in the Delta to enhance, for example, sediment transport and food web support and to improve system-wide flood management

Source: Adopted from Delta Protection Commission 2012.

Framework in Depth: Goal B

Educate the Public about Delta Cultural and Ecological Values

Most Californians who live and work outside the Delta have little sense of it as a unique place with a rich agricultural and recreational history, or don't understand how Delta ecosystems support local and statewide economies through water supply and other ecosystem services. Some only drive through the Delta on major highways with little notion of "where it begins and where it ends."[9] The *Delta Conservation Framework* recommends that statewide and national Delta education initiatives work in concert with the ongoing Delta Awareness Campaign[9] to close this awareness gap. These efforts should work to explain the Delta's historical legacy and economic importance to the public and decision-makers, as well as the urgency of improving its degraded natural areas and novel ecosystems (see Key Terms p. 108) so that they can better support Delta residents and native wildlife. Accordingly, 2016 workshop participants developed a public education goal and related strategies aimed at integrating recognition of the "Delta as an evolving place" with information about the importance of ecosystem conservation. The effort should build on existing education and outreach initiatives and target national, state, and local audiences.

Delta Public Education

Strategy B1 under Goal B of the *Delta Conservation Framework* suggests the importance of a well-coordinated, widely accessible local education program that heightens public awareness of, and support for, conservation and restoration activities. This increased awareness will foster ongoing local collaboration in conservation planning and increase appreciation for the direct and indirect contributions of ecosystems to people's well-being and quality of life. For example, the ecosystem services provided by conservation — including maintained or expanded areas for boating, fishing, and hunting — benefit both Delta residents and visitors. Increased awareness will also highlight how integrating activities that support conservation with those that support communities and local economies through the *Delta Conservation Framework* can increase benefits to both. Engaging the local community in conservation related discussions should be an ongoing priority.

The *Delta Conservation Framework* supports working with the several organizations already engaged in similar activities including: the Delta Regional Foundation, Delta Conservancy, Delta Protection Commission, and Water Education Foundation. One result of these kinds of education efforts has been the Delta Heritage Area Initiative. This initiative will define an area with specific boundaries within which projects and resources are focused to preserve the human heritage of the Delta.[9] Other educational initiatives have been the non-profit Delta Regional Foundation's Delta Leadership Program and the Delta FOREVER art show, presented at California State University, Sacramento, in March of 2016.[22,23]

Strategy B2 under Goal B focuses on educating audiences outside the region — across the State of California and the nation — about the Delta. In 2013, the Delta Protection Commission and the Delta Conservancy joined forces in response to a statewide survey that showed that 78 percent of voters had never heard of the Delta. In a two-stage effort they initiated a Delta Awareness Campaign to help educate Californians

FRAMEWORK IN DEPTH: GOAL B CONTINUED



Illustration, Afsoon Razavi

Goal B

Support and expand existing public outreach efforts advancing Delta conservation.

STRATEGY B1

Promote and update existing local and regional public education programs to broaden scope, audience, and messaging about future conservation challenges.

- Include educational curricula for all ages integrating agriculture, Delta communities, and ecosystem conservation across large landscapes and regional scales.
- Incorporate education about impending changes to ecosystem services and essential agricultural, wildlife, fish, water, and other common Delta resources from climate change.

STRATEGY B2

Continue support for the implementation and expansion of existing outreach campaigns to statewide and national audiences about the importance of both the Delta and multi-benefit conservation outcomes.

about the Delta as a historic, cultural, recreational, and ecological treasure of the State.[9] This Delta branding effort – led by the Commission — supported tourism research, identified promising market opportunities in the Delta, and commissioned logos and brand standards for the Great California Delta Trail and the proposed Delta National Heritage Area.[9] The second phase, led by the Conservancy, is creating a Delta-focused web presence linked to Visit California,[24] which will provide a more comprehensive overview of the Delta's cultural, recreational, historical, ecological, and agricultural tourism opportunities to potential visitors.

The *Delta Conservation Framework* also supports a public outreach theme suggested by 2016 workshop participants: "Where does your water come from?" Campaigns answering this question will help inform people throughout California and the U.S. about the Delta as a major source of water and ecosystem services for the fifth largest world economy.[22]

The *Delta Conservation Framework* also suggests that the Delta's existing outreach and branding programs be expanded to promote an appreciation for the unique ecosystems and wildlife in the Delta, as well as of impending changes to this unique place associated with climate change, rising sea levels, and extreme weather and precipitation events. Public support will also help fuel future conservation funding initiatives.[25]

Framework in Depth: Goal C

Seek Multiple Benefits to Float all Boats

When stakeholders and conservationists are able to collaborate, they can identify multi-benefit projects that simultaneously improve ecosystem function and provide human benefits. These kinds of "win-win" conservation strategies include wildlife-friendly farming, multi-use floodplains planted with annual crops, and low-impact outdoor recreation in conservation areas.

The benefits of conservation actions to ecosystems and Delta communities can be realized both immediately after construction and more slowly over the course of years or decades. Individual conservation projects can be designed to achieve multiple benefits within a short time frame, such as incentives for farmers to use wildlife-friendly practices or the addition of hiking trails and boat launches to restoration sites. These short-term benefits do not preclude more long-term conservation benefits, however. If properly designed, projects should also result in a slow restoration of habitats, biological processes, and ecological function to the Delta system, especially if multiple projects become established within a region.

Such forward thinking, multi-benefit approaches to conservation and agricultural evolution are especially critical for Delta stakeholders preparing for prolonged drought, extreme runoff events, potential levee failures, salinity intrusion and seepage, as sea levels rise and many parts of the Delta continue to sink. Such threats to the Delta's future agricultural productivity [26,27,28,29,30] are of particular concern on subsided lands, including most of the western and central Delta islands that are more than 10 feet below mean sea level.

The *Delta Conservation Framework* suggests that stakeholders explore a variety of possible solutions to these problems but be sure to consider science-based approaches. Scientific projections of long-term changes in climate, air temperature, precipitation, flooding, ecological trends and economic, social, and land-use priorities can all inform multi-benefit decision-making. If all stakeholders are willing to give a little and embrace certain tradeoffs — short-term losses in light of longer-term gains — community supported, multi-benefit conservation is a real possibility. [32,33,34,35]

> *"Facing forward will entail envisioning and implementing preferred transitory futures. We will need to drop old battles more quickly and look ahead to what the future holds for our environment and how it fosters our economy and well-being."*
>
> RICHARD NORGAARD, PROFESSOR EMERITUS OF ENERGY AND RESOURCES, UC BERKELEY[31]

Flood Management and Conservation

Strategy C1 under Goal C explores opportunities provided by the 2017 *Central Valley Flood Protection Plan's* (CVFPP) Conservation Strategy.[36] The CVFPP strategy presents a comprehensive, non-regulatory approach to providing ecological benefits and protecting public safety through the creation of multi-benefit improvement projects within riverine and floodplain ecosystems. It offers a regional programmatic framework for increasing the efficiency of planning and permitting, improving individual project cost effectiveness, and enhancing ecosystem benefits associated with flood control projects. The *Delta Conservation Framework* recommends that planning partnerships and project proponents follow the specific guidance in CVFPP Conservation Strategy when planning and implementing projects that integrate flood



Marinas, warehouses, riparian habitats, fishing holes and many other waterfront features all co-exist along Delta channels. Photo: Amber Manfree


Illustration: Afsoon Razavi

Goal C
Develop multi-benefit conservation and land management strategies and plans that balance environmental and human needs.

STRATEGY C1
Incorporate conservation goals in levee maintenance and flood management practices to provide or increase habitat along Delta channels, river corridors, and riparian zones.

- Work toward the objectives identified by the 2017 Central Valley Flood Protection Plan Conservation Strategy.
- Collaborate with groups of established flood control experts, such as the Delta Levee Habitat Advisory Committee.

STRATEGY C2
Support sustainable wildlife-friendly agriculture to provide additional habitat for wildlife and migratory birds.

- Develop a common, science-based understanding of the potential benefits of wildlife friendly agricultural practices in the Delta.
- Use existing incentives (such as agricultural conservation easements and Habitat Exchange programs) and investigate new financial incentives for wildlife friendly farming and ranching.
- Solicit, reference, and incorporate local agricultural and community expertise in wildlife-friendly agricultural practices during conservation planning.

STRATEGY C3
Control and reverse land subsidence and support climate change mitigation efforts in the Delta.

- Pursue carbon farming projects and conservation funding opportunities provided by growing carbon markets.
- Prioritize carbon management activities consistent with established carbon sequestration strategies including the practices for Natural and Working Lands in the 2017 AB 32 Climate Change Scoping Plan.
- Encourage and provide incentives for agricultural practices that reduce subsidence.

STRATEGY C4
Improve communication and coordination between stakeholders and state and local agencies concerning the ongoing management of state-owned lands.

STRATEGY C5
Develop best practices that ensure reliable water distribution for in-Delta uses during implementation of conservation plans and projects.

STRATEGY C6
Integrate best practices for improving surface- and groundwater quality into conservation project planning and implementation.

STRATEGY C7
Identify, develop, and implement conservation strategies that integrate habitat management goals and practices across both land and water, and for both terrestrial and aquatic species.



Flooding and levee stress have already started to affect the Delta during extreme weather conditions, and such extremes are expected to increase with climate change in the future. In the winter of 2017, heavy rains damaged levees along the North Mokelumne River, forcing residents on Tyler Island to evacuate. Flooding also spurred the evacuation of residents in the New Hope Landing Trailer Park and Marina and damaged farmland. Farmland was damaged along New Hope Road at another levee breach. These areas contain habitat for wildlife, such as the sandhill crane. Planned levee adjustments on nearby McCormack-Williamson Tract (pictured above), where a levee breached in 1997, are intended to provide tidal habitat for endangered species and improve local flood capacity. Photo: TNC

management and conservation in the Delta. The *Delta Conservation Framework* also recommends that project proponents coordinate directly with the Delta Levee Habitat Advisory Committee–a group that has been operating for 25 years to balance the need to conduct regular levee maintenance with habitat conservation efforts–and also consult the Delta Levees Investment Strategy Decision Support Tool.[37,38]

Planning partnerships and project proponents should consider lessons learned from past projects, incorporating long-term monitoring of project results and providing real world assessments of the costs of building and maintaining levee/habitat enhancement projects. Project proponents could also deliberate the importance of water elevation, vegetation (riparian and emergent), bank slope, substrate type for channel margin to benefit juvenile salmonids, for example.[35,38]

Other considerations in the Delta include evaluating the costs of constructing setback levees on subsided islands and conditioning Delta peat soil to provide stable levee foundations. Working with willing landowners and ensuring protection of existing structures and utilities are also important factors.[38] Risk assessments and outcome strategies, developed in close collaboration with levee engineers, will be required when choosing the location and design for setback levee construction. For example, the probability of flooding at a given location due to seismic events needs to be assessed, as well as state priorities for levee improvements. Planning partnerships or project proponents should consult the Delta Levees Investment Strategy and associated tools when planning setback levee projects.[37,39]

As a combined approach, the CVFPP Conservation Strategy,[36] the Delta Levees Investment Strategy,[38] and the Delta Levee Habitat Advisory Committee will continue to provide a balance of large-scale Central Valley wide planning and local site-specific expertise, both of which are essential for the success of individual projects and consistency with the broader goals of the *Delta Conservation Framework*.

Wildlife-friendly Agriculture

Strategy C2 under Goal C supports wildlife-friendly agricultural practices as tools farmers can use to improve ecosystem services, control pests, maintain biodiversity, preserve soils, reverse subsidence, and renew soil fertility.[39,40,41,42,43,44,45,46] Many of the state's HCPs/NCCPs in the Delta planning area, such as in Yolo County, include wildlife-friendly farming programs. The *Delta Conservation Framework* recommends that these and other programs that work with farmers to create and maintain habitat on private land should be promoted and expanded where possible. Many agricultural fields already contain wildlife-friendly features, such as hedgerows, irrigation canals with vegetation, and tree rows.

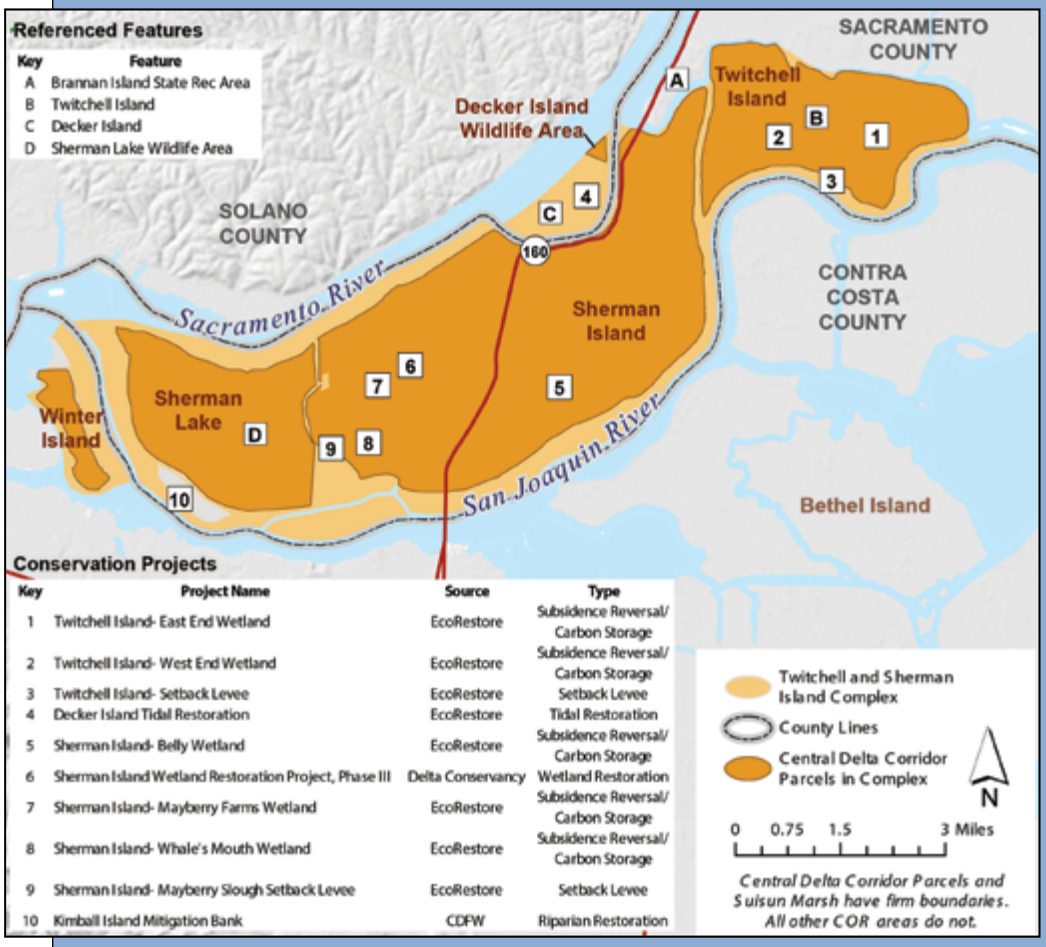
Wildlife-friendly farming is compatible with, and can even increase crop yields.[40,41] Coupled with financial incentives, this multi-objective approach to agriculture can offer benefits to both farmers and wildlife. For example, wildlife-friendly farming operations on Staten Island have benefited waterbirds—particularly migratory waterfowl and wintering sandhill cranes—while growing crops like corn, triticale, potatoes, alfalfa, and supporting permanent pastures.[39,42,46]

On the Ground Example: Twitchell Island Setback Levees

Many Delta levees need to be strengthened or upgraded to meet modern design standards and withstand future earthquakes, rising sea levels, and extreme flood events. In the process of these upgrades, it is often appropriate to consider adding habitat or additional flood plain by setting levees back from riverfronts. For example, a project on Twitchell Island under the California EcoRestore initiative, if approved and implemented, will not only stabilize a threatened section of the levee along the San Joaquin River but also construct waterside habitat features. The project will span nearly all of the San Joaquin River levee, plus a proposed 80-acre tidal marsh restoration site. Restoration through setback levees is expensive, however, and cannot be considered a standard design approach. Funding may come from Cap-and-Trade funds, Proposition 1 grants, and State Water Project mitigation.

This project would benefit both the Delta community and ecosystem function, reduce flood threat, and solve a number of problems on Twitchell Island. Currently, heavy winds cause waves to run up onto the roads and fields. The amount of space (freeboard) between high water levels and farms or structures is inadequate. The waterside levee slopes are also overly steep.[62] In addition to enhancing levee stability and increasing freeboard space, the proposed project would create waterside habitat and gently sloping "fish friendly levees." Fish friendly levees are designed to provide rearing and outmigration habitat for juvenile salmon. Adjacent to the main levee, tidally submerged and emergent vegetation will also benefit fish and marsh species, and a continuous corridor of riparian and upland scrub habitats will provide a diversity of vegetation and canopy structure for riparian birds and other wildlife.[62]

The *Delta Conservation Framework* suggests that these kinds of projects need to integrate science and monitoring into construction and maintenance in order to succeed. Evaluating the effects of different types of habitat improvements and levee designs on target species requires monitoring data.[62] Future setback levee designs should consider monitoring results, species responses and life history requirements, and Delta-specific constraints among many factors. For example, elevation of inundated areas needs to be evaluated to determine if: 1) tidal or seasonal inundation will support riparian, wetland, and upland habitats and species; 2) the setback distance will be sufficient to allow the channel to reinitiate riverine processes; and 3) the timing, duration, and frequency of flood flows are appropriate for habitat improvement. To create a multi-benefit project, the amount of setback needs to be balanced with the loss of productive farmland.



Map: CDFW, 2018

FRAMEWORK IN DEPTH: GOAL C CONTINUED

Crop rotation can also benefit wildlife and increase the economic return of farmland. For example, Swainson's hawk primarily forages in alfalfa fields within heterogeneous agricultural lands.[44] Because Swainson's hawk also forages in other crop types, they may benefit from crop rotations that follow fluctuating market values, as long as some cropland is maintained in high-value foraging crops. For example, fallowed fields, grain crops, sunflower, safflower, dryland pasture, and row crops such as beets or tomatoes are all used by Swainson's hawk[45,46,47,48] and other special status birds, such as white-tailed kite and tricolored blackbird. Crop rotation patterns are considered when scoring Swainson's hawk habitat value for the Central Valley Habitat Exchange program.[48]

Carbon farming in subsided areas offers another example of a multi-benefit approach. When rice, tules, or other wetland species are planted to replace conventional crops in subsided areas, they sequester carbon, increase organic substrate, reverse subsidence, and provide income to landowners through the emerging carbon market[49,50] (see Strategy C3, p. 57). In this example, tule marshes and rice fields could also support Delta wildlife, including giant garter snake and tricolored blackbird.[48,50,51] If conservation-focused financial incentives are available to allow farmers to continue earning revenue from wildlife-friendly agriculture, despite changes in ground water salinity levels and flooding frequencies, they could bolster long-term agricultural sustainability in the Delta.

Many governmental and nonprofit entities already recognize the value of establishing a mosaic of wildlife-friendly agricultural areas for wildlife habitat, and offer incentives to farmers for embracing this approach. Resource Conservation Districts, the Natural Resources Conservation Service, and federal Farm Bill programs—including the Conservation Reserve and Wetland Reserve Programs—have all been working in collaboration with farmers for decades to improve wildlife habitat and other aspects of environmental quality on agricultural land.[51]

As mentioned before, the DWR's ALS workgroup developed a series of strategies to expand existing collaborations between farmers and local, state, and federal agencies, which the *Delta Conservation Framework* embraces.[17]

The *Delta Conservation Framework* also supports incentive based programs such as the Migratory Bird Partnership[51] and the Nature Conservancy's Bird Returns pilot program.



The white-tailed kite relies on certain kinds of crops for food. Photo: Rick Lewis

The *Delta Conservation Framework* suggests a number of considerations be taken into account when promoting wildlife-friendly agricultural practices. These include demonstrating the economic benefits of habitat-friendly cultural practices; understanding the social, economic, environmental, and governmental policy hurdles of practicing conservation; and communicating the advantages to landowners.

This *Delta Conservation Framework* strategy recognizes that private agriculture as the major, potentially wildlife-friendly, land use of the Delta can be part of the solution.

More details on bird partnerships, wildlife friendly farming and other multi-benefit initiatives can be found in the Guide to Supporting Partnerships and Programs on pp. 70-75.

Wildlife-Friendly Agriculture[39]

- Deferring fall tillage until later in the year to increase the quantity of forage on cornfields for waterfowl and greater sandhill cranes
- Shallow flooding of seasonal croplands in fall/winter to increase the availability of forage for wintering waterfowl, shorebirds, and other species
- Retaining a percentage of the crop in the agricultural field for wildlife use to enhance the value of flooding
- Screening agricultural water diversions
- Improving fish passage at water diversion structures
- Maintaining individual trees and tree rows at the margins of agricultural fields
- Planting native hedgerows along farm and district waterways to provide wildlife, pollinator, water conservation, and erosion control benefits
- Promoting vegetated waterways and tail-water ponds
- Using livestock for weed control as a key tool to maintaining desirable habitat conditions, for example, in vernal pool grasslands

Potential benefits to agricultural stakeholders from improving conditions for wildlife include:

- Reduction in regulatory framework with species improvements
- Groundwater recharge to aquifers used for summer irrigation
- Leaching salts from soils
- Biological decomposition of crop residue
- Reduction in soil erosion
- Creation of opportunities for income from hunting and increased aesthetic values, both of which may increase property values
- Financial incentives associated with agricultural conservation easements
- Improved relationships with regulatory entities

Landscape-Level Farming[52]

Guidelines for farming in diverse landscapes with a mixture of restored ecosystems and agriculture:

- Maintain the existing benefits from a mixed landscape of agricultural and natural ecosystems, and encourage agricultural practices that maintain this diversity (e.g., maintain forest remnants, scattered trees, and crop diversity).
- Restore native ecosystem connectivity through commonly vetted projects across property boundaries or strategic land acquisition. These measures will benefit species that need large areas and are sensitive to agriculture.

Guidelines for farming in areas where farming is the predominant land use:

- Protect and expand large patches of native vegetation, because these provide important refuge habitat for species sensitive to agriculture.
- Create connections between existing conservation areas to increase the adaptive capacity of wildlife in the face of climate change. Connections may be created by traditional corridors or by innovative management strategies within agricultural lands, such as temporary fallows or intermittently flooded wetlands.
- Increase landscape heterogeneity by diversifying land use and crops, subdividing large fields to create more smaller fields, and establishing beneficial vegetation such as riparian areas and hedgerows along field boundaries and roads, irrigation and drainage canals.



Wintering sandhill cranes visit the Delta's Staten Island and Brack Tract (Isenberg Sandhill Crane Reserve) because of the food and habitat provided by wildlife friendly agriculture. Their visits also draw enthusiastic visitors to the Delta, who in turn bring in local revenue. Delta residents, meanwhile, regard the crane as a local icon and celebrate their winter arrival with events such as the Lodi Crane Festival. Photo Rick Lewis

FRAMEWORK IN DEPTH: GOAL C CONTINUED

Reversing Land Subsidence

Strategy C3 under Goal C encourages carbon farming conservation practices to reduce land subsidence, build up soils, and offset greenhouse gases. The Delta's peat soils are rich in carbon. If California converted an area the size of the subsided lands in the Delta into carbon farms, the annual benefits could equal: changing from standard light bulbs to compact fluorescents in all California households; turning all SUVs in California into small hybrids; or turning off all residential air conditioners in California.[49]

In 2006, Governor Schwarzenegger signed the Global Warming Solutions Act (AB 32, 2006)[53] to scale back California's greenhouse gas emissions to 1990 levels by 2020. AB 32 required the California Air Resources Board to develop solutions to meet emission reduction goals, including carbon sequestration and carbon credit trading. The emerging carbon market can offer opportunities for reversing land subsidence in the Delta while providing benefits to society in the form of carbon storage and financial incentives.

Carbon can be sequestered in the Delta both by restoring wetlands and conserving natural carbon trapping habitats, as well as by replacing conventional crops on subsided lands with rice, tules, or other soil-building wetland species. One large-scale demonstration project can be found on Twitchell Island in the western Delta (see also p.54). In this project the US Geological Survey is collaborating with a team of university researchers in the Carbon Capture Program[49] to show that flooding tule wetlands or rice fields during most of the year (especially during the summer and early fall months) reverses subsidence. Inundated tules and rice fields reverse subsidence by increasing root structure and producing bulky organic matter and new soil. The program shows promise as a technique to rebuild subsided Delta islands and help combat climate change by taking carbon dioxide (an important greenhouse gas) out of the atmosphere.[49]

Delta landowners can capitalize on the emerging carbon market by switching from growing traditional crops to farming carbon by planting tules, rice, or alfalfa and maintaining the land in agricultural use. Carbon farming offers a unique multi-benefit, win-win opportunity to increase elevation on subsided lands, restore a large portion of the Delta wetlands, and benefit the local Delta community.[49,50,51,53]

CARBON FARMING[49,53]

BENEFITS

- Reduces the cumulative stress on the levees
- Decreases the risk of levee failure, flooding, and costs of recovery
- Halts soil loss
- Reverses the effects of subsidence
- Sequesters carbon (captures and converts CO_2 to an organic compound and stores it)
- Generates revenue through carbon credits
- Creates habitat for Delta wildlife
- Reduces greenhouse gas emissions to meet the 2020 goal established by AB32
- Provides room for adaptation to sea level rise associated with climate change
- Preserves open space

CONCERNS

- Potential adverse environmental impacts need to be resolved, including contamination from mercury and dissolved organic carbon, and the need for mosquito control
- Implementation will be difficult on islands with multiple owners, unless all owners agree to take part in the project.
- Subsidence reversal requires land management practices that differ from much of conventional agriculture in the Delta
- Expansion of low-carbon agriculture, in the form of rice cultivation, may not be economically feasible for farmers, because rice yields are lower in the Delta than in the Sacramento Valley

GROWTH STRATEGIES

- Provide incentives to stabilize or reverse land subsidence
- Help farmers and landowners produce and sell greenhouse gas offset credits
- Investigate options to designate subsidence reduction and carbon sequestration crops as agricultural production for regulatory and incentive purposes.

FRAMEWORK IN DEPTH: GOAL C CONTINUED

Agency Land Management

Strategy C4 under Goal C seeks to advance and improve agency land management processes and procedures. Participants in the 2016 workshop series identified a number of challenges with state and federal land management practices in the Delta. Many of the public lands in the Delta are owned and managed by state agencies such as DWR, CDFW, and California Department of Parks and Recreation. County agencies have title to, and responsibility for, other Delta lands including the Petersen property in the Cache Slough region, owned by the Solano County Water Agency. Federal agencies also own land in the Delta, including the Stone Lakes National Wildlife Refuge owned by the USFWS. During the 2016 workshops, stakeholders repeatedly said there were "too many agencies involved in the Delta" and that government agency landowners can be "bad neighbors." Ownership and management of state lands in the Delta is split among several departments. Better coordination among state and local agencies could improve land management practices, streamline conservation implementation, and address some of the concerns of neighboring private landowners.

DWR's Agricultural and Land Stewardship workgroup provides a checklist (see p.75) for agencies and other conservation practitioners to ensure that they comprehensively consider the impacts of conservation lands on neighbors and neighboring land uses when managing lands in the Delta.[17]

The *Delta Conservation Framework* recommends use of this checklist, which includes specific actions such as contacting and communicating with neighbors, agreeing upon site access routes, discussing security or law enforcement, evaluating increased fire danger and introduction of invasive weeds or pests, identifying potential issues with flood control structures or other infrastructure, and understanding how neighboring agricultural operations may affect conservation projects through applications of chemicals or livestock presence. Through coordination and the development of standard procedures for management of both farmlands and conservation lands, impacts on either side could be measurably reduced.



Multi-benefit conservation, supported by collaborative public-private land management, is exemplified by the Cosumnes River Preserve, which encompasses 46,000 acres of conservation lands. The preserve offers not only hiking trails, canoe and kayak launches, waterfowl hunts, fishing, and classroom field trips, but also sustains row crops such as corn. These crops are farmed in a manner that benefits wintering migratory waterfowl and waterbirds, cranes and hawks.[32,33] Conservation in the preserve also offers local communities the benefits of improved flood protection and in-Delta water quality.[34,35,36,37] The conservation lands in the Preserve are owned and managed by multiple partners, including state and federal agencies (Bureau of Land Management, CDFW, California State Lands Commission, and DWR); Sacramento County; and non-governmental organizations (The Nature Conservancy and Ducks Unlimited). Agreed-upon goals and a management plan have been critical to good relations with neighbors. Photo: Carson Jeffres

Reliable In-Delta Water Distribution

Strategy C5 under Goal C supports the development of practices and permitting tools to assure reliable water distribution for in-Delta uses when implementing conservation. Water diversions are used to distribute water to agricultural fields or ponds throughout the Delta. As a side effect, small fish and other aquatic or semi-aquatic wildlife may be pulled into these diversions and perish.[54] Recent studies show that most small diversions take place at times and places when Delta smelt, especially larval smelt, are not likely to be present. Therefore, while small diversions are found throughout the Delta, it is unlikely that large numbers of Delta smelt have been entrained at the small intakes located close to shore.[55] Entrainment of juvenile salmon in unscreened diversions was also low relative to other fish species.[56]

While not opposed to conservation or integrated flood management in principle, local landowners and reclamation district managers are concerned that high profile projects targeted to benefit listed species could result in enforcement actions limiting local water diversions which have been providing water essential to the local agricultural economy for decades. Specifically, reclamation district managers and landowners have expressed concerns that water diversions will be curtailed in the future, or that the cost per unit of water will increase significantly as a result of successful restoration projects on neighboring lands. Without durable assurances that their operations can be maintained over the long term in the vicinity of listed species habitat, these local stakeholders find it difficult, if not impossible, to support individual projects.

The Framework suggests developing tools to minimize adverse effects of local water diversions on native fish, wildlife, and water quality and help preserve a reliable water supply for human use. These best practices could include raised awareness of the critical times when native fish, especially Delta smelt and juvenile salmonids, are most sensitive to entrainment to avoid negative effects. The Family Water Alliance is an example of a partnership among state and federal agencies and private contributors to fund and install fish screens on small agricultural diversions in the Sacramento Valley.[57] The success of the program resulted in the delivery of diverted water that is free of fish, protecting both the fishery resource and the local agricultural community.[58] As a further benefit to farmers, certain fish screens can keep fish and debris out of irrigation pipes, saving substantial operational and maintenance costs.[58]

If fish screens are not feasible — since screens are not effective in excluding larval life stages of fish — permitting tools are available to provide take authorization to conservation practitioners, neighboring landowners, and Delta residents for the diversion-associated take. Existing tools available under the California Endangered Species Act include incidental take permits, safe harbor agreements, and associated neighboring landowner agreements (see p.34 and Section V).



Irrigation water for Delta farms comes from both local waterways and state and federal water projects. Photo: Amber Manfree

FRAMEWORK IN DEPTH: GOAL C CONTINUED

Conservation-Related Water Quality

Strategy C6 under Goal C seeks to improve surface and groundwater quality when undertaking conservation related construction and restoration projects. During conservation project construction and management, certain practices such as the removal of water hyacinth or other invasive floating plants, installing new infrastructure, or breaching levees to reestablish tidal flows into marshes may affect water quality. Potential impacts can include increased turbidity and decreased levels of dissolved oxygen; nutrients and specific toxics can temporarily be affected. The *Delta Conservation Framework* recommends considering surface and groundwater quality improvements during conservation project planning and implementation. Attention should also be paid to lasting negative effects, especially if they affect groundwater and legacy contaminants.

Long-term negative impacts to water quality from wetland restoration may include an increase in the bioaccumulation of methylmercury or selenium.[59,60,61,62,63,64,65,66] For example, because of extensive mercury mining in the Coast Range and mercury use in Sierra Nevada gold mining, methylmercury production rates are higher in natural or managed Delta wetland habitat types than in other California aquatic ecosystems.[67] In some cases, wetland restoration may release mercury from sediment and increase the bioaccumulation of methylmercury in Delta wildlife.[59,60]

The Central Valley Water Quality Control Board's Delta Methylmercury TMDL Phase 1 implementation program requires studies and pilot projects to develop and evaluate management practices to control methylmercury discharges.[62,63] The studies and pilot projects will be evaluated by the Delta Mercury Control Program Technical Advisory Committee and the Board to inform implementation actions to control methylmercury during Phase 2 of the control program. These types of actions may help to minimize adverse impacts of bioaccumulatives like methylmercury or selenium caused by wetland restoration projects. Such actions have been successful in reducing methyl mercury impacts downstream in South Bay Salt Pond Restoration projects, for example.[61]

Wetland habitat restoration efforts in the Delta also provide numerous positive effects on water quality. With careful management, and attentive monitoring of hot spots and pathways related to each conservation or restoration project, potential contaminant-related negative effects can be minimized.



These gates allow managers of restoration sites in South San Francisco Bay downstream of the Guadalupe River Watershed, site of a historic mercury mine, to control water and limit methylmercury production levels. Photo: James Hobbs

Like mercury, some pesticides, such as the banned organochlorine pesticide DDT, are legacy problems in the larger San Francisco Estuary Watershed.[62] Careful project design and monitoring is all that can be done to minimize mobilization of these legacy contaminants into the Delta ecosystem. Yet, most contaminants responsible for reduced water quality arise from current-use compounds from industrial, agricultural, urban, transportation, and natural sources. There is increasing concern over new classes of contaminants, such as pyrethroid pesticides, pharmaceuticals, and personal care products.[62] Further, major contaminants of California's groundwater include salt, organic compounds, nitrates, pesticides, and metals.[63] Such water quality issues may not only affect fish and wildlife, but also recreational waters, fisheries, and farming operations.

To minimize adverse effects of restoration on water quality and Delta wildlife, the *Delta Conservation Framework* supports integrating or expanding best practices that align with State and Regional Water Board policies for improved surface and groundwater quality.[64,65] A review of existing best practices during project planning could help ensure the implementation of conservation efforts in a manner appropriate to project conditions and site specific water quality concerns.

Multi-species Floodplain Management

Strategy C7 under Goal C seeks to develop conservation goals to manage floodplain habitat for both terrestrial and aquatic species, while at the same time addressing human needs. Creating floodplains not only benefits terrestrial and aquatic species but also provides multiple benefits by conveying floodwaters away from human infrastructure and settlements, thereby reducing flood risk. In order to benefit fish species, floodplains should mimic natural flooding patterns, and remain flooded long enough to activate food webs and support fish rearing and spawning.[66] To support native fish species, remaining lakes should be managed as intermittently flooded habitat allowing fish access to cooler waters. For terrestrial species, particularly riparian wildlife, re-establishing flow and flooding is critical to ensuring dynamic woody riparian habitats.[66] To do so, re-establishing and maintaining hydrologic connection to the watershed with appropriate amounts of sediment is important, as is restoring and protecting complex, wide and continuous estuarine-terrestrial transition zones.[66]

The main objective of this strategy is to identify and implement opportunities to pursue multi-benefit floodplain projects and to manage land simultaneously for terrestrial and aquatic species, for example by planting nesting trees for bird species, and establishing high water refuge areas and overwintering habitat for species such as giant garter snake within floodplains, and by mimicking natural inundation patterns. The *Delta Conservation Framework* therefore supports the assessment of habitat suitability across several aquatic and terrestrial taxa found in the Delta.

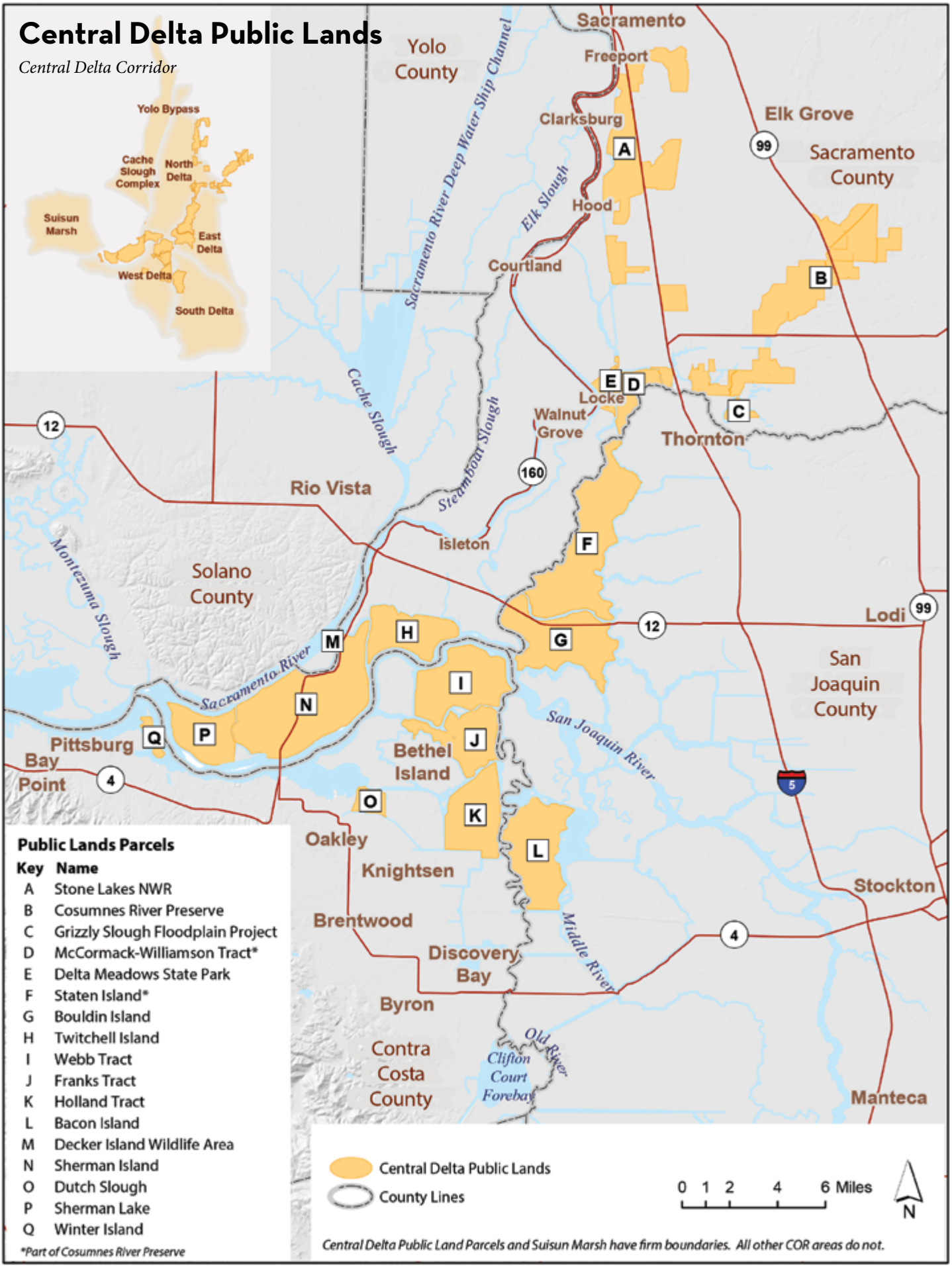
Economically viable, soil friendly agricultural practices can result in multiple benefits for wildlife and society. Developing and encouraging agricultural practices in the Delta such as no till, cover crops, periodically flooding fields, or walking wetlands helps reduce or negate the amount of subsidence that normally occurs on agricultural lands and allows for wildlife movement. Private agriculture as the major land use of the Delta can be part of the solution.

YOLO HABITAT CONSERVATION PLAN/NATURAL COMMUNITY CONSERVATION PLAN



An innovative setback levee in Hamilton City reconnects the Sacramento River to its floodplain, creates habitat, and strengthens the failing J levee, originally built in 1906. The town has been evacuated six times in the last 25 years due to flood fears. The project is a collaboration of the US Army Corps of Engineers, local landowners, Reclamation District 2140, and The Nature Conservancy. Photo: The Nature Conservancy

CONSERVATION OPPORTUNITY REGION



Map: CDFW, 2018



CONSERVATION OPPORTUNITY REGION

Public Lands First: A Coordinated Central Delta Strategy

Any talk of large scale Delta restoration, especially for those concerned about preserving the rich heritage of farming in the region, begins with the refrain "public lands first." Consideration of this important priority, and a look at just which lands were publicly-owned or funded in the heart of the Delta, reveals a corridor of islands and parcels stretching from Stone Lakes National Wildlife Refuge near Clarksburg in the north, down past the confluence of the Mokelumne and Cosumnes Rivers in the northeast, through the central Delta, and all the way southwest to Chipps Island near Pittsburg – 17+ parcels encompassing roughly 50,000 acres. More importantly, the configuration of this corridor – once mapped – suggests the potential for large-scale ecological benefit in terms of habitat connectivity for fish and wildlife often surviving on remnant patches and edges of habitat, rather than on more viable landscapes of 1,000 acres or more.

The Central Delta Corridor Partnership, established in 2017 to coordinate planning and restoration for this corridor, reflects *Delta Conservation Framework* goals for forward-thinking regional partnerships and strategies. The Framework also highlights the corridor as one of seven "conservation opportunity regions" where a critical mass of public lands, potential conservation opportunities, and conservation-minded people and existing partnerships occur in one place. The Framework seeks to support such regions and partnerships in strategic conservation planning. Together these regions will one day add up to a healthier Delta – both for people and wildlife.

Regional Setting & Background

The Central Delta Corridor Partnership (CDCP) oversees a network of roughly 50,000 acres of publicly owned or funded lands in the central delta area (see map p.62). The region is characterized by lakes, floodplain, tidal wetland, deeply subsided islands,[1] and includes the flooded Franks Tract Recreation Area. While the bulk of the lands that are included in the partnership are contiguous, some parcels are interspersed with privately owned property. The Central Delta Corridor partners include government agencies, water districts, and NGO conservancies managing publicly funded lands, among others. The partners have met regularly since early 2017, with the goal of developing a regional strategy of coordinated conservation efforts. The partnership has steadily grown by reaching out to neighboring landowners, both public and private, and including them in conservation planning.



Photo: Christina Sloop

Management goals include flood management, agricultural sustainability, and conservation of aquatic, avian and terrestrial resources. The deep subsidence on most central Delta islands limits potential prospects for conservation, but there are opportunities to enhance channel margin habitat and tidal habitat on the western-most islands. As long as levees are maintained, there is also significant potential for managed marsh for waterfowl, for subsidence reversal, and for the conservation of interior woodland areas on many of these islands. In the long term, CDCP partners believe that the creation and enhancement of wildlife habitat could go hand-in-hand with levee improvements and maintenance, and not only support target species but also improve flood protection and water quality, and sustain agriculture and the local economy.

Central Delta Corridor At A Glance

Area: ~ 50,000 acres

Location: Within the northeast and central Delta, including Stone Lakes National Wildlife Refuge, Cosumnes River Preserve, McCormack-Williamson Tract, Staten Island, Bouldin Island, Twitchell Island, Sherman Island, Webb Tract, Franks Tract, Holland Tract, Bacon Island, Decker Island Wildlife Area, and Dutch Slough

Elevation range: ~ 23 feet below sea level - 56 feet above sea level

Primary land use: ~ 50-60 percent agriculture - 40-50 percent public lands

Other primary land uses: flood protection, wildlife habitat, water supply, recreation, scientific research, carbon sequestration

Natural communities: Managed wetland, tidal wetland, freshwater emergent wetland, floodplain, grasslands, riparian, vernal pools, channel margin, open water, wet meadows

Urban population: 0

Rural or small community population: ~ 400-450

Recreational opportunities: Wildlife observation, hiking trails, boating, fishing, hunting, photography, interpretation

Listed species: Greater sandhill crane, Delta smelt, longfin smelt, Chinook salmon, Central Valley steelhead, green sturgeon, giant garter snake, Swainson's hawk, tricolored blackbird, vernal pool fairy shrimp, vernal pool tadpole shrimp, California black rail, Ridgway's rail, California least tern.

Planning History

When Southern California's Metropolitan Water District (MWD) acquired a number of large islands in the central Delta in 2016 for public purposes, the shape of a significant swath of public lands that could be improved, restored or managed for environmental, water quality, and wildlife purposes began to emerge. The Delta Conservancy — tasked with conserving both Delta farmlands and habitat — encouraged MWD and other public landowners in this corridor to begin thinking about their common conservation objectives and the opportunity to pursue the "public lands first" focus popular among in-Delta communities. Current members of the resulting Central Delta Corridor Partnership include MWD, The Nature Conservancy, the California Department of Water Resources (DWR), the California Department of Parks and Recreation, the California Waterfowl Association, the Bureau of Land Management, the U. S. Fish

and Wildlife Service, and the California CDFW. Their decision to collaborate in developing a collective corridor vision recognizes their capital investments in the Delta, the historical legacy of the Delta, and the state's policies to rehabilitate the Delta ecosystem. To develop this vision, the Central Delta Corridor Partnership is engaging in a regional conservation strategy planning process of the kind recommended by the *Delta Conservation Framework*. The Partnership's combination of public and private large-parcel landowners provides a unique chance to explore opportunities for conservation, identify collaborative multi-benefit solutions, and coordinate implementation.

Conservation Opportunities

From north to south, the Central Delta Corridor conservation areas range from minimally to deeply subsided, and landscape-level conservation planning efforts need to consider opportunities along the full range of this environmental gradient.[2] From the perspective of the *Delta Conservation Framework*, specific conservation strategies that should be considered within this corridor include restoring tidal marshes in areas of intertidal elevations, restoring woody riparian vegetation in areas with stronger fluvial influence, and promoting wildlife-friendly agriculture and the construction of managed marshes in deeply subsided areas.[2] Other critical connections to the corridor that should be evaluated in conservation planning include: the tidal-terrestrial transition zone in the southwest portion (along the Sacramento River near the Sacramento-San Joaquin River confluence); stepping stone marshes leading to the eastern and southern Delta from the confluence; connections to the upstream watershed and Mokelumne and Cosumnes riversheds; and connections to the brackish estuary on the western edge of the Delta.[2]

Cornfield at McCormack Williamson Tract before flooding in 2017.
Photo: Christina Sloop



Major Central Delta Corridor Existing & Planned Restoration Projects

- McCormack Williamson Tract, 1600 acres floodplain restoration
- Grizzly Slough floodplain project, 400 acres floodplain restoration
- Decker Island Wildlife Area, 34 acres tidal restoration
- Decker Island, 140 acres tidal restoration
- Twitchell Island east end wetland, 800 acres subsidence reversal and carbon storage
- Twitchell Island west end wetland, 1,250 acres subsidence reversal and carbon storage
- Sherman Island belly wetland; 1500 acres subsidence reversal and carbon storage
- Sherman Island Wetland Restoration Project Phase III
- Dutch Slough tidal marsh restoration, 1,187 acres of tidal restoration
- Sherman Island wetland restoration project Phase II, 1,009 acres wetlands
- Sherman Island wetland restoration project Phase I, 666 acres wetlands
- Winter Island, 589 acres tidal restoration
- Chipps Island 887 acres tidal restoration
- Reclamation District special projects that include some in-channel habitat enhancement

Additional Conservation Opportunities

CHANNEL MARGIN HABITAT AND LEVEE IMPROVEMENTS

Restoration of suitable zones along the aquatic side of levees to a more natural state would benefit salmonids and other native species. Restoration might include planting vegetation, anchoring woody debris, and constructing shallow benches where native species could find refuge from predators.[3] Suitable locations include from Franks Tract east through the Delta to the McCormack-Williamson Tract and the Cosumnes River Preserve. These "fish friendly levees" are currently part of the DWR's multi-benefit Delta Levees Program.

AQUATIC HABITAT RESTORATION ON TWO TRACTS

The McCormack-Williamson Tract is considered a prime site for floodplain restoration, tidal freshwater marsh, seasonal wetlands, and riparian forest. The restoration plan would allow the area to flood naturally under high-water conditions to alleviate flood risks downstream while providing valuable aquatic and terrestrial habitat for native Delta species. Over time, this could seasonally reconnect lakes, channels, and marshes to prominent features in the region including Delta Meadows, Snodgrass Slough, the Mokelumne River, Burton Lake, Grizzly Slough, Stone Lakes, Dead Horse Island, Staten Island, and the Cosumnes River Preserve.

Franks Tract offers another unique opportunity for aquatic habitat restoration as it is one of the least subsided flooded islands in the Central Delta Corridor. Restoration of Franks Tract would enhance habitat conditions for Delta smelt[4] and other native fishes by minimizing suitable habitat for nonnative fish and submerged and floating aquatic invasive plant species, as well as modifying tidal circulation to create channel conditions similar to historic conditions. Results of an early CDFW feasibility study, and efforts to engage the local community early in the planning process, both suggest Franks Tract could be a project of the multi-benefit scope and landscape scale encouraged by the *Delta Conservation Framework*. In addition, the state's Delta Smelt Resiliency Strategy[4] identifies Franks Tract as a strong candidate for improvements to smelt habitat and food supply (see also p. 88).

REFERENCING EXISTING REGIONAL HABITAT PLANNING

The *South Sacramento Habitat Conservation Plan* (SSHCP)[5] encompasses the northern and northeastern part of the corridor. The plan aims to streamline federal and state permitting processes for SSHCP-covered development and infrastructure projects while protecting habitat, open space,



Delta smelt habitat at Franks Tract, a state owned recreation area, could be improved with restoration of 40-60 percent of the now flooded tract to tidal marsh. Photo: Christina Sloop

and agricultural lands. It also provides the kind of a carefully analyzed body of existing planning work regarding ecosystems and conservation opportunities in an area of overlap with the corridor that the *Delta Conservation Framework* encourages regional partnerships such as the CDCP to reference.

Potential Solutions to Recognized Challenges

SUSTAINABLE LONG-TERM OPERATION AND MANAGEMENT OF CONSERVATION LANDS

Sherman and Twitchell islands, like other deeply subsided Delta islands, require high flood protection levees that are costly to maintain in the long term. DWR has begun to address the causes of subsidence by withdrawing from agricultural leases and developing wetlands in their place to build back peat soils. However, this transition from agricultural production to ecosystem services means a significant increase in annual management costs and associated loss in revenue. Thus far, DWR has provided the necessary funds for flood control and land management on their lands in the western Delta; however, this is not sustainable. One new possible source of revenue is carbon market credits for carbon capture now associated with subsidence reversal. By quantifying the level of carbon sequestered in the newly-developed peat soil of the wetland, credits can be sold.[6] Additional alternative sources of revenue may include authorizing hunting leases on the wetlands and fulfilling mitigation requirements associated with other DWR projects.

Levee management and maintenance remains at the forefront of challenges to all Delta islands.[7] California ground squirrel and beaver dens threaten levee integrity; bird nesting season constrains maintenance activities. Alternative conservation-compatible management activities include: grazing sheep on levees, which would clear vegetation to maintain standards and detect leaks; providing raptor perches to help limit ground squirrel activity; and pre-placing emergency materials for flood events. Creating more gradual landside levee slopes could also create more habitat.



Levee failure at McCormack-Williamson Tract in 2017. Photo: The Nature Conservancy

SUSTAINABLE WILDLIFE-FRIENDLY AGRICULTURAL USES

Providing food resources for migratory birds within a diverse land use mosaic that balances minimal foraging distances with agricultural and recreational uses remains an ongoing challenge on a landscape scale. For example, an enduring management challenge is providing adequate wintering habitat (September-March) to sustain greater and lesser sandhill crane populations on Delta islands, while maintaining economically viable agricultural operations. Both species require shallow flooded areas for roost sites and dry agricultural fields (corn, wheat, pasture, alfalfa) for foraging habitat.[8] Land management to benefit sandhill cranes involves finessing the timing and amount of flooding and drawdown, carefully selecting the types and amounts of wildlife-friendly crops that can be grown, and balancing tradeoffs between harvest efficiency and availability of residual grain for waterbirds.[9] Crop diversity in the Delta can be limited as a result of soil, climate, low commodity prices, herbicide-resistant weeds, predation by grazing geese, salt build-up, and limited markets for non-GMO crops. All of these factors also limit the economic viability of farming operations on Staten Island, one of the larger islands in the public corridor. One potential solution to balancing agricultural production with wildlife needs would be to use additional flooding to reduce salts and subsequently increase yield.

CONSERVATION OPPORTUNITY REGION CONTINUED

To evaluate where decreased agricultural productivity aligns with opportunities for conservation as sea level rises and soil salinities increase, it will be critical to use the kind of strategic scenario planning recommended by the *Delta Conservation Framework*. It will also be important to consider the carbon footprint of certain crop types commonly used to reverse subsidence of peat soils when conducting scenario planning to set the stage for the long-term sustainability of a balanced land-use mosaic across the Central Delta Corridor.

HABITAT FRIENDLY RECREATION

In order to heighten public support for conservation and benefit the local agricultural economy, the *Delta Conservation Framework* suggests that conservation planning in the corridor incorporate agro-tourism and increased public wildlife viewing opportunities. Sandhill crane conservation on Staten Island and Brack Tract in the corridor is linked not only to wildlife-friendly agriculture, but also to the Lodi Crane Festival and other crane viewing events, which bring many enthusiastic viewers to the area and draw in local revenue. In some cases, however, enhanced public use can result in trespassing, poaching, vandalism, and burglary and compromise safe access for public viewing of wildlife. As a result, the *Delta Conservation Framework* suggests that public access planning should include consideration of greater enforcement in designated public areas and more signage.[18]

CLIMATE CHANGE ADAPTATION OPPORTUNITIES

Climate change induced sea level rise and changing rainfall and temperature patterns will increasingly affect the Central Delta Corridor in the next 30-100 years. Lands currently in the intertidal zones are projected to become subtidal (Map p.20).[10] Rising water levels will induce flooding when unprotected shorelines and nearby areas are submerged and will affect levee stability and resilience, especially along subsided islands.[11] In some parts of the Delta, sea level rise will mean that current agricultural land will be lost to increased salinity levels or inundation.[11] Additionally, flood dynamics are projected to change over the next few decades, with more frequent and extreme storm and rainfall events and associated flood pulses coming through the region.[11,12]

As mentioned above, the *Delta Conservation Framework* suggests that scenario planning[13,14] could be a useful tool for helping the CDCP anticipate impacts of climate change on ecosystems, species, infrastructure, agricultural practices, recreation, and other land uses and integrate these into the long-term conservation planning picture.Another useful tool could be pilot projects supported by Proposition 1 bond funding[15] that could explore new technologies and approaches to multi-benefit, adaptive restoration — such as living shorelines,[16] horizontal levees,[17] carbon farming,[18] early detection and rapid response of invasive species[19] — and assist with levee strengthening and subsidence reversal.



Setback levee, riparian habitat strip, and carbon farming on the state's Twitchell Island. Photo: Christina Sloop

Monitoring, result sharing, and regular reevaluation of scenarios over time will help with examining how exactly projections play out and how management actions of conservation lands need to be adjusted over time.

CARBON SEQUESTRATION AND SUBSIDENCE REVERSAL

The Central Delta Corridor public lands contain a significant percentage of the most deeply subsided Delta lands. Since the late 1800s when the lands were first drained for agriculture, more than 3.3 billion cubic yards of organic soils have disappeared in the Delta, resulting in land surface elevations 20 to 25 feet below sea level (see map p.20).[20] The volume below sea level of approximately 1.7 million acre-feet not only limits continued agricultural practices, but also represents a significant opportunity to implement carbon sequestration projects. Previous research has demonstrated that carbon dioxide (CO_2) emissions are positively correlated with subsidence.[21] Modelling results estimate that 1.5 to 2 million metric tons of CO_2 are emitted from about 200,000 acres of organic and highly organic mineral soils in the Delta each year as they continue to subside. In addition to CO_2, nitrogen dioxide and methane emissions are also released during oxidation of soils. The Central Delta Corridor provides a unique opportunity to continue and expand subsidence reversal trials to stabilize peat loss and enhance soil accretion. The corridor's Twitchell and Sherman islands, for example, will continue to sink unless subsidence-neutral crops like rice, irrigated pasture, or wetland tules are grown. Subsidence reversal actions also ultimately reduce the risk of flooding as islands increase in elevation over time; maintain revenue through agricultural sales and sale of carbon credits; and provide habitat for terrestrial, aquatic, and avian species.[2]

Looking Ahead

Delta community members and stakeholders at the 2016 *Delta Conservation Framework* workshops commented that public lands should be the focus of Delta conservation efforts. The Central Delta Corridor represents a great opportunity to achieve this goal. The current Central Delta Corridor partnership initiated steps in 2018 to inventory and coordinate ongoing efforts, highlight additional opportunities, and develop an outreach strategy. The partnership also recognizes that a critical component of the success of the effort is local support. Partners are conducting focused outreach to engage neighboring landowners early in the process. The partnership is currently developing a high-level strategy document that identifies the most promising opportunities and most challenging constraints. This coordinated conservation strategy is intended to advocate for funding to better manage conservation lands, encourage wildlife-friendly farming, and implement activities for habitat restoration.

QUICK LINKS

Delta Carbon Program
http://deltaconservancy.ca.gov/delta-carbon-program/

Franks Tract Restoration Feasibility Study
https://www.wildlife.ca.gov/conservation/watersheds/dcf

Sacramento-San Joaquin Delta Conservancy Central Delta Corridor Partnerhsip
http://deltaconservancy.ca.gov/centraldeltacorridor/

South Sacramento Habitat Conservation Plan
https://www.southsachcp.com/

USGS Carbon Capture Farming Program
https://ca.water.usgs.gov/Carbon_Farm/

For more detailed descriptions of these conservation opportunity regions, see Appendix 2.

GUIDE TO SUPPORTING PARTNERSHIPS AND PROGRAMS

BirdReturns Project

STRATEGY A1, EXISTING PARTNERSHIP

The Nature Conservancy (TNC) is spearheading this project, which aims to conserve the Pacific Flyway. As a result of habitat destruction, water and food shortages, and climate change, migrating birds are having difficulty finding wetlands along the Pacific Flyway to stop for feeding, resting, and overwintering. To address the decline of the Pacific Flyway's support for avian migration from Alaska to South America, the pilot BirdReturns project combines scientific data with economic incentives to provide habitat for birds on rice fields in the Sacramento Valley. Two of the BirdReturns strategies to conserve migratory birds are to 1) protect and enhance bird-friendly agricultural lands; and 2) secure adequate water supply to wetlands and compatible agricultural lands. The project's goal is to create one million acres of Central Valley wetland habitat through citizen science. Bird sightings recorded in the eBird database are sent to the Cornell Lab of Ornithology, which will generate maps showing the highest concentration of birds on the remaining Central Valley wetlands and where the habitat needs are greatest. Along the Sacramento River, for example, TNC pays farmers to keep rice fields flooded to optimal depths as flocks of migrating birds arrive.

Central Delta Corridor Partnership

STRATEGY A1, EXISTING PARTNERSHIP

A large portion of the central Delta is publicly owned or publicly financed, and if restored and managed on a landscape scale could link together conserved lands in the northeastern and central portions of the Delta in a vibrant conservation corridor. The owners of these lands have met regularly since early 2017, and the Central Delta Corridor Partnership (CDCP) has steadily grown via outreach to neighbors. CDCP members own and manage approximately 50,000 acres of land in the Delta, and include The Nature Conservancy (TNC), the Metropolitan Water District (MWD) of Southern California, the California Department of Water Resources (DWR), the California Department of Parks and Recreation, the California Waterfowl Association, the Bureau of Land Management, the US Fish and Wildlife Service, and the California Department of Fish and Wildlife. In March 2018 CDCP began a nine-month inclusive planning process evaluating conservation opportunities available on Delta islands and other existing conservation properties in the central Delta.

See p. 63 for an overview of the Central Delta Corridor Partnership.

Central Valley Joint Venture

STRATEGY A1, EXISTING PARTNERSHIP

A long-standing and cooperative partnership in the region, the Central Valley Joint Venture (CVJV) has worked on conservation to benefit migratory birds, special status species, and other wildlife throughout the Central Valley since 1988. The CVJV is led by a management board of 21 public and private entities and is one of 18 joint ventures throughout North America formed under the North American Waterfowl Management Plan. The CVJV leverages public and private resources for projects throughout the Central Valley. The 2006 CVJV Implementation Plan outlines objectives for Central Valley habitats that support shorebirds, waterbirds, and riparian songbirds.[78] A revised CVJV Implementation Plan with updated bird population objectives is slated for release in 2019.

The objectives set by the CVJV for the Yolo-Delta, Delta Basin, and Suisun Marsh are relevant to *Delta Conservation Framework* Goal C, Strategy C2, "Support sustainable wildlife-friendly agriculture to provide additional habitat for wildlife and migratory birds"; Goal D, Strategy D1, "Restore, enhance, and manage ecosystem processes Delta-wide to improve function and life history support for native and migratory wildlife;" and Goal D, Strategy D2, "Conduct technical analyses within groups such as regional conservation partnerships" to prioritize areas for conservation and climate adaptation.

The *Delta Conservation Framework* suggests that regional partnerships and planning groups should consider and reference CVJV's habitat objectives for resident and migratory birds.



In the first year of BirdReturns, 10,000 acres owned by 40 farmers were flooded for up to eight weeks. Participating farmers included the Rue & Forsman Ranch, which grows sushi rice near Wheatland, California. While the timing of flooding may have had a disadvantage for planting, the compensation was "better than adequate," according to the farmer. Photo: Rick Lewis

See Quick Links p. 75 to access some of these partnerships and programs.

Delta Working Landscapes Program

STRATEGY A2, BEST PRACTICES

The Delta Protection Commission program, which ran from 2010–2012, provided examples of wildlife-friendly agriculture and wetland restoration measures private landowners could adopt on larger scales throughout the Delta. In collaboration with Ducks Unlimited, Hart Restoration, Inc., and local landowners, the objectives of this program were to:

- Improve the environmental quality of existing landscapes in the Delta;
- Demonstrate economic benefits of habitat-friendly cultural practices;
- Understand the social, economic, environmental, and governmental policy hurdles to conservation; and
- Communicate the advantages of wildlife-friendly agricultural practices to landowners.

The Delta Working Landscapes Program focused on pilot projects that demonstrated how farmers can integrate habitat restoration into farming practice. For example, the program established vegetative buffers along irrigation ditch banks and hedgerow plantings, designed to provide habitat for wildlife, improve water quality, and enhance levee stability. Restoration projects also included creating seasonal and permanent wetlands on marginal farmlands, providing essential habitat for waterfowl. By the time work on the program was completed in 2012, the projects resulted in a total of 312 acres of wetlands and 6.5 miles of enhanced levees and waterways. The *Delta Conservation Framework* supports multi-benefit conservation efforts that keep landscapes working for both people and wildlife.

See p. 74, Table 2.1 for examples of projects under this program.

Migratory Bird Conservation Partnership

STRATEGY A1, EXISTING PARTNERSHIP

Since 2008 this partnership has addressed issues concerning bird habitat and biological needs while working with a broad array of partners to develop multi-benefit conservation solutions for birds, wildlife, and human communities. Aligned with the work of the Central Valley Joint Venture, the MBCP is comprised of three of California's top bird conservation organizations: Audubon California, Point Blue Conservation Science, and The Nature Conservancy. The partnership currently focuses on three regions in the Central Valley: Sacramento Valley, San Joaquin River Basin, and the Sacramento-San Joaquin Delta. The ten million acre Central Valley provides particularly important habitat for Pacific Flyway migratory birds. The *Delta Conservation Framework* supports conservation efforts that integrate migratory bird ecology and habitat needs into working landscapes.

One focus of MBCP is a program on wildlife-friendly working lands. Since the steep decline of natural wetlands in California, millions of birds depend on over 25 million acres of agricultural fields. The MBCP works with farmers to keep agriculture productive for human food supply, while at the same time providing critically needed habitat and food for birds. For example, the MBCP has worked with rice farmers to optimize management practices for wildlife, so migrating birds are able to use the rice fields for nesting, roosting, and foraging on waste grains to prepare for their long migrations. Benefits to the farmers include long-term productivity and protection from urban development.



Snow geese near rice field habitats. In August 2011, the National Resources Conservation Service (NRCS) provided nearly $3 million for a pilot program to give farmers incentives to manage their lands as bird habitat. Working closely with the NRCS and the California Rice Commission, the MBCP helped to enroll about 75 farmers and more than 23,000 acres in the program. Based on that success, the MBCP helped the NRCS expand the program in 2012 and 2013 to over 100,000 acres. Today, the program encompasses roughly 20 percent of all rice lands in California. Photo: Jim Morris, California Rice Commission.

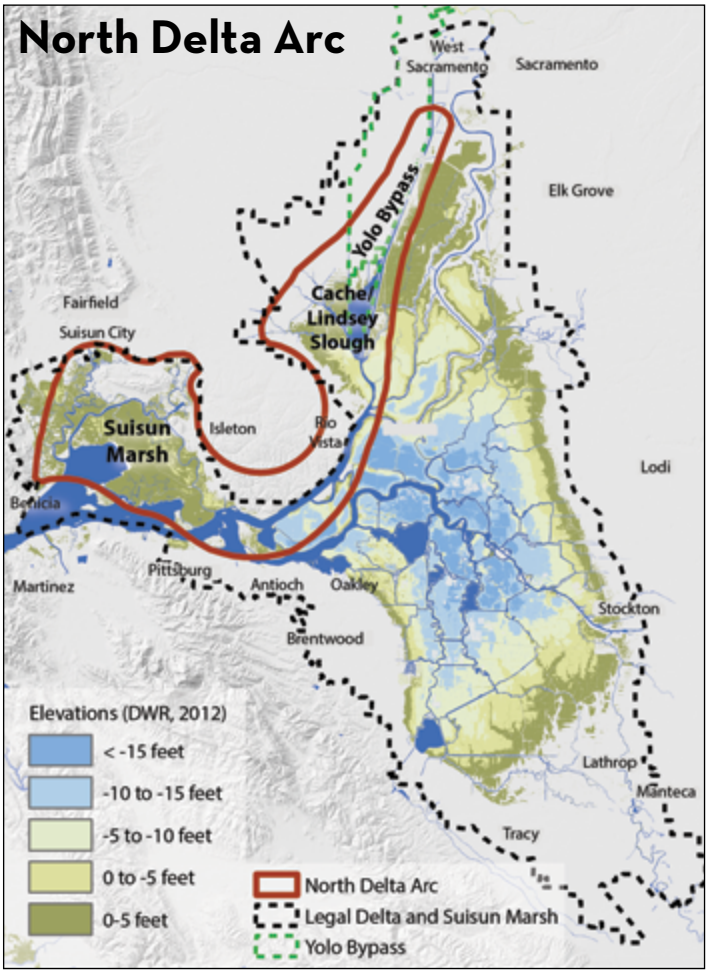
To skip these references go to p. 77

GUIDE TO SUPPORTING PARTNERSHIPS AND PROGRAMS - CONTINUED

North Delta Habitat Arc

STRATEGY A1, EXISTING PARTNERSHIP

Landscape-scale connectivity is emerging as an important emphasis for Delta conservation. Connecting a series of habitats across regions allows for continuous habitat "corridors" that are more ecologically valuable than individual disconnected parcels. The "North Delta Habitat Arc" is a reconciled ecosystem strategy (originating from UC Davis) that creates an arc of habitats connected by the Sacramento River to benefit native fish and other wildlife. The upstream end of the arc starts in the Yolo Bypass, continues through the Cache-Lindsey Slough-Liberty Island region (CSC) into the Sacramento River, includes Twitchell and Sherman Islands, and ends in Suisun Marsh. The state's Fish Restoration Program, and regional conservation plans for the two southern components of this "arc" (Suisun Marsh and CSC) are already under implementation by conservation partnerships. The northern portion includes public lands managed by CDFW (Yolo Bypass Wildlife Area) and has several existing successful planning efforts underway, including the Yolo Bypass working group, and the CVJV. While all the geographic subregions of this arc have benefited from conservation planning, there may be an opportunity to tie these efforts together through a landscape-scale approach. The *Delta Conservation Framework* supports regional scale conservation thinking such as the work that led to proposals for this arc of connected north delta habitats. For more details on the North Delta Arc components see also pp. 90 and 149.



Map: CDFW, 2018

Suisun Marsh Habitat Management, Preservation and Restoration Plan

STRATEGY A1, EXISTING PARTNERSHIP

Established in 2013, this plan (the SMP)[88] aims to provide a long-term structure for conservation planning and implementation in the Suisun Marsh region. As a 30-year, comprehensive conservation plan it balances protection and enhancement of managed wetlands and the restoration and protection of tidal wetlands. It addresses habitats and ecological processes, public and private land use, levee system integrity, and water quality. Implementation of the SMP is overseen by an advisory team of eight federal, state and regional agencies.

For more details see pp. 35 and 149.

See Quick Links p. 75 to access some of these partnerships and programs.

Yolo Bypass-Cache Slough Complex Planning Effort

STRATEGY A1, EXISTING PARTNERSHIP

Several partnership efforts have focused on conservation and floodplain management issues in the Yolo Bypass-Cache Slough Complex, described below. Their Corridor Management Framework allows local and regional agencies to engage more specifically in the Yolo Bypass partnership efforts. With sufficient coordination, these partnerships can serve as a conduit for successful conservation planning and management in the Yolo Bypass-Cache Slough region.

YOLO BYPASS CACHE SLOUGH PARTNERSHIP

This partnership offers a path for executive-level collaboration among agencies and other stakeholders at the government agency level. Formed in 2016 via a Memorandum of Understanding, the policy-level Yolo Bypass Cache Slough Partnership emphasizes the importance of achieving across-the-board improvements in habitat, flood protection, agricultural sustainability, recreation, and other public values.[90] Made up of 15 local, state, and federal agencies, its purpose is to improve executive-level interagency coordination. The partnership has set the stage for improved trust between stakeholders, a key ingredient in successful efforts of this scale. It also provides a vehicle to incorporate local governments into planning and decision making, relative to restoration actions in the Yolo Bypass and Cache Slough.

CORRIDOR MANAGEMENT FRAMEWORK

In 2015, local reclamation districts, counties, and flood control agencies developed the Corridor Management Framework (CMF), a vision for the integration of local, state, and federal interests in the region (including the Cache Slough Complex). The CMF continues to guide local agency participation in the Yolo Bypass Partnership and other forums.[91]

YOLO BYPASS WORKING GROUP

The Yolo Bypass Working Group, established in 1998, is a grassroots example of a multi-stakeholder partnership approach to conservation planning. Forty regular attendees represent a wide range of stakeholders interested in managing the multiple uses of the Yolo Bypass for flood control, agriculture, recreation, and floodplain habitat supporting juvenile salmon, waterfowl, and other waterbirds. Over the years, stakeholders have participated in discussions and problem solving efforts related to the many planning efforts affecting the Yolo Bypass. Various topics discussed over the years were the development of the Central Valley Flood Protection Plan, the Regional Corridor Management Framework, Yolo Bypass Wildlife Area Land Management Plan, *Central Valley Joint Venture Implementation Plan*s, and proposed fish passage and flood plain enhancement projects including the Bay Delta Conservation Plan and California EcoRestore. Information on federal and state habitat easement programs has been shared. Initial methyl-mercury studies and projects for Yolo Bypass Drainage and Infrastructure Study were also developed with work group participation.

CACHE SLOUGH RESTORATION PLANNING PARTNERSHIP

This effort is an example of a new regional conservation partnership process initiated in the Delta. The Cache Slough Restoration Planning Partnership (CSRPP) was launched in 2016 by the Delta Conservancy and included Solano and Yolo counties, Solano County Water Agency, Reclamation District 2068, agricultural community stakeholders from Resource Conservation Districts, and government agency representatives from the Delta Stewardship Council, California Natural Resources Agency, DWR, and CDFW. The CSRPP's purpose is to develop a regional conservation strategy for the Cache Slough Complex that identifies areas for habitat restoration and projects that would be eligible for Proposition 1 funding and avoid or minimize potential conflict between land uses. The CSRPP incorporated existing land use plans and input from local stakeholders to develop a locally supportable vision using a strategic planning approach. Ultimately, the Cache Slough Complex conservation strategy could integrate with adjacent planning efforts in the Yolo Bypass (upstream) or Suisun Marsh (downstream). This regional planning complements ongoing collaborative work among local, state, and federal agencies in the Suisun Marsh and the larger Yolo Bypass/Cache Slough region, and build on past efforts by the coalition of local agency partners in the Lower Sacramento/Delta North Region Corridor of important habitat for birds and other wildlife. Such landscape scale planning efforts are the foundation of the *Delta Conservation Framework*.

For more information on conservation opportunities and partnership activities in the Yolo Bypass Cache Slough subregion see pp. 91-101.

To skip these references go to p. 77

GUIDE TO SUPPORTING PARTNERSHIPS AND PROGRAMS - CONTINUED

Table 2.1: Delta Working Landscapes Projects, Delta Protection Commission
Strategy A2, Best Practices

Project Name and Location	Project Partners	Project Goals
Uslan Farms, Hamilton Road	Uslan Farm, Ducks Unlimited	Create semi-permanent wetland, seasonal wetland, and associated upland habitat
Winchester Vineyards, Winchester Lake	Ducks Unlimited, Hart Restoration, Winchester Vineyards, Winchester Lake Ski Club, Reclamation District 999	Create habitat along Winchester Lake that promotes slope stability, and create adjacent seasonal wetland habitat in low-yield crop area
Heringer Ranch, Elkhorn Slough	Heringer Vineyards, Hart Restoration	Reduce erosion of landside levee slope and prevent burrowing animals through plantings of native grasses
Heringer Ranch, Netherlands Road	Heringer Vineyards, Hart Restoration	Reduce erosion on slopes along Netherlands Road through vegetation plantings
Heringer Ranch (Vineyard), between Elkhorn Slough and Netherlands Road	Heringer Vineyards, Hart Restoration	Plant native vegetation to reduce erosive surface water runoff and provide habitat for wildlife
Vino Farms (Lambert Road), Pierson District	Vino Farms, Hart Restoration, Ducks Unlimited	Create slope wetland and use buffer plantings to stabilize slope bank
Vino Farms (Ditch 1 & 2), Merritt Island	Vino Farms, Hart Restoration	Plant native grasses and vegetation to reduce erosive surface water runoff and provide habitat for wildlife
C&M Orchards, North Stone Lake	C&M Orchards, Ducks Unlimited	Improve three acres of unfarmable land through creation of seasonal wetland
Woody's by the River, Empire Tract	Woody's by the River, Ducks Unlimited	Create berms around the existing corn field to facilitate seasonal flooding for waterbird habitat
Wilson Farms, Merritt Island	Wilson Vineyards, Hart Restoration	Create buffer strip to promote habitat and slope stabilization
San Joaquin Delta Farms, Lower Jones Tract	San Joaquin Delta Farms, Ducks Unlimited, U.S. Fish and Wildlife Service Partners for Fish and Wildlife Program	Create seasonal wetland, upland habitat, and a brood pond on a 400-acre cereal crop farm
Van Loben Sels Ranch, Pierson District	Van Loben Sels Farms, Hart Restoration	Plant native grasses along the levee of Snodgrass Slough to prevent erosion. Plant wild rye, sedge, and rushes along the irrigation ditch to reduce runoff from irrigation

See Quick Links p. 75 to access some of these partnerships and programs.

Table 2.2: Good Neighbor Checklist
Strategy C4: Multiple Benefits

Department of Water Resources Agricultural Lands Stewardship Workgroup

The Sacramento-San Joaquin Delta is the home of numerous habitat restoration efforts. Many Delta farmers are concerned that habitat lands could harm nearby agriculture in various ways. They would like assurance that entities that establish and manage habitat projects will consult with their neighbors and find ways to avoid impacts and resolve problems if they arise.

Restoration project managers can use the following checklist to ensure they comprehensively consider and examine the impacts of their project on neighbors as well as the impacts of neighboring lands on conservation projects. The checklist is based on a discussion paper, entitled Agricultural and Land Stewardship Strategies, which identifies a menu of mitigation measures and enhancements for the Delta. The measures described in the discussion paper, called Strategies, are referenced in the checklist.

- Have project proponents consulted with all neighboring landowners and operators about the project and its potential impacts? (See Strategy E1.1, which recommends involvement of landowners in project planning.)
- Have project proponents designated a local contact person to meet with neighboring landowners and discuss any issues of concern? (See Strategy D5.1, which suggests establishment of a public advisor position to help the public work with government agencies.)
- Will the project need access through other properties? If so, have access agreements been obtained?
- Does the management plan for the project provide for an on-site patrol or manager to deter trespass and vandalism? (See Strategy A4.3, which suggests the hiring of game wardens, sheriff's deputies, or private security guards.)
- Will the project increase the presence of vegetation susceptible to fire? (If yes, see Strategy A4.3.)
- Will the project discontinue maintenance of flood control features, involve prolonged or repeated flooding of previously dry land, or affect wind fetch across waterways? (If yes, see Strategy A1, which discusses flood protection improvements, and Strategy E1.3.2, which discusses drainage and seepage.)
- As a result of the project, are species on the project site expected to increase markedly in abundance and move from the site to neighboring lands or waterways? If yes, which species? (See Strategy A4.2, which suggests ways to protect landowners from liability under endangered species laws.)
- Is it reasonably possible that species in the project area could damage crops or promote the growth of weeds or diseases on neighboring farms? (If yes, see Strategy A3, which suggests ways to control weeds, and Strategy A4.1, which suggests the use of buffer zones and mechanisms for compensation for crop damages.)
- Will the project disturb utilities, roads, bridges, or other infrastructure that serve agricultural uses? (If yes, see Strategy D3, which suggests improvements to transportation infrastructure.)
- Will the project fragment or isolate farmland? (If yes, see Strategy E1.1, which encourages collaborative project planning.)
- Do domestic or feral animals or livestock occur on lands neighboring the project? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)
- Do neighboring farms use chemicals as fertilizer or to control weeds or crop pests? (If yes, see Strategy A4.1, which suggests the use of buffer zones.)

QUICK LINKS

Bird Returns
www.nature.org/en-us/about-us/where-we-work/united-states/california/stories-in-california/california-migratory-birds/

www.nytimes.com/2014/04/15/science/paying-farmers-to-welcome-birds.html

Change the Course 2017
http://changethecourse.us/projects/sacramento-river-wetland-enhancement-project

Delta Working Landscapes Program (DWLP)
http://delta.ca.gov/land_use/wildlife

Good Neighbor Checklist & Strategies
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Docs/Materials/ALS/ALS---Framework-and-Strategies-Updated.pdf?la=en&hash=6E0ED25D3D1906C-F2AD1786DB520D3B0EF2E6539

Migratory Bird Conservation Partnership
www.camigratorybirds.org/?page_id=60

Program On Wildlife-Friendly Working Lands
www.camigratorybirds.org/?page_id=30

To skip these references go to p. 77

Your Project, Your Ideas, Your Partners?

SECTION III

Value of Conserving the Delta Ecosystem



Illustration: Aksoon Razavi

Historical Change in Ecosystems and Uses 80

Resilient Delta Landscapes 82

Goal D: Conserving Ecosystem Function and Processes. 84

Yolo-Cache Conservation Opportunity Region 91

Guide to Delta Ecosystems and Habitats 102

KEY TERMS

- **LANDSCAPE CONNECTIVITY** — "Structural connectivity refers to the physical relationship between landscape elements, whereas functional connectivity describes the degree to which landscapes actually facilitate or impede the movement of organisms and processes. Functional connectivity is a product of both landscape structure and the response of organisms and processes to this structure. Thus, functional connectivity is both species- and landscape-specific. Distinguishing between these two types of connectivity is important because structural connectivity does not imply functional connectivity. In general, when we use the term 'connectivity' we are using the functional definition."
- **ECOSYSTEM** — a community of living organisms interacting as a system in conjunction with the nonliving components of their environment (such as air, water and mineral soil). Each ecosystem is a defined area of varying sizes where biotic and abiotic components are interacting as a system and are regarded as linked together through nutrient cycles and energy flows. Example: Grassland ecosystems are made up of low herbaceous plants occupying well-drained soils with native forbs and annual and perennial grasses and are usually devoid of trees. The term "novel ecosystem" is described on p. 108.
- **HABITAT** — an ecological or environmental area that is inhabited by a particular species of animal, plant, or other type of organism. The term typically describes the area in which this organism lives and where it can find food, shelter, protection, and mates for reproduction. It can describe the natural environment in which an organism lives or the physical environment that surrounds a population of a given species. Example: In portions of San Joaquin County, native grassland ecosystems provide habitat to the endangered San Joaquin kit fox.
- **ECOLOGICAL RESILIENCE** — the amount of disturbance that an ecosystem could withstand without changing self-organized processes and structures (defined as alternative stable states).
- **ECOLOGICAL SUSTAINABILITY** — the ability of ecological systems (ecosystems) to persist indefinitely by remaining diverse and productive, another product of functioning ecosystems.

Footnotes: The Delta Conservation Framework *footnote and endnote references can all be found in Appendix 1 online by section.*

Introduction

Delta ecosystems have degraded substantially over time, and continue to do so, because of a host of factors including land use changes, poor water quality, reduced sediment supply, and invasive species. Populations of native fish and wildlife species have seriously declined in the past decade.[1,2] The Delta's capacity to supply ecosystem services, drinking and irrigation water, and agricultural livelihoods to its residents and the state, while also sustaining its native fish and wildlife, continues to decrease. The novel Delta ecosystem is much altered.[3] Climate change and related extreme weather events will intensify pressures on the Delta (see Section IV, p. 119-120).[4]

This section of the *Delta Conservation Framework* explains how long-term landscape-scale conservation planning can be used to implement projects that improve ecosystem function and connectivity. It also describes how this approach can benefit listed species and be successfully integrated with the strong agricultural traditions and local communities of the Delta.

Recent investigations into the way Delta ecosystems functioned prior to 1800, how their function changed once land use changes took effect, and what processes will reestablish or improve this function serve as the foundation for Goal D of the Framework. Goal D aims to conserve Delta ecosystems to improve resiliency to climate change and benefit society and wildlife over the long term. Seven strategies under Goal D address the following key factors determining the health of Delta ecosystems:

- ecosystem function and life-history support for resident and migratory species
- conservation of transition zones
- ecosystem and wildlife population connectivity
- conditions conducive to listed species recovery
- support for aquatic food webs
- invasive species detection, management and control
- public access to conservation sites

Regaining ecological function in the Delta is crucial to sustaining native wildlife, supporting persistence and recovery of special status species, and maintaining ecosystem services to Delta residents and Californians.[5,6] These services directly or indirectly support human survival and quality of life. Uncertainty over future development and climate change impacts on the Delta ecosystem, however, threaten even the most well-intended, well-planned conservation measures. It is both unclear how effectively conservation efforts will reestablish ecological processes and improve resilience in today's Delta[7,8,9,10] but also clear that without such efforts some of the biological and physical foundations of the Delta may fail.

The *Delta Conservation Framework* seeks to integrate improved ecosystem function with human uses of the Delta, while supporting the persistence of native plants and animals over the long term. The *Delta Conservation Framework* does not seek to achieve a Delta that resembles a pre-development, "pristine" state. Instead it supports an adaptive, long-term management process that guides future responses to uncertain conditions.

This section of the *Delta Conservation Framework* provides a historical overview of changes in Delta ecosystems over the past 300 years, and highlights conservation strategies that promote ecological function on a landscape scale. It also offers an overview of the specific Delta ecosystem types targeted for conservation.



Wetland habitats in the Delta. Photo: Amber Manfree

Historical Change in Ecosystems and Uses

Before the 1800s, the Delta was home to a number of Native American tribes (primarily Miwok and Wintun).[11] Native American Delta residents fished, hunted, and foraged for food and materials. Although they did not practice agriculture, they managed the landscape with fire and other tools to favor the plants they used for food, work, or shelter.[11] Population estimates in the Delta before European arrival are between 3,000 and 15,000, with most native villages situated on natural levees on the edges of the eastern Delta, typically containing around 200 residents in each.

Prior to European settlement, large areas of the Delta were subject to seasonal flooding, and nearly 60 percent was submerged by daily tides, occasionally flooding it entirely during "spring" tides. (A spring tide refers to the 'springing forth' of the tide during new and full moons, while the term "king tide" describes an especially high spring tide. When king tides coincide with extreme storms or floods, water levels rise significantly).

During historic tidal cycles, water within the interior Delta remained primarily fresh, although most of the Delta was a tidal wetland. Early explorers reported saltwater intrusion during the summer months in some years.[12] The historical Delta contained a massive network of small distributary or "capillary-like" channels with natural levees that created floodplains, marshes, and riparian forests and served as an extensive fluvial-tidal interface (Figure 3.1 below). The upland edges of transition zones from the wetlands were composed of alkali seasonal wetlands, grassland, oak savannas, and oak woodlands. Gently sloping sand mounds around the marshes provided high-tide refugia for terrestrial species.[3]

The San Francisco Estuary, and in particular the Delta, once supported an extraordinary diversity and abundance of endemic, resident, and migratory wildlife within a wide array of native animal and plant communities.[3] Before European arrival, the Delta teemed with birds and wildlife such as tule elk, deer, and California grizzly bear.[7] Few traces of the early Native American culture, diversity of wildlife, and rich plant communities remain in the Delta today.

Scientists, resource managers, and residents all recognize that we cannot return to the historic Delta conditions. Indeed the Delta no longer functions as an estuarine delta, distributing water and sediment from rivers and ocean tides across wetlands, floodplains, and riparian forests.[3] Instead, the Delta now comprises a system of confined

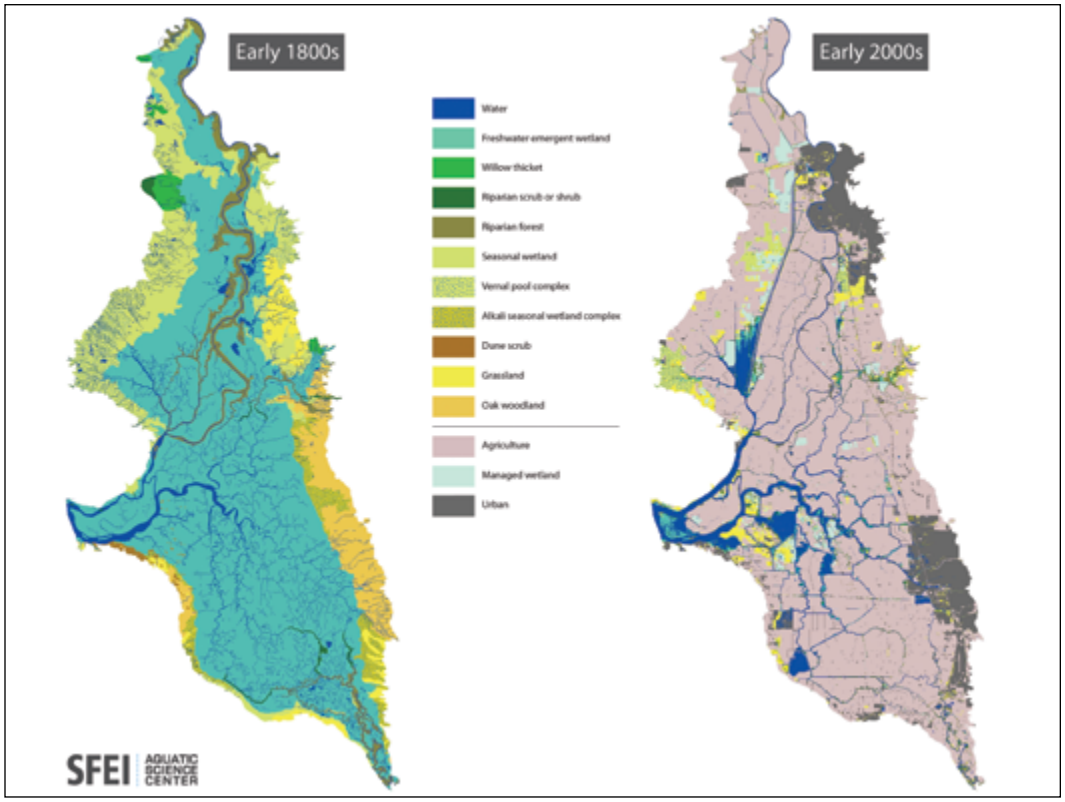


Figure 3.1: Delta waterways historically (left) and current (right). Historical channels depict "capillary-like" distributary channel networks, now largely missing. Aqua green (left) depicts wetlands; pink (right) depicts agricultural landscapes.[6] Source: SFEI

channels and levees, engineered by people to protect their communities and agricultural land from flooding, and to convey water where humans want it to go (Figure 3.1, p.80). Fresh water entering the Delta from rivers and watersheds is used to irrigate in-Delta agricultural fields or diverted by the state and federal water projects for delivery to farms and municipalities in the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and southern California. Depending on the time of year, some of the fresh water is allowed to stay in the Delta, mix with ocean tides, and flow out to San Francisco Bay to meet water quality standards and endangered species requirements.[13] The remaining Delta hydrograph fluctuates much less than it did historically, as dams upstream store and manage freshwater releases into the system.

"Before modern development, almost half of California's coastal wetlands were found in the Sacramento-San Joaquin Delta. The Delta supported the state's most abundant salmon runs, the Pacific Flyway, and endemic species ranging from the Delta smelt to the Delta tule pea. In the region's Mediterranean climate, the Delta's year round freshwater marshes were an oasis of productivity during the long dry season. Until reclamation, the Delta stored vast amounts of carbon in its peat soils." [17]

DELTA HISTORICAL ECOLOGY,
SAN FRANCISCO ESTUARY INSTITUTE



Tule pea. Photo: Amber Manfree

Beginning in the mid-1800s, mining, reclamation, agricultural practices, and urbanization by European immigrants dramatically changed the Delta landscape and function.[3,7] Agriculture has been the mainstay of economic life and culture in the Delta since then. According to the 2012 *Economic Sustainability Plan for the Sacramento-San Joaquin River Delta*, close to 80 percent of all farmland in the Delta is classified as prime farmland, with annual economic value of approximately $702 million from crop-based agricultural operations and $93 million from animal production.[14]

Delta ecosystems, and their historic ecological and biophysical processes, were altered significantly to support this agricultural growth over the past 160 years. Agricultural practices and urbanization cleared forests and stripped natural levees of vegetation.[7] Land reclamation and flood protection activities drained wetlands, constructed riprapped levees, straightened meandering channels, eliminated small distributary channels and extended blind channels so they connected with others. In the process, they also converted vast and fertile floodplains and riparian woodlands into cultivated fields.[3] As a result, the ability of Delta ecosystems to support native California fish, wildlife, and plant species and communities is now severely degraded or absent entirely.[1,12,15,16]

The Delta ecosystem, which now encompasses agricultural lands, remnant marshes, riparian habitats and aquatic habitats, has continued to decline since reclamation.[17] While much of the land continues to serve viable and productive agricultural enterprises today, portions are slowly subsiding or degrading due to oxidation and wind erosion of peat soils. Remnant wetlands and riparian zones, meanwhile, are also subsiding or eroding. Many are now functionally disconnected from the estuary, dominated by nonnative invasive species, and damaged by pollution, diminishing their habitat quality for native species and their resilience to climate change and other anthropogenic impacts.[18,19,20,21,22,23,24] Some habitats are so degraded that a number of California native and Delta endemic species are in serious decline or almost extinct.

The loss of these valuable ecosystem services and native species isn't just felt in the accounting of numbers of small fish and nesting birds; it is also a loss in terms of the recreational and environmental quality of human habitat; not to mention the flood safety provided by natural buffers and healthy woodlands and wetlands. All subsided islands in the Delta — whether habitat for humans, crops or wildlife — are dependent upon levees increasingly vulnerable to seismic events and sea level rise.[25,26] As the conditions continue to change, future Delta ecosystems will not resemble historical or contemporary ones.

Resilient Delta

Landscapes

The central challenge for Delta conservation is to create and maintain resilient "landscapes that support desired ecological functions while retaining the overall agricultural character and water-supply service of the region."[26,27] Landscape-scale conservation differs from more piecemeal, smaller-scale approaches to conservation focused on the restoration or enhancement of particular sites or parcels. Planning on a landscape scale integrates consideration of ecological factors such as large-scale connectivity, biodiversity, and resilience to climate change with consideration of other factors such as local economies, agriculture, ecotourism, geographic diversity, and the health and social benefits of the environment to humans.[28] As such, landscape scale conservation planning is both ambitious and rewarding for all, given a consistent commitment to embracing the complexities.

The *Delta Conservation Framework* provides landscape-level guidance by offering strategies for conservation based on the latest insights from scientific and historical ecology investigations conducted by the San Francisco Estuary Institute with support from the California Department of Fish and Wildlife.[5,17]

These investigations highlight the importance of processes, diverse ecosystems, connectivity, and scale.

Processes

Thriving wildlife populations depend on functional ecosystems where biological and physical processes, or groups of processes, link different elements together. Ecological processes are dynamic, not static, and occur over large landscapes. These processes sustain habitats, food supplies, species, and many other components of the Delta ecosystem. Examples include the energy transfer in food webs (a biotic process) or the daily exchange of tides that supports these food webs (an abiotic process). These natural ecological processes don't stop at property lines, though they may be altered or deflected by fences, levees, and other barriers to landscape connection. On working landscapes, such as farm fields, the same biological processes of nutrient cycling, plant growth and decomposition, as well as wildlife movement, still occur, along with physical processes such as erosion and water filtration. On working landscapes there is more human intervention in these processes, however.

To maximize benefits for native species, landscape-scale conservation planning must support, for example: fluvial processes along streams, functional channels, river corridors, and tidal floodplains to benefit resident and anadromous fish; tidal marsh processes linking intertidal, open water, and transition zone areas to benefit marsh wildlife and the aquatic food web; and other processes that connect terrestrial habitats, wildlife-friendly agricultural zones, and managed wetlands to benefit migratory birds and other wildlife species.

Ecosystem Types

The Delta is composed of a mosaic of interconnected types of aquatic, terrestrial, transitional, and agricultural ecosystems. Improving the function of these ecosystems will benefit not only wildlife species, but also provide water quality, pollination, open space, flood protection, and other services to humans.[2,29,30,31]

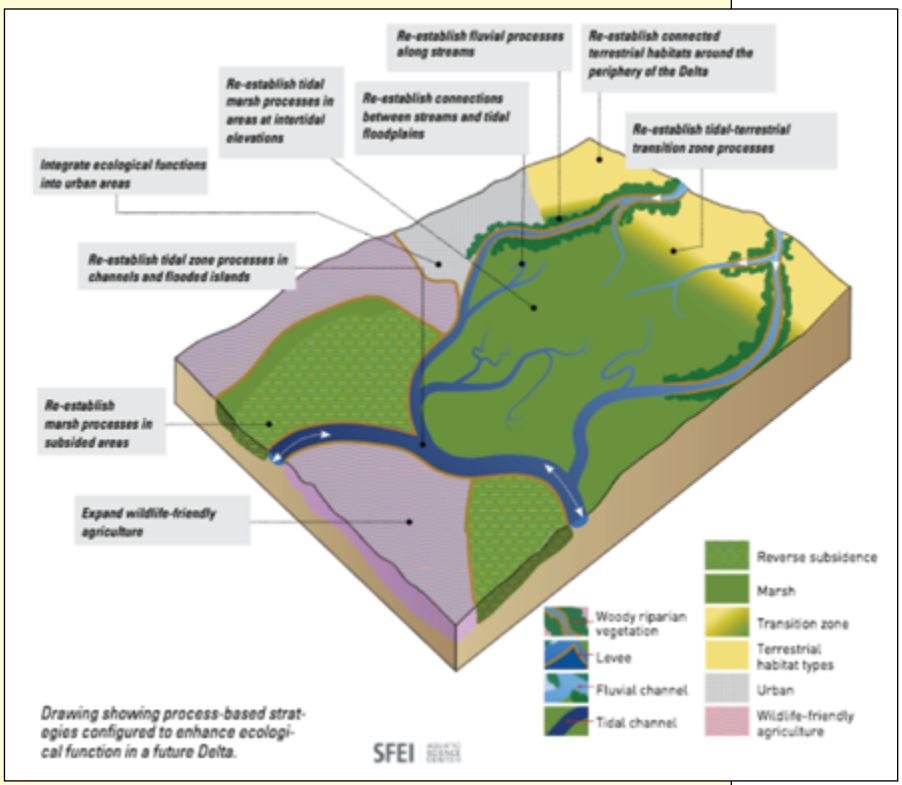


Figure 3.2: Future Delta model. Source: A Delta Renewed, SFEI

The Delta's diverse ecosystems can be divided into a number of basic categories. The vegetation, wildlife, and natural communities in each of these ecosystems are characterized by their location in the Delta landscape. In terrestrial and upland areas woodland and grassland ecosystems can be found, along with farms and cities. In riparian zones along creeks and rivers, willow thickets and floodplain ecosystems still occur. In aquatic and intertidal areas, freshwater and salt water influences lead to a variety of ecosystems, ranging from freshwater ponds to tidal channels to salt marshes. Finally, the transitional areas between natural areas and developed land uses support ecosystems at the edge of marshes, floodplains, levees, and hedgerows. For a full description of Delta ecosystems see Guide to Delta Ecosystems, Table 3.1, pp. 102-105.

Connectivity

Planning for conservation, and habitat and process connectivity at larger scales, requires consideration of the fact that wildlife, water, sediment and other components of a healthy ecosystem move around. When conditions become inhospitable, species move into new habitats. When conditions become extreme, such as during a large rain and flood event, and there is no contiguous place to retreat, species may be permanently displaced. As the Delta continues to develop, and as sea levels rise, fewer and fewer connections and pathways for migration, transition and adaptation will remain.

Today, fragmentation and habitat loss already threaten the movement of organisms and their genes.[32] For example, the giant garter snake requires uplands for hibernation and cover[33] and wetlands for foraging and reproduction, and a disconnect between these two critical habitats can reduce species viability. The giant garter snake is just one example of many species that may suffer from reduced connectivity between habitats and across larger landscapes.

Any disruption of the size and quality of available habitat, wildlife movement among habitats, and seasonal migration patterns can lead to detrimental effects on populations and species, including decreased carrying capacity, loss of genetic variation, and ultimately species extinction.[3,25,29] While these dynamics generally apply to all wildlife species, they may serve as stronger stressors on special status species present in the Delta.[33,34] Small populations are more sensitive to isolation and reduced genetic diversity may affect their long-term fitness.[35,36,37]

Landscape Scale

A landscape-scale approach to conservation planning offers the opportunity to strike a balance between implementing many smaller, widely spaced projects and fewer, larger, and less spatially distributed conservation projects. The main questions are where and how to reestablish the dynamic natural processes and diverse connected ecosystems. The recommended approach is to create an appropriate configuration of ecosystem types at the landscape scale (see Figures 3.2 and 3.3). Restoring a diversity of interconnected ecosystem components provides insurance in the form of resiliency and redundancy across the Delta landscape.[3,31] Associated monitoring and adaptive management will allow tracking of whether restored processes and ecosystem functions remain resilient over time.[3,31]

Many current conservation efforts acknowledge the importance of protecting and enhancing landscape-scale connectivity and ecosystem resilience to potential threats by establishing interconnected reserve networks, or in case of the Delta, mosaics of conservation areas (for more information see Goal D, Strategy D2, p. 84).[32,38]

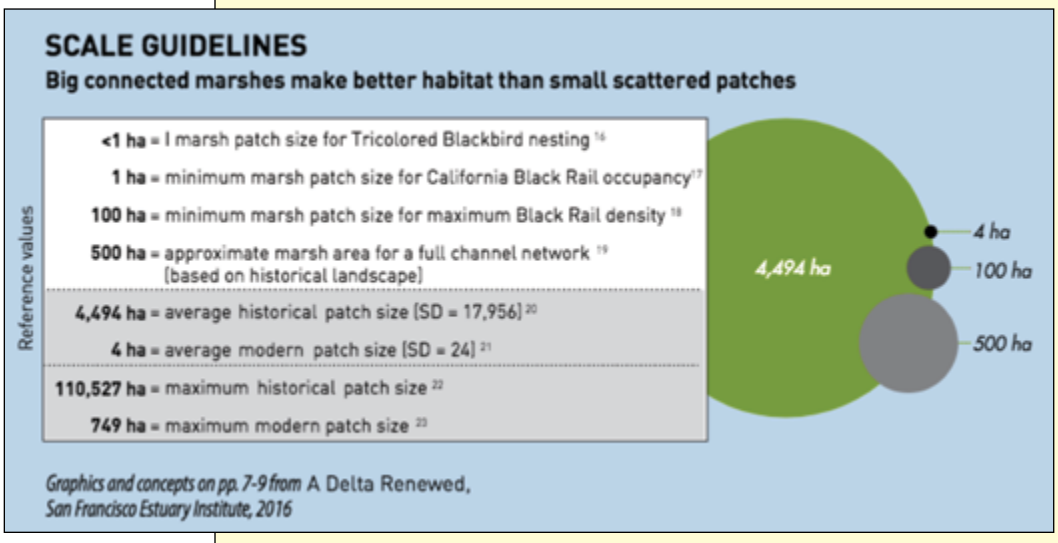


Figure 3.3

Framework in Depth: Goal D

Conserve Ecosystem Function and Processes

The *Delta Conservation Framework*'s overarching goal for improving ecosystem function (Goal D) is founded on a landscape-scale approach.[5] The goal's associated strategies are intended to serve as starting points for restoring ecosystem function over the next 30 years, and to occur within the context of "Delta as an evolving place." Many of the strategies associated with Goal D are also consistent with climate adaptation strategies that have been identified for biodiversity and habitat.[4,39] and with efforts to address long term challenges such as invasive species, pollution, and maintenance the vast Delta levee system.[40,41] In order to find long-term solutions, alternative future scenarios considering evolving human land uses, different levels of flood protection, a changing climate, and other ecosystem pressures need to be evaluated going forward (see Section VI).

Ecosystem Processes

Strategy D1 under Goal D focuses on recovering and restoring ecological processes to improve Delta ecosystem function. To achieve this, the Framework recommends that planning partnerships and project proponents consider the latest insights from a series of historical ecology investigations conducted by the San Francisco Estuary Institute with support from the California Department of Fish and Wildlife and regional agencies. These investigations focus on the status of Delta ecosystems now in relation to their historical condition. They also provide a big-picture perspective on how to reestablish a landscape that functions well for people and native wildlife.[2,3,32] The most recent report from this series, *A Delta Renewed*, provides tools and on-the-ground strategies for reestablishing desired ecological functions in different regions of the Delta.[5]

The *Delta Conservation Framework* recommends that any new region-specific targets align with parameters described in *A Delta Renewed*. They should also take into consideration of existing regional targets (such as the habitat conservation plans presented in Table 3.2, p. 86) and broader targets, such as those outlined in the 2017 *Central Valley Flood Protection Plan Conservation Strategy* (CVFPP) described on p.31.[33]

Landscape Connectivity and Resilience

Strategy D2 under Goal D focuses on protecting ecosystems to improve connectivity and resiliency.

To maximize functional connectivity and resilience (see Key Terms p. 78), the Framework recommends that regional conservation partnerships conduct technical analyses to identify potential ecosystem types that would persist over the long term in the region and prioritize available opportunities to protect them. In any of the conservation opportunity areas, region-specific targets could be developed based on an assessment of ecological opportunities, existing land uses, and existing plans. These then should also integrate, where possible, with broader-scale plans that pertain to the surrounding landscape, such as the 2017 CVFPP mentioned above, or other relevant planning or regulatory documents (see Guide pp. 30-37).

In doing so, two primary approaches to promote connectivity should be employed: 1) protecting areas that facilitate movement and 2) restoring connectivity across areas that impede movement (e.g., by removing a fence, aquatic barrier, or building a wildlife-friendly highway underpass).[42] A mosaic of interconnected ecosystem types, including wildlife-friendly agricultural lands and managed ecosystems, will maximize the adaptive capacity of wildlife populations at various scales.[42] A highly connected landscape is crucial for facilitating species movement and accommodating distribution shifts in response to climate change.[42] In some contexts, those undertaking conservation planning should also recognize that the subtidal aquatic system in the Delta could be viewed as overly connected. Historic meandering channels, and residence time diversity that benefit native fish species were much reduced through land reclamation and channelization activities.



One historic and current ecosystem process is flooding, and in this photo the Yolo Bypass – historic Sacramento River floodplain – absorbs high waters (2017) on multi-objective pastures and farm fields. Photo: Carson Jeffres



Illustration: Arsoon Razavi

GOAL D

Conserve Delta ecosystems and their ecological processes and functions to benefit society and wildlife, and to enhance resilience to climate change.

STRATEGY D1

Restore, enhance, and manage ecosystem processes and habitats Delta-wide to improve function and life history support for native and migratory wildlife and to build ecological resilience.

- Align ecosystem conservation initiatives with *A Delta Renewed* strategies to restore tidal marsh processes at intertidal elevations; marsh processes in subsided areas; tidal zone processes in channels and flooded islands; connections between streams and tidal floodplains; fluvial processes along streams; tidal-terrestrial transition zone processes; connected terrestrial habitats; expanded wildlife friendly agriculture; and ecological functions in urban areas.
- Align enhancement of ecosystem processes with Regional Conservation Investment Strategies.

STRATEGY D2

Conduct technical analyses within groups such as regional conservation partnerships to coordinate, identify, and prioritize available geographic areas for conservation and climate adaptation.

- Protect and restore transition zones with the potential for providing landscape connectivity and ecosystem resiliency.
- Protect areas in regional landscapes most vulnerable to climate change.
- Identify opportunity areas to support climate-vulnerable species.
- Support the development and initiation of projects that improve migration and movement corridors for species to improve the connectivity of populations at multiple scales.

STRATEGY D3

Create conditions conducive to maintaining or improving the distribution and abundance of native Delta species, and to meeting the goals of existing habitat and species recovery plans.

- Consider *Habitat Conservation Plans* and *Natural Community Conservation Plans*.
- Support *Regional Conservation Investment Strategies*.
- Consult the multi-agency *Sacramento Valley Salmon Resiliency Strategy* and *Delta Smelt Resiliency Strategy*.
- Consider California's *State Wildlife Action Plan*.

Goal D continued next page

GOAL D - continued

STRATEGY D4

Support a thriving aquatic food web in the Delta through conservation actions, scientific investigations, and existing management initiatives.

STRATEGY D5

Support and coordinate proactive approaches for the early detection, rapid response, and long-term control and management of harmful invasive species.

- Reduce negative impacts on ecosystem function, special status species, Delta communities, and ecosystem resilience.
- Use existing resources such as Delta County Weed Management Areas and California State Parks and Recreation Division of Boating and Waterways programs when possible.

STRATEGY D6

Balance human use of conservation areas with protection of sensitive Delta wildlife.

- Reduce adverse effects of human disturbance.
- Consider existing or develop new public access plans and land management plans.
- Support increased law enforcement and public safety on conservation lands.

Table 3.1

Current Conservation Planning Documents	Related DCF Conservation Opportunity Regions
Suisun Marsh Plan	Suisun Marsh
East Contra Costa County HCP/NCCP	West Delta
South Sacramento HCP	North Delta
San Joaquin County Multi-Species Habitat Conservation and Open Space Plan (SJMSCP)	South Delta
Solano Multispecies HCP (MSHCP)	Yolo Bypass; Cache Slough Complex
Yolo HCP/NCCP; Yolo RCIS	Yolo Bypass; North Delta



Native tree assemblage in the Delta.
Photo: Amber Manfree

Special Status Species

Strategy D3 under Goal D focuses on improving Delta conditions for special status species. The *Delta Conservation Framework* suggests that individual conservation projects should address existing recommendations in species recovery plans, federal and state conservation plans (HCP and NCCP respectively), and Regional Conservation Investment Strategies (RCIS). HCPs and NCCPs provide endangered species take authorizations and associated mitigation for development projects. Most HCPs and NCCPs overlapping the Delta have a strong link to agricultural preservation, striking a balance between natural resource conservation and economic sustainability in the region. The *Delta Conservation Framework* defers to the conservation targets outlined in the HCPs and NCCPs available or under development in Delta counties or priorities set in the Yolo County RCIS (Table 3.1 opposite). The various descriptions of conservation opportunity regions in this Framework include short overviews of ongoing HCPs, NCCPs, and RCISs relative to each specific portion of the Delta (see also Guide pp.33-34). Regional conservation partnership efforts should integrate targets and goals of these plans or strategies into their conservation planning efforts.

The *Delta Conservation Framework* recommends that efforts to meet or exceed recovery goals for special status species should also consider improving the long-term resiliency and adaptive capacity of ecosystems and wildlife populations to habitat loss, climate shifts, exotic species invasions, and other pressures.[43,44,45]

California State Wildlife Action Plan

This 2015 plan (SWAP) is an ecoregion-based strategic conservation plan developed by the California Department of Fish and Wildlife.[3] The document provides a blueprint for actions necessary to sustain the integrity of California ecosystems, for their intrinsic values and as natural resources and heritages. The SWAP highlights the Delta as part of the Bay Delta Conservation unit, within the Bay Delta and Central Coast Province. The conservation target ecosystems for the Bay Delta Conservation unit are freshwater marsh, including non-tidal freshwater emergent wetlands; salt marsh, including saline emergent wetlands and tidal freshwater wetlands in the Delta; and American Southwest riparian forest and woodland, which includes the Valley Foothill Riparian natural community in the Delta. The SWAP highlights the pressures in the Delta that make it a prime region for conservation. (See also Guide p. 30).



Swainson's hawk. Photo: Rick Lewis

As mentioned before, several special status species including giant garter snake, greater sandhill crane, tricolored blackbird, and Swainson's hawk benefit from agriculture in the Delta (see Species Recovery Briefs, Appendix 5). Continued conservation and agricultural land stewardship will require a common appreciation among stakeholders for how crop selection and management to support special status species will affect agricultural productivity, and how growing stressors such as sea level rise or salinity intrusion will affect both agriculture and wildlife.

Food Webs

Strategy D4 under Goal D focuses on supporting the Delta's aquatic food web.

Primary production is an essential ecosystem process that may limit the quality and quantity of food available for invertebrates, fish, and other secondary consumers, including species of special concern. An inventory of organic-carbon sources — which included phytoplankton, detritus, and aquatic weeds — revealed that the Delta is currently a low productivity ecosystem, yet it is unclear whether this was always the case.[46,47,48] A recent research study tested the hypothesis that "the Delta has been transformed from a high-productivity ecosystem largely dependent upon marsh-based production to a low-productivity ecosystem dependent upon production of aquatic plants and algae."[47,47,48] Such studies linking changes in primary production over time with reductions in the extent of tidal marshes and associated marsh channel networks have generated a renewed appreciation for the importance of primary productivity in the Delta aquatic food web.

Large-scale conversion of tidal marsh to agriculture has altered the Delta's current capacity to produce food for native biota and support species of concern. The *Delta Conservation Framework* recommends that estimates of differences between historic and modern primary production be used to shape targets and evaluation metrics,[46,47,48] assess the progress of individual conservation projects, and gauge the trajectory of ecological recovery. Of particular relevance to the Framework are recent investigations highlighting the importance of landscape configuration in determining levels of primary production in the Delta. These investigations demonstrate that interactions between terrestrial and aquatic food webs vary across the current landscape.[46,47,48]

FRAMEWORK IN DEPTH: GOAL D CONTINUED

The *Delta Conservation Framework* also supports development of the Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary (see p. 115). This monitoring initiative seeks to evaluate the potential benefits of tidal wetland restoration to aquatic food webs and at risk Delta fish species.[49]

With the additional information provided by these investigations and monitoring results, the *Delta Conservation Framework* can give priority to those conservation actions most likely to improve ecosystem primary production and better track the course and progress of Delta ecosystem recovery at the base of the food chain.

Resiliency Strategies for Fish

Two native fish species now declining in the Delta are the subject of resiliency strategies that inform the *Delta Conservation Framework*.

The *Delta Smelt Resiliency Strategy* is a science-based document prepared by the State of California to voluntarily address both immediate and near-term needs of Delta smelt. The Strategy aims to promote smelt resiliency to drought conditions, as well as to future variations in habitat conditions.[43] The Strategy relies on the Interagency Ecological Program's Management, Analysis, and Synthesis Team ("MAST") report and conceptual models[44] that suggest actions designed to benefit Delta smelt. These will be implemented within the next few years to address predation, turbidity, and food availability and quality.[46] These management actions include:

- Aquatic weed control
- North Delta food web adaptive management projects
- Outflow augmentation
- Reoperation of the Suisun Marsh salinity control gates
- Sediment supplementation in the low salinity zone
- Spawning habitat augmentation
- Roaring River distribution system food production
- Coordinating managed wetland flood and drain operations in Suisun Marsh
- Adjusting fish salvage operations during summer and fall storm water discharge management,
- Rio Vista Research Station and Fish Technology Center
- Near-term Delta smelt habitat restoration
- Franks Tract restoration feasibility study

The *Sacramento Valley Salmon Resiliency Strategy* promotes actions that address specific life-stage stressors and contribute to the achievement of overall viability of Sacramento Valley salmonids. The Strategy outlines habitat restoration and management actions necessary to improve the immediate and long-term resiliency of Sacramento Valley salmonid species.[45] For each proposed action, the Strategy lays out objectives, linkages to conceptual models that are consistent with existing priorities, estimated costs, funding sources, and timing. Recommended actions relevant to the Delta include:

- Improve Yolo Bypass adult fish passage
- Increase juvenile salmonid access to Yolo Bypass, and increase duration and frequency of Yolo Bypass floodplain inundation
- Construct a permanent Georgiana Slough nonphysical barrier
- Restore tidal habitat in the Delta



Delta smelt. Photo: Joel Sartore/ The Photo Ark/ National Geographic Collection



Research by UC Davis and USDA continues to evaluate the best mix of surfacants and herbicides, and the best spray volumes, for optimizing control of the water hyacinth infestation in the Delta (test plots pictured). For conservation planning purposes, the impacts of control (spraying and mechanical removal) on the ecosystem have to be balanced with the impacts of infestation on navigation, algal blooms, and predation on native species. In a novel ecosystem like the Delta, trade offs are not always black and white which is why conservation partnerships are so important to decisionmaking. Photo courtesy: UC Davis

Invasive Species

Strategy D5 under Goal D focuses on controlling invasive species area-wide through coordinated partnership efforts. Such coordination has the potential to reduce their spread throughout Delta waterways, farmlands, and Delta conservation lands, lowering management costs over the long term. Both terrestrial and invasive aquatic plant species are a widespread problem in the Delta and can have multiple adverse effects on native wildlife, recreation, and local agriculture and businesses.

Aquatic weeds – spread through water – are the most difficult to control. Over the last decade, floating and submerged aquatic plant species – water hyacinth, water primrose, Brazilian waterweed, and giant reed – have spread dramatically within the Delta. This spread has steadily reduced the quality of habitat for native species, hampered recreation and navigation, increased mosquito habitat, and impeded the flow of water (increasing the cost of pumping). It has also increased the need for pesticides and decreased water quality.[50,51,52,53,54]

The *Delta Conservation Framework* supports the Delta Region Areawide Aquatic Weed Project, which informs state aquatic invasive species programs under State Parks' Division of Boating and Waterways (DBW). These efforts control floating and submerged invasive aquatic vegetation in the Delta except inside State Water Project facilities, where the Department of Water Resources has jurisdiction and manages weeds.

On land, terrestrial weeds and invasive plant species have enjoyed long and careful management on the part of both private landowners and farmers, and local agricultural and conservation districts. The *Delta Conservation Framework* supports the DWR Agricultural Lands Stewardship (ALS) Workgroup's suggested strategies for both terrestrial and aquatic weeds, including prioritizing weeds and other pests for area-wide control, and reinvigorating county Weed Management Areas (WMAs). Led by the County Agricultural Commissioner or local Resource Conservation District, WMAs are local stakeholder groups with strategic plans focusing on invasive species control and management, both aquatic and terrestrial. The WMAs that overlap the Delta are Alameda-Contra Costa, Sacramento, Nor–thern San Joaquin Valley, Solano, and Yolo.

Sustaining current control efforts by DBW, and a revival of WMAs, will help keep the focus of Delta conservation projects on the invasive species challenge, and emphasize the value of early detection and rapid response both on public and private lands and waterways. Once identified, invasive species populations, particularly those outlined in the Delta smelt and salmon resiliency strategies,[43,45] could be prioritized by the WMAs for coordinated area-wide control or eradication, offering multiple benefits of reduced environmental impacts, nuisance, and cost and reduced threat to ecosystem function, special status species, and Delta community interests. Changing climatic conditions may favor or accelerate the spread of certain invasive plant species. Early detection and eradication can help to reduce existing ecosystem stressors and increase overall resilience to change.

Public Access

Strategy D6 under Goal D focuses on optimizing the use of conservation areas for both people and wildlife. In the Delta, public access to open space is a mainstay of Delta life, with its long history of hunting, fishing, boating, recreation use, and tourism. These kinds of recreational activities have long been considered compatible with species protection. An increasing body of research demonstrates, however, that outdoor recreation — even non-consumptive activities like bird watching and hiking (as compared to hunting and fishing) — can negatively impact plant and animal communities.[55,56,57,58,59] This is particularly the case in the absence of buffers or exclusion zones to mitigate potential negative effects. As a result, public access is not always recommended in conservation and restoration designs.

The *Delta Conservation Framework* recognizes the importance of balancing tradeoffs between desired restoration outcomes and human use. In addition to many recognized human health and economic benefits of outdoor recreation,[60] access to open space also encourages public support for land and wildlife conservation.[61]

Despite public awareness and support for conservation in general, California still has the greatest number of listed species threatened by recreation in the U.S.[55] Land and wildlife managers in the Delta, as elsewhere, must seek solutions for balancing the benefits of outdoor recreation for human visitors with the potentially negative effects on species and ecosystems. Signage, informational kiosks, and clearly developed nature trails or boardwalks can reduce visitor impacts on sensitive wildlife and their habitat.

The *Delta Conservation Framework* suggests careful consideration of where to allow and how to best regulate and enforce public access in relation to protecting wildlife needs. The Framework also suggests consideration by regional planning partnerships as they evaluate potential conservation scenarios in their area, and at the entire Delta landscape scale.



CDFW cannabis patrol, human and canine, in the Delta.
Photo: CDFW



CONSERVATION OPPORTUNITY REGION

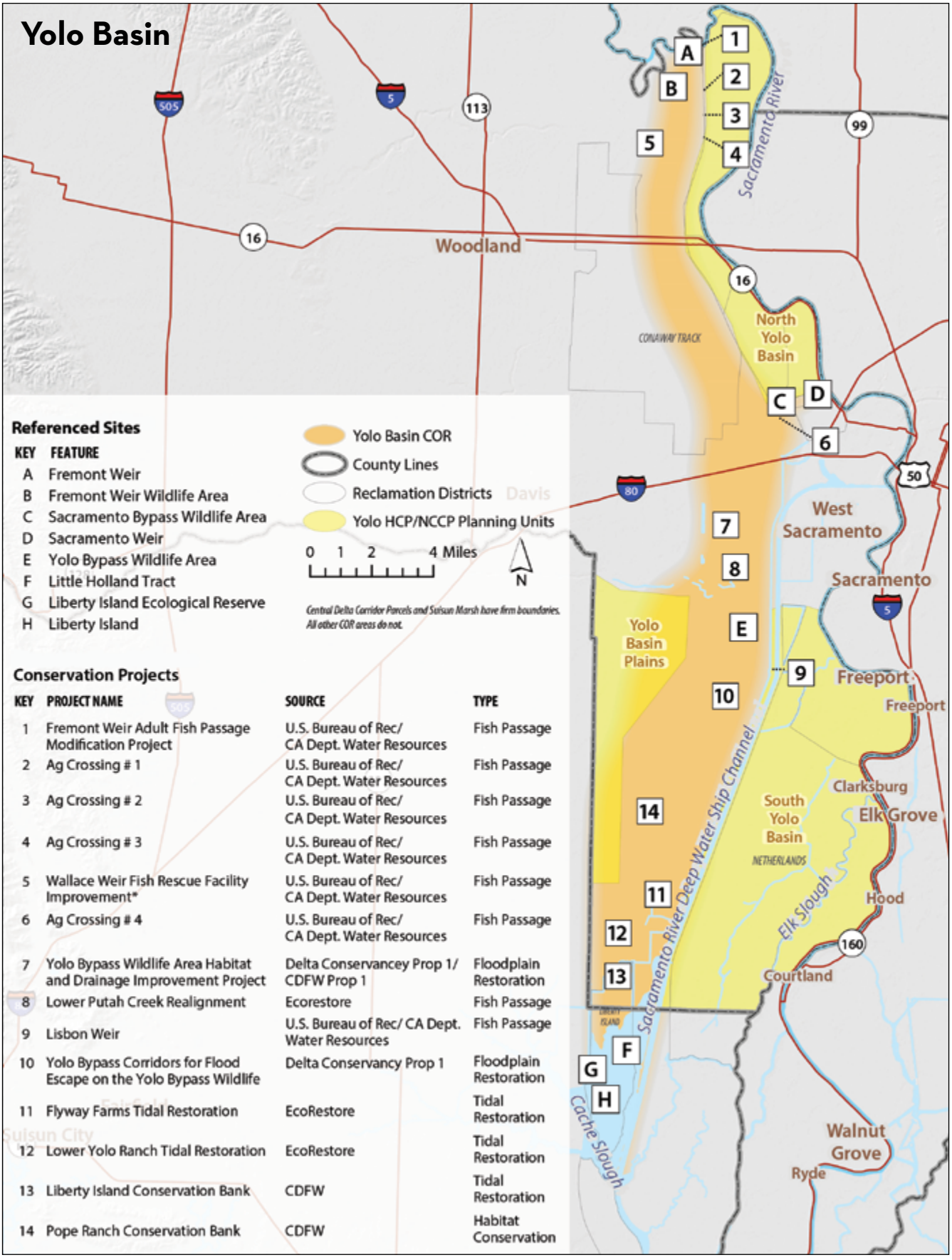
A Big Canvas for Multi-Benefit Conservation – Yolo Bypass, Cache Slough and the North Delta Arc

Photo: Carson Jeffres

When it really rains and the Sacramento River swells, it spreads out into its former floodplain in the Yolo Bypass. These vast flats off Highway 80 between Davis and Sacramento provide essential flood protection for the City of Sacramento and surrounding towns; here local farmers have learned to live with these somewhat infrequent flood events and plan their crops and pastures accordingly. In addition to rice, safflower, and tomatoes, this floodable farmscape also grows salmon fry and fish food when wet. For decades now local landowners, several counties, and myriad government agencies have been working in partnerships at many levels to make the most of the bypass as a multi-use landscape for flood protection, fish and bird habitat, and agriculture. Linked with major fish and habitat restoration efforts in Cache Slough and Suisun Marsh to the south, Yolo County and the bypass are at the heart of big ideas, high hopes, and hard work to improve conditions in the Delta.

These Yolo-Cache partnerships and initiatives reflect *Delta Conservation Framework* goals for forward-thinking regional partnerships and strategies. The Framework also highlights the Yolo Bypass and Cache Slough as two of seven "conservation opportunity regions" where a critical mass of natural landscapes, public lands, potential conservation opportunities, conservation-minded people, and existing partnerships occur in one place. The Framework seeks to support such regions and partnerships in strategic conservation planning. Together these regions will one day add up to a healthier Delta – both for people and wildlife.

CONSERVATION OPPORTUNITY REGION



Referenced Sites

KEY	FEATURE
A	Fremont Weir
B	Fremont Weir Wildlife Area
C	Sacramento Bypass Wildlife Area
D	Sacramento Weir
E	Yolo Bypass Wildlife Area
F	Little Holland Tract
G	Liberty Island Ecological Reserve
H	Liberty Island

Conservation Projects

KEY	PROJECT NAME	SOURCE	TYPE
1	Fremont Weir Adult Fish Passage Modification Project	U.S. Bureau of Rec/ CA Dept. Water Resources	Fish Passage
2	Ag Crossing # 1	U.S. Bureau of Rec/ CA Dept. Water Resources	Fish Passage
3	Ag Crossing # 2	U.S. Bureau of Rec/ CA Dept. Water Resources	Fish Passage
4	Ag Crossing # 3	U.S. Bureau of Rec/ CA Dept. Water Resources	Fish Passage
5	Wallace Weir Fish Rescue Facility Improvement*	U.S. Bureau of Rec/ CA Dept. Water Resources	Fish Passage
6	Ag Crossing # 4	U.S. Bureau of Rec/ CA Dept. Water Resources	Fish Passage
7	Yolo Bypass Wildlife Area Habitat and Drainage Improvement Project	Delta Conservancy Prop 1/ CDFW Prop 1	Floodplain Restoration
8	Lower Putah Creek Realignment	Ecorestore	Fish Passage
9	Lisbon Weir	U.S. Bureau of Rec/ CA Dept. Water Resources	Fish Passage
10	Yolo Bypass Corridors for Flood Escape on the Yolo Bypass Wildlife	Delta Conservancy Prop 1	Floodplain Restoration
11	Flyway Farms Tidal Restoration	EcoRestore	Tidal Restoration
12	Lower Yolo Ranch Tidal Restoration	EcoRestore	Tidal Restoration
13	Liberty Island Conservation Bank	CDFW	Tidal Restoration
14	Pope Ranch Conservation Bank	CDFW	Habitat Conservation

Map: CDFW, 2018

Regional Setting

Constructed about 100 years ago, the 59,000-acre Yolo Bypass is a complex mosaic of agricultural fields and managed wetlands located within the historic 89,000-acre Yolo Basin. Primarily a flood protection area, the bypass reduces the risk of flooding in the Sacramento region through a system of weirs that connect to the Sacramento River to the north (Fremont Weir) and to the east (Sacramento Weir). Fremont Weir overtopped in approximately 70 percent of flood seasons between 1934 and 2012, augmenting flows from western tributaries.[1] In addition to these freshwater outflows, there is a significant tidal influence in the lower Yolo Bypass south of Interstate 80.



Fremont Weir.
Photo: Christina Sloop

The portion of the Yolo Bypass north of Interstate 80 and North Yolo Basin is largely owned by a few private landowners, and also includes two state wildlife areas containing unmanaged grassland and riparian forest. These areas provide wetland values when their weirs overtop. Several thousand acres just north of the Union Pacific Railroad tracks are in private ownership but are managed wetlands protected by federal easements. The southern Yolo Bypass (south of Interstate 80) includes the state's 16,800-acre Yolo Bypass Wildlife Area (YBWA). It also includes thousands of acres of privately owned wetlands that are managed as duck clubs, many protected by state or federal wetland conservation easements. A large giant garter snake mitigation bank lies just south of the YBWA.

The bypass ultimately drains into the Cache Slough complex. Cache Slough in turn drains into the Sacramento River and San Francisco Estuary. Low-lying grasslands and seasonal wetland/vernal pool complexes separate the Cache Slough complex from the

Yolo-Cache At A Glance

- **Size**:
  Yolo: 59,000 acres
  Cache: 53,000 acres
- **Location**:
  Northwestern Delta in Solano and Yolo counties
- **Elevation range:**
  Yolo:10 feet below to 36 feet above sea level
  Cache:10 below to 45 above sea level
- **Zoning**:
  Yolo: 60 – 65 percent agriculture; 35 – 45 percent public lands
  Cache: 80-92 percent agriculture; 15-20 percent public lands
- **Other primary land uses**: flood protection, wildlife habitat, water supply, recreation, duck clubs (Yolo), scientific research
- **Natural communities:**
  Yolo: Managed wetland, tidal wetland, freshwater emergent wetland, vernal pools, seasonal floodplain, grasslands, valley foothill riparian, alkali prairie
  Cache: Seasonal wetlands, vernal pools, seasonal floodplain, tidal perennial aquatic, grasslands, valley foothill riparian
- **Urban population:** 0
- **Rural population:**
  Yolo: 40-45
  Cache: 600-650
- **Recreational opportunities:** Wildlife observation, boating, fishing, hunting, interpretive services, as well as proposed hiking, picnicking, paddling (Cache)
- **Sampling of Listed Species:** Delta smelt, longfin smelt, Chinook salmon, Central Valley steelhead, green sturgeon, giant garter snake, Swainson's hawk, tricolored blackbird, least Bell's vireo, bank swallow, Solano grass, Colusa grass, Conservancy fairy shrimp; vernal pool fairy shrimp, vernal pool tadpole shrimp, California black rail, western burrowing owl, and western yellow-billed cuckoo.

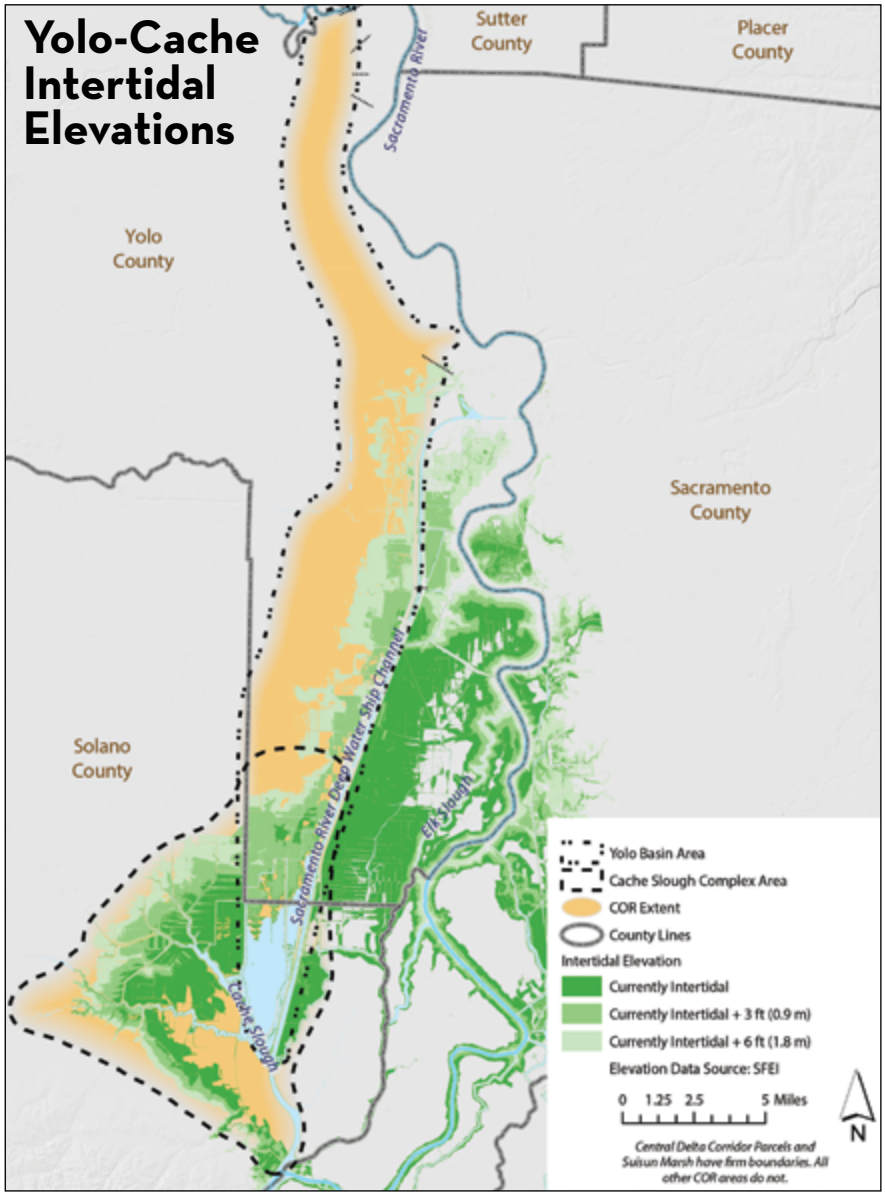
northeast corner of Suisun Marsh. Primary land uses include grazing, local and regional flood protection, terrestrial and aquatic wildlife habitat, and water supply for local agriculture and regional municipal and industrial needs, including the North Bay Aqueduct. Agriculture is the primary land use in the Cache Slough region and relies both on water rights and soils suitable to support a range of agricultural land uses, as well as on protection from the tides and floods influencing the Yolo Bypass, Sacramento River, and local watersheds.

Planning History

The Yolo-Cache region is emerging as a test case for how to effectively manage a variety of land uses in combination, such as flood protection, agriculture, recreation, education, and habitat for fish, migratory birds,[2] and other wildlife. The Yolo Bypass has been the focus of public agency planning efforts around sensitive species and habitat restoration over the past two decades, as has Cache Slough. [3,4,5,6,7,8,9,10,11,12,13,14] Both regions are now at the intersection of many public and private interests and efforts to discuss and vet implementation of state- and federally- led initiatives in the context of local land uses. Ensuring sustained cross-communication among the varied partnerships is a critical element for achieving multiple benefits in the region (see also Section II and Guide p. 73 for details on each).

Opportunities for Conservation and Potential Solutions

The Yolo Basin and Bypass offer notable conservation value for wildlife species associated with floodplains, managed wetlands, seasonal and semi-permanent wetlands, tidal wetlands, grasslands, pasture, and riparian zones, and for a number of special status species.[3] Fish and wildlife include resident and anadromous fish native to the Delta, amphibians and reptiles, as well as resident and migratory birds, including shorebirds, neo-tropical migrants, waterfowl, raptors, and wading birds. There are thousands of acres of existing conservation easements and a wildlife area owned by



Map: CDFW, 2018

Primary Yolo-Cache Partnerships

- **The Yolo Bypass Cache Slough Partnership** (BCSP) is focused on flood risk reduction, ecosystem restoration, and local sustainability. The partnership provides a framework and arena for dialogue for the planning and management of the Yolo Bypass and Cache Slough. Made up of 15 local, state, and federal agencies, the partnership's purpose is to improve executive-level interagency coordination. This policy-level partnership was formed via a 2016 Memorandum of Understanding[6] that emphasizes the importance of achieving across-the-board improvements in habitat, flood protection, agricultural sustainability, recreation, and other public values. This foundational acknowledgement and high-level support has set the stage for developing trust among stakeholders. One new potential focal point for the partnership is the development of a road map for collective, multi-benefit, integrated water management in the region.
- **The Yolo Bypass Working Group** (YBWG), coordinated by the Yolo Basin Foundation, offers an example of local "grassroots" collaboration. Established in 1998, the group is a forum for about 40 stakeholders representing a wide range of interests in managing the multiple uses of the Yolo Bypass. This forum has been particularly helpful in vetting flood plain modeling tools, and assessing the impacts of various projects on agriculture and wetland management. Over the years, stakeholders have participated in discussions and problem solving related to the development of the *Central Valley Flood Protection Plan,* the *Regional Corridor Management Framework,* the *Yolo Bypass Wildlife Area Land Management Plan*, the *Central Valley Joint Venture Implementation Plans*, and proposed fish passage and flood plain enhancement projects under the *Bay Delta Conservation Plan* and California EcoRestore, among many topics. The group has also shared information on federal and state habitat easement programs and recent methyl-mercury studies, and provided input on infrastructure and drainage projects.
- **Regional Corridor Management Framework** (CMF) is a coalition of local reclamation districts, counties, and flood protection agencies that developed the framework as a vision for the integration of local, state, and federal interests in the Yolo-Cache region.[7] Established in 2015, the CMF continues to guide local agency participation in the BCSP and other forums.
- **The Cache Slough Restoration Planning Partnership** (CSRPP) a regionally focused effort including the Delta Conservancy, state agencies, local RCDs, reclamation districts and counties, and consultants such as the San Francisco Estuary Institute and Flow West. Outreach added Delta farmers, landowners, and residents to the partnership. The partnership[8] examined opportunities to develop a broader regional conservation strategy for the Cache Slough complex. Building on the California EcoRestore[9] and Department of Fish and Wildlife's Fish Restoration Program,[10] the aim of the first phase was to develop a locally supportable vision and strategic planning approach that reduces potential conflicts between land uses, and recognizes opportunities for a landscape-level integrated approach to conservation that includes ecosystem processes, multiple habitat types, and species.

Current Yolo-Cache State and Federally Led Planning Efforts

- **California EcoRestore.** The Department of Water Resources and the US Bureau of Reclamation are pursuing the enhancement of up to 17,000 acres of floodplain habitat and restoration of 8,000 acres of tidal habitat in the Yolo Bypass and Suisun Marsh, consistent with a 2008 USFWS Biological Opinion and a 2009 NMFS Biological Opinion.[11] California EcoRestore is focused on benefitting native fish species through provision of increased juvenile rearing habitat, enhanced adult fish passage, and improvement of primary production. This includes priority projects like the realignment of the Lower Putah Creek and is consistent the 2012 *Yolo Bypass Salmonid Habitat Restoration and Fish Passage Implementation Plan* (see p. 36).
- **Central Valley Flood Protection Plan** (CVFPP). The 2017 CVFPP Conservation Strategy[12] includes continued analysis of floodplain restoration opportunities. This analysis offers decision diagrams to identify and prioritize potential locations for: 1) modifying floodplain topography (specifically, lowering floodplain topography through targeted excavation) and 2) relocating levees (specifically, constructing setback levees). Yolo Bypass levee setbacks and weir extensions are central to the state strategy for increasing flood system resiliency.
- **Sacramento River General Reevaluation Report.** Working in partnership with the California Department of Water Resources (DWR), the US Army Corps of Engineers is developing this planning vehicle to secure Congressional approval for significant improvements to the Yolo Bypass and Sacramento River.
- **Central Valley Joint Venture Implementation Plan.** This plan is part of an international effort to manage and restore migratory bird populations along the North American flyways. This plan has specific objectives for wetlands and riparian habitat in each of the Joint Venture planning regions associated with the Sacramento River. The goals for the Yolo Basin are based on sustaining current rice growing operations, and sustaining and improving managed wetlands (see p. 70).
- **Cache Slough Complex Conservation Assessment.** DWR completed Volume 1 of the assessment in 2016 in collaboration with the California Department of Fish and Wildlife Fish Restoration Program (FRP).[13] The assessment evaluates the potential for restoring the Cache Slough complex as part the FRP. It also provides information on current and historic conditions in order to generate a regional landscape conceptual model for conservation of tidal habitats to support the recovery of Delta smelt. Volume 2 will present restoration strategies and assess compatibility with other regional plans.

Yolo Bypass. Photo: Christina Sloop



CONSERVATION OPPORTUNITY REGION CONTINUED

the California Department of Fish and Wildlife in place within the Yolo Bypass that protect habitat managed to benefit these fish and wildlife species.

Just downstream, the Cache Slough complex offers notable conservation value for species associated with tidal wetlands, seasonal wetlands (including vernal pools), and grasslands in and around the Delta.[15] The complex has been established as the only known Delta site supporting year-round populations of endangered Delta smelt, and provides spawning and rearing habitat for populations migrating from the San Francisco Estuary's low salinity zone.[16,17] Moreover, undeveloped lowland grasslands and ranch land span the short distance between the Cache Slough complex and Suisun Marsh to the west. Altogether these offer an ecological corridor for movement of wildlife and provide sea level rise accommodation space over the long-term.[18]

Major planned and existing conservation projects in the Yolo-Cache complex are listed in the sidebar. Additional conservation opportunities follow.

REFERENCING EXISTING REGIONAL HABITAT PLANNING

The Yolo Habitat Conservation Plan/Natural Community Conservation Plan (HCP/NCCP)[19] is a countywide conservation plan coordinated by the Yolo Habitat Conservancy. The plan addresses Endangered Species Act permits and associated mitigation for infrastructure (e.g. roads and bridges) and development activities (e.g. agricultural facilities, housing, and commercial buildings) identified for construction over the next 50 years in Yolo County.[20] The Yolo HCP/NCCP will coordinate mitigation to maximize benefits and conserve habitat beyond required mitigation for 12 identified species. The plan has a strong link to agricultural preservation, and strikes a balance between natural resource conservation and economic growth in the region.

Major Yolo-Cache Planned or Existing Restoration Projects

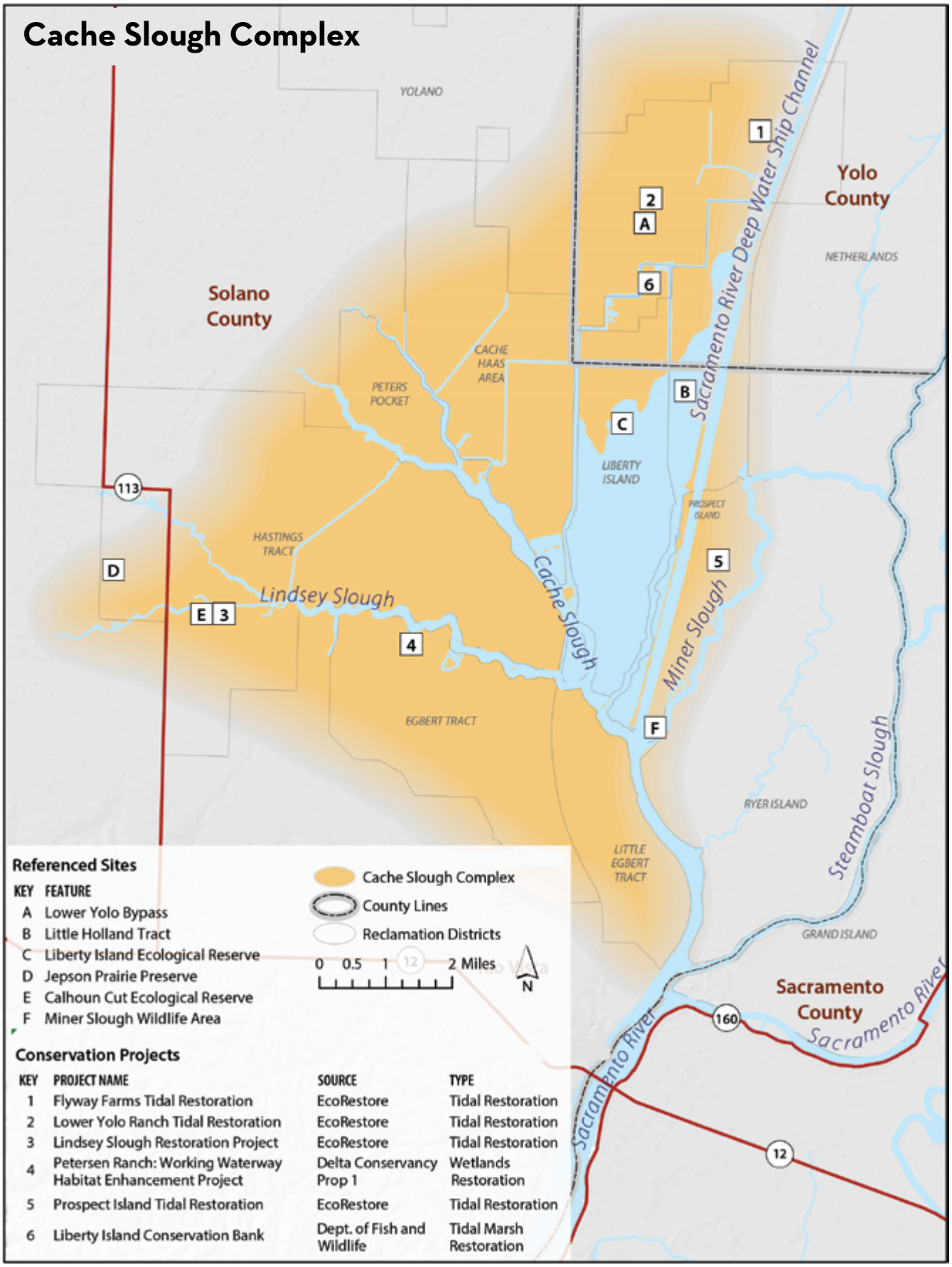
- Lower Yolo Ranch tidal and floodplain restoration (1,480 acres)
- Liberty Island Conservation Bank (809 acres, tidal)
- North Delta Fish Conservation Bank (Liberty Island 809 acres, tidal)
- Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project
- Fremont Weir Adult Fish Passage Modification Project
- Wildlife corridors for flood escape on the Yolo Bypass Wildlife Area (approximately four linear miles, 82 acres)
- Yolo Wildlife Area habitat and drainage project (approximately 2,617 acres)
- Putah Creek realignment project (approximately two channel miles of Lower Putah Creek in the Bypass to enhance fish passage)
- Yolo Bypass agricultural crossing fish passage improvements
- Lisbon Weir modification project
- Yolo Flyway Farms (359 acres of subtidal, intertidal, and seasonal wetlands)
- Lower Elkhorn levee setback project (approximately 7 miles of setback levee for floodplain enhancement)
- Prospect Island restoration project (1,617 acres tidal)
- Lindsey slough tidal restoration, completed 2015.
- Pope Ranch Garter snake mitigation bank
- Wallace Weir improvement project and fish collection facility (keeps adult salmon out of the Ridge Cut and Colusa Basin)

(see also maps pp. 92 & 97)

The Solano Multi-Species HCP is still in development, with a final administrative draft last updated in October 2012. This HCP will promote conservation of biodiversity and preservation of covered species and their habitats in relation to urban development, flood control, and infrastructure improvement activities.[21] Federal- and state-listed fish species and other species of concern on lands within the Delta will be included in the HCP as covered species. Natural communities to be protected include grasslands and vernal pools, riparian and stream habitats, and marshes.

The Yolo Regional Conservation Investment Strategy/Local Conservation Plan (Yolo RCIS/LCP)[22] is a voluntary, landscape-scale conservation plan identifying conservation priorities to guide public and private conservation actions and investment. It will provide a blueprint for additional voluntary, non-regulatory conservation in Yolo County that addresses needs not covered in the Yolo HCP/NCCP.

CONSERVATION OPPORTUNITY REGION



Map: CDFW, 2018

NORTH DELTA ARC CONNECTIONS

Both the Yolo Bypass and Cache Slough fit into a "grand strategy" to create an interconnected series of habitats, mostly tidal, in this region as a result of its potential for biodiversity conservation and location at the southern end of the Yolo Bypass. Developed by the UC Center for Watershed Sciences, this strategy is referred to as the "North Delta Habitat Arc" and consists of a reconciled ecosystem strategy to create an arc of habitats connected by the flows of the Sacramento River.[23] The Yolo Bypass is the upstream end of the arc, which continues through the Cache-Lindsey Slough-Liberty Island region (Cache-Slough complex), down the Sacramento River (including Twitchell and Sherman Islands), and into Suisun Marsh. Very few areas of the Delta offer these opportunities for significant habitat connectivity (for more information see p. 72).

FISH, FLOODPLAIN, AND MARSH HABITAT IMPROVEMENTS

The Northwest Delta around Yolo Bypass and Cache Slough offers unique opportunities to support native fish using landscape scale approaches and ecological processes. What's special about the Yolo Bypass region is the opportunity for floodplain habitat and shallows rich in food and shelter for young salmon and resident fish; what's special about Cache Slough is its proximity to the Yolo Bypass and the distributary channels of the lower Sacramento River. Cache Slough benefits from natural flood pulse flows, providing seasonal migration, spawning, and rearing habitats for adult and juvenile native and anadromous fish. The flood plains and distributary channels are primary sources for food web productivity during inundation and high flow events, and also bring winter sediment supply. The Cache Slough complex also hosts mineral soils that minimize land subsidence relative to the more organic soil in other parts of the Delta. The gradual alluvial slopes of the surrounding uplands could accommodate sea level rise through lateral marsh expansion.[24] As the Cache Slough complex still contains natural drainage patterns, and connects to the Sacramento River, the area is widely regarded as prime location for restoration projects. Liberty Island (1998)[25] and Little Holland Tract (1982)— two very large, naturally restored islands—now support a mix of emergent tidal marsh, intertidal flats, and shallow-to-moderate-depth subtidal aquatic habitats. The Cache Slough complex is also adjacent to a biologically unique, broad, lowland grassland/vernal pool complex which connects to Suisun Marsh.



Geese over bypass near Sacramento. Photo: David Feliz



*Copepod (*p. Marinus*), a favored fish food for young salmon and other natives. Photo: Vogt*

Potential Solutions to Recognized Challenges

In any Yolo-Cache complex conservation planning effort, tradeoffs must be considered. For example, floodplain related conservation goals to provide extended inundation to promote juvenile salmonid rearing habitat,[26] or tidal restoration related goals to improve the

Delta food web, have the potential to conflict with existing agricultural land uses, wetlands management, hunting, wildlife viewing, and education.[27,28] Increased restoration activities may also create the need for mosquito control, and the potential for mercury contamination. Below are some potential solutions to some of these challenges:

WILDLIFE-FRIENDLY AGRICULTURE

Wildlife-friendly farming integrates conservation goals with agriculture to benefit wildlife and conserve biodiversity. Wildlife-friendly agricultural practices in the Yolo Bypass include farming crops that benefit wildlife (such as rice, safflower, and irrigated pasture), and providing drainage ditches and hedgerows with habitat value. In the Yolo Bypass and Cache Slough region, like elsewhere in the Delta, agriculture has been a way of life for generations, however, and farmers and ranchers remain concerned about being displaced by conservation. As conservation projects are implemented and managed over the long term, it is essential to have early, clear, and consistent communication among all stakeholders (landowners, agencies, and NGOs), and to consider good neighbor practices such as those outlined by the Agricultural Lands Stewardship Working Group (see p. 75).[29]

INTEGRATED FLOOD MANAGEMENT

The Yolo Bypass is part of the regional integrated flood management system. It is important to recognize the critical role agriculture and managed wetlands play in maintaining an open floodway. During standard operations, farmers and wetland managers on the Yolo Bypass keep their fields clear (emergent vegetation at less than five percent of total cover). Without these efforts, the Yolo Bypass would eventually support large woody vegetation that would slow the flood flows. Long term-flood protection, levee maintenance, and agricultural operations can be linked to conservation outcomes in other ways.[30] For example, maintaining hedgerows at the margins of agricultural fields can increase their habitat value, and levees can be used to provide wildlife transition habitat. These potential links between flood control and conservation provide opportunities consistent with specific actions identified in the Central Valley Flood Protection Plan Conservation Strategy for the Yolo Bypass, and with the goals and objectives of California EcoRestore and the Sacramento River General Reevaluation Report. While Cache Slough does not provide the key flood protection role of Yolo Bypass, considering the two as part of one important Sacramento River drainage system offers further opportunities for integrating habitat conservation with flood protection.



Hawks harvest rodents in tractor's wake. Photo: Dave Feliz

LOW-IMPACT RECREATION

Several state-run areas within the Yolo Bypass provide public access for recreation and waterfowl hunting, including the Yolo Bypass Wildlife Area, and Fremont Weir and Sacramento Weir Wildlife Areas. The California State Parks Proposal for the Sacramento-San Joaquin Delta[31] recognizes potential additional opportunities in this area for ecosystem restoration coupled with outdoor recreation (wildlife observation, boating, fishing access, and hunting), particularly in the southern end of the Yolo Bypass. The integration of floodplain conservation activities with

current educational and recreational uses may provide additional opportunities. However, providing public access to restoration sites remains a general challenge in the Delta. Human activities — vehicles, litter, illegal hunting — can disturb wildlife and damage sensitive habitats.

Around Cache Slough, there are several private facilities set up for hunting waterfowl and other game birds, as well as public areas such as the Miner Slough Wildlife Area and Liberty Island Ecological Reserve that allow hunting and fishing. Barker Slough is on a list of locations for a new state park, where habitat restoration could be integrated with picnic sites, trails, kayak, canoe and other small paddle-craft facilities, and interpretive services. The expansion of recreation and related tourism, if integrated with conservation efforts, could increase both the economic value and the ecosystem services derived from the Delta.

CLIMATE CHANGE AND ADAPTATION OPPORTUNITIES

The Yolo-Cache region will be affected by climate change induced sea level rise within the next 30-100 years. Lands currently in the intertidal zones are projected to become subtidal.[32] Rising water levels will alter and submerge current shorelines and nearby areas. In some areas sea level rise will mean that current agricultural land will be lost to increased salinity levels or inundation. Further, flood dynamics will likely change over the coming decades, with more frequent and extreme storm and rainfall events and associated flood pulses. Scenario planning will help evaluate forecasted impacts on ecosystems and species, and integrate these into the long-term planning and management picture. Regular re-evaluation of scenarios over time will allow land managers and planners to re-examine how earlier projections played out and to adapt to changes.



Yolo Bypass. Photo: Christina Sloop.

Looking Ahead

The *Delta Conservation Framework* supports further efforts to make the most of the Yolo-Cache conservation opportunity regions, existing planning foundations, and active partnerships. Efforts in both Yolo and Cache to date exhibit the cornerstones for successful conservation planning and implementation including establishing trust and inclusion among stakeholders, setting goals, agreeing on structure for partnerships, communicating, and using science to support decision-making.

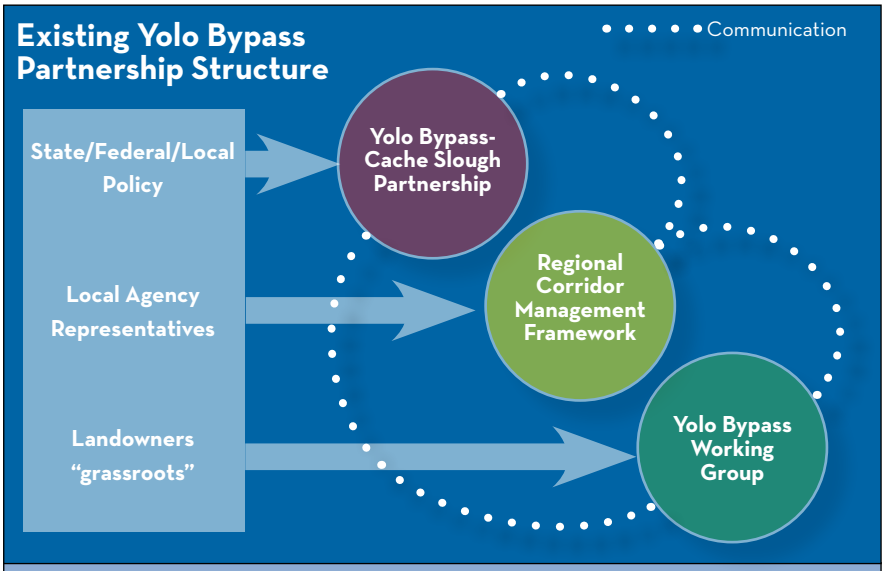


Figure 2.2

Several partnership efforts have focused on conservation and floodplain management issues in the Yolo Bypass-Cache Slough Complex. With sufficient and consistent communication, coordination, and an effective governance structure, these efforts could serve as an ongoing forum for successful long-term conservation in the Yolo Bypass-Cache Slough region and lead to the development of regional conservation strategies. This would afford landscape scale integration of the existing HCP/NCCP, RCIS/LCP, and other Yolo Bypass and Cache Slough focused plans, tying them in with the *Delta Conservation Framework's* landscape scale and long-term goals and strategies.

A Yolo Bypass or Cache Slough regional conservation strategy could utilize scenario planning to develop strategies to ensure flood protection, improve ecological function, assist species recovery, integrate benefits for wildlife-friendly farming operations, and provide recreation at the local and landscape scales.

For Yolo, regular communication and coordination (between BCSP, CMF, and YBWG) as part of a Yolo Bypass regional conservation strategy effort would help balance the interests of each group, consistent with *Delta Conservation Framework* Goal A. An RCS could also focus on developing multi-benefit conservation solutions consistent with Framework Goals C, D & E. The Cache Slough Restoration Planning Partnership, meanwhile, is also poised to develop priority projects that tie in with the *Delta Conservation Framework* overarching goals and strategies.

A Yolo Bypass-Cache Slough regional conservation strategy could present a unique opportunity to align with the North Delta Arc vision, as well as with *Delta Conservation Framework* Goals F and G. These Framework goals are aimed at addressing conservation-related permitting through a general regional permit approach, and developing short-and long-term funding via bond initiatives and other opportunities. A facilitated process for Yolo Bypass conservation related permitting would increase the efficiency of project implementation and continued management, and help balance short and long term impacts and benefits.

QUICK LINKS

Yolo Bypass-Cache Slough Partnership
www.dailydemocrat.com/2016/05/11/agencies-to-coordinate-flood-and-habitat-projects-in-yolo-bypass/

Yolo Bypass Wildlife Area
www.wildlife.ca.gov/Lands/Places-to-Visit/Yolo-Bypass-WA

http://yolobasin.org/yolobypasswildlifearea/

For more detailed descriptions of these conservation opportunity regions, see Appendix 2.

Guide to Delta Ecosystems and Associated Habitat Types

This listing was developed through collaboration between the California Department of Fish and Wildlife, Delta Conservancy, and Delta Stewardship Council, with close alignment to the information presented in A Delta Transformed *(Robinson, Safran et al. 2014) and* A Delta Renewed *(Robinson, Safran et al. 2016).*

Table 3.1: Delta Habitats

Upland / Terrestrial Ecosystem	Definition	Source
Grassland	Low herbaceous communities occupying well-drained soils and composed of native forbs and annual and perennial grasses and usually devoid of trees. Few to no vernal pools present.	Delta Transformed (p. 18)
Oak woodland/savanna	Oak dominated communities with sparse to dense cover (10-65 percent cover) and an herbaceous understory.	Delta Transformed (p. 18)
Stabilized interior dune vegetation	Vegetation dominated by shrub species with some locations also supporting live oaks on the more stabilized dunes with more well-developed soil profiles.	Delta Transformed (p. 18)
Agriculture - high intensity	Active agricultural lands in high-intensity crops such as fruit or nut orchards and/or vineyards.	Delta Transformed (p. 18) with added split between high/low intensity
Agriculture - low intensity	Active agricultural lands in low-intensity crops such as row crops, rice fields, alfalfa, or pasture.	Delta Transformed (p. 18) with added split between high/low intensity
Ruderal/nonnative	Areas dominated by nonnative vegetation and ruderal lands.	Delta Transformed (p. 18)
Urban	Urban remnant natural areas (greens, trees, and other features such as water-treatment wetlands).	Delta renewed (p. 78)

Riparian Ecosystem	Definition	Source
Valley foothill riparian	Mature riparian forest usually associated with a dense understory and mixed canopy, including sycamore, oaks, willows, and other trees. Historically occupied the supratidal natural levees of larger rivers that were occasionally flooded.	Delta Transformed (p. 18)
Willow riparian scrub-shrub	Riparian vegetation dominated by woody scrub or shrubs with few to no tall trees. This habitat type generally occupies long, relatively narrow corridors of lower natural levees along rivers and streams.	Delta Transformed (p. 18)
Willow thicket	Perennially wet, dominated by woody vegetation (e.g., willows). Emergent vegetation may be a significant component. Generally located at the "sinks" of major creeks or rivers as they exit alluvial fans into the valley floor.	Delta Transformed (p. 18)

Aquatic - Perennial Wetland Ecosystem	Definition	Source
Freshwater emergent marsh/wetland - tidal	Perennially wet, high water table, dominated by emergent vegetation. Woody vegetation (e.g., willows) may be a significant component for some areas, particularly the western-central Delta. Wetted or inundated by spring tides at low river stages (approximating high tide levels).	Delta Transformed (p. 18)
Freshwater emergent wetland/marsh - nontidal	Temporarily to permanently flooded, permanently saturated, freshwater nontidal wetlands dominated by emergent vegetation. In the Delta, occupies upstream floodplain positions above tidal influence.	Delta Transformed (p. 18)
Saline emergent wetland (SEW)	Herbaceous-dominated: > 2 percent total cover by herbaceous species and < 10 percent total cover by tree or shrub species; limited to tidally-influenced portions of coastal regions. SEW cross-walks to CALVEG[1] pickleweed-cordgrass and tule-cattail.	(CDFG 1988, Springer 1988)
Vernal pool complex	Area of seasonally flooded depressions, characterized by a relatively impermeable subsurface soil layer and distinctive vernal pool flora. These often comprise the upland edge of perennial wetlands.	Delta Transformed (p. 18)

Aquatic - Seasonal Wetland Ecosystem	Definition	Source
Alkali seasonal wetland complex	Temporarily or seasonally flooded, herbaceous, or scrub communities characterized by poorly-drained, clay-rich soils with a high residual salt content. These often comprise the upland edge of perennial wetlands.	Delta Transformed (p. 18)
Wet meadow and seasonal wetland	Temporarily or seasonally flooded, herbaceous communities characterized by poorly-drained, clay-rich soils. These often comprise the upland edge of perennial wetlands.	Delta Transformed (p. 18)
Managed wetland	Areas that are intentionally flooded and managed during specific seasonal periods, often for recreational uses such as duck clubs.	Delta Transformed (p. 18)

Aquatic - Open Water Ecosystem	Definition	Source
Fluvial - low order channel	Distributaries, overflow channels, side channels, swales. No influence of tides. These occupy nontidal floodplain environments or upland alluvial fans.	Delta Transformed (p. 18)
Fluvial - mainstem channel	Rivers or major creeks with no influence of tides.	Delta Transformed (p. 18)
Fluvial - shaded riverine aquatic	Aquatic edge habitat that is shaded by adjacent riparian vegetation.	(IAMIT 2017)
Fluvial - channel margin habitat	In-water habitat along the channel margin which generally ranges from perennial aquatic wetlands to floodplain and riparian habitats. This habitat type generally includes shaded riverine aquatic habitat at upper elevations. It is also referred to as fish-friendly levee habitat.	(IAMIT 2017)
Freshwater pond or lake	Permanently flooded depressions, largely devoid of emergent Palustrine vegetation. These occupy the lowest-elevation positions within wetlands.	Delta Transformed (p. 18)
Freshwater intermittent pond or lake	Seasonally or temporarily flooded depressions, largely devoid of emergent Palustrine vegetation. These are most frequently found in vernal pool complexes at the Delta margins and also in the nontidal floodplain environments.	Delta Transformed (p. 18)
Tidal - mainstem channel	Rivers, major creeks, or major sloughs forming Delta islands where water is understood to have ebb and flow in the channel at times of low river flow. These delineate the islands of the Delta.	Delta Transformed (p. 18)
Tidal - low order channel	Dendritic tidal channels (i.e., dead-end channels terminating within wetlands) where tides ebb and flow within the channel at times of low river flow.	Delta Transformed (p. 18)

To skip these references go to p. 107

Guide to Delta Ecosystems and Associated Habitat Types - CONTINUED

Overlapping/Transitional Ecosystem Categories/ Features	Definition	Source
Upland transitional corridors	The connected terrestrial ecosystems within and around the periphery of the Delta (e.g., to support wildlife movement and dispersal).	Delta Renewed (p. 70)
Marsh-terrestrial transition zone	"Marsh" includes both tidal and nontidal freshwater emergent wetland; the "marsh-terrestrial transition zone" was mapped wherever marsh polygons and terrestrial habitat type polygons were adjacent to one another; "terrestrial habitat types" include oak woodlands, seasonal wetlands, and riparian habitat, among others (i.e., everything other than marsh, open water, urban/barren, and agricultural/nonnative)	Delta Transformed (pp. 71-72)
Marsh to open-water edge	All areas mapped as open water and marsh, regardless of their tidal status, connectivity, or form. Seasonally and tidally inundated areas are not included within the area mapped as open water. Linear areas where the two habitat types were mapped as adjacent to one another are identified as the open water-marsh edge.	Delta Transformed (p. 44)
Floodplain	The area at low to mid elevations adjacent to and transitioning between fluvial, or riverine, and tidal areas, that is subject to flooding during periods of high discharge.	(IAMIT 2017)
Floodplain - seasonal short-term flooding	**Floodplain:** The area at low to mid elevations adjacent to and transitioning between fluvial, or riverine, and tidal areas, that is subject to flooding during periods of high discharge. **Seasonal short term flooding:** Short-term fluvial inundation • intermediate recurrence (~10 events per year) • low duration (days to weeks per event) • generally shallower than seasonal long-duration flooding	(IAMIT 2017); Delta Transformed definitions for subtypes (pp. 38-39)
Floodplain - seasonal, long duration	**Floodplain:** The area at low to mid elevations adjacent to and transitioning between fluvial, or riverine, and tidal areas, that is subject to flooding during periods of high discharge. **Seasonal, long duration:** Prolonged inundation from river overflow into flood basins • low recurrence (~1 event per year) • high duration (persists up to 6 months) • generally deeper than seasonal short-term flooding	(IAMIT 2017); Delta Transformed definitions for subtypes (pp. 38-39)
Floodplain - tidal inundation	**Floodplain:** The area at low to mid elevations adjacent to and transitioning between fluvial, or riverine, and tidal areas, that is subject to flooding during periods of high discharge. **Tidal inundation:** Diurnal overflow of tidal sloughs into marshes • high recurrence (twice daily) • low duration (<6 hours per event) • low depth ("wetted" up to 0.5 mile)	(IAMIT 2017); Delta Transformed definitions for subtypes (pp. 38-39)
Floodplain - ponds, lakes, channels, and flooded islands	**Floodplain:** The area at low to mid elevations adjacent to and transitioning between fluvial, or riverine, and tidal areas, that is subject to flooding during periods of high discharge. **Ponds, lakes, channels, and flooded islands:** Perennial open water features (with the exception of historical intermittent ponds and streams) • recurrence not applicable (generally perennial features) • high duration (generally perennial features) • variable depth	(IAMIT 2017); Delta Transformed definitions for subtypes (pp. 38-39)

Overlapping/Transitional Ecosystem Categories/Features	Definition	Source
Wildlife-friendly agriculture best management practices (BMPs)	Any activity carried out on agricultural lands that benefits wildlife. These wildlife-friendly activities may help protect or increase quantity and/or quality of habitat found in or adjacent to agricultural landscapes. Availability, quantity, and quality of crop and grain residue within the field and fence-line vegetation, pesticide application and management, water management, and timing of these activities affect the value agricultural lands provide for wildlife. Delta Renewed guidelines to benefit wildlife include six categories of BMPs, defined as "practices that support native wildlife on agricultural lands, including practices which manage fields as wetlands that wildlife can access (rice crops and flooded fields)."	(Burmester 2015); Delta Renewed (pp. 76-77, 117)
Wildlife-friendly agriculture BMPs - minimize water quality impacts from agriculture	BMPs that include reduced pesticide use, integrated pest management, settling basins, and buffer strips to filter runoff.	Delta Renewed wildlife-friendly agriculture (pp. 76-77, 117)
Wildlife-friendly agriculture BMPs - minimize water diversion impacts from agriculture	BMPs that could include adding fish screens to prevent entrainment, conservation measures to reduce volume of water diverted, or changing the location or timing of diversion to minimize impacts.	Delta Renewed wildlife-friendly agriculture (pp. 76-77, 117)
Wildlife-friendly agriculture BMPs - flexible and responsive management in agricultural areas	Managing different crops with potential to provide support for different wildlife species. For example, The Nature Conservancy's "pop-up habitats" divert water to farms when waterbird densities are high; or row crops and rice fields support waterbirds and fish, while hedgerows support terrestrial wildlife.	Delta Renewed wildlife-friendly agriculture (pp. 76-77, 117)
Wildlife-friendly agriculture BMPs - agricultural fields managed as seasonal wetland or floodplain	Agricultural practices that create seasonal or perennial wetlands that mimic the hydrology of historical wetlands. For example, rice fields provide long-duration floods and invertebrate-rich rearing habitats, which flood basins provided historically. Agricultural wetlands can support high densities of wintering and migrating waterbirds, as well as fish, and are critical to supporting these species in the absence of extensive natural wetlands. Agricultural wetlands support different species depending on crop type, flooding patterns, and post-harvest practices.	Delta Renewed wildlife-friendly agriculture (pp. 76-77, 117)
Wildlife-friendly agriculture BMPs - hedgerows and native vegetation within/between agricultural fields	Patches of native vegetation within or between agricultural fields, whether remnants of historical habitats (e.g., oak trees, vernal pools) or linear features along the edge of fields (e.g., buffer strips, hedgerows), to provide habitat for native wildlife and easier movement through the landscape.	Delta Renewed wildlife-friendly agriculture (pp. 76-77, 117)
Wildlife-friendly agriculture BMPs - minimize distance from agricultural fields to nearby wildland areas	Species supported by wildlife-friendly agriculture that benefit from close proximity to appropriate wildland habitats.	Delta Renewed wildlife-friendly agriculture (pp. 76-77, 117)

1 The CALVEG ("Classification and Assessment with Landsat of Visible Ecological Groupings") system

QUICK LINKS

Landscape Connectivity, Meiklejohn, et al. 2009

www.wildlandsnetwork.org/sites/default/files/terminology%20CLLC.pdf

To skip these references go to p. 107

Your Project, Your Ideas, Your Partners?

SECTION IV

Delta Conservation Based on Science



Illustration: Alison Kozai

One Delta – One Science 109
Adaptive Management 110
Goal E: Assessing Progress and Informing Management 111
Priority Science Actions 113
Conservation Status 116
Climate Change Effects 118
West Delta Conservation Opportunity Region 121
Guide to Related Plans and Programs 128

KEY TERMS

- **ADAPTIVE MANAGEMENT** - involves a series of cyclical steps that include: defining the problem; establishing measurable goals and objectives; modeling linkages between objectives and proposed actions; selecting actions and related performance measures; designing and implementing actions and developing an associated monitoring plan; analyzing, synthesizing, and evaluating new data; disseminating learned information; and adapting practices to incorporate what was learned.[21] Adaptive Management is not to be confused with managing adaptively. Both have value – yet they are very different concepts. Managing adaptively, or adjusting management actions to fit circumstances, often based on experience, is common practice.[21]
- **CLIMATE CHANGE** - Any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from natural factors, including changes in the sun's intensity or changes in the Earth's orbit around the sun; natural processes within the climate system (such as changes in ocean circulation); or human activities that change the composition of the atmosphere (for example, through release of carbon) and land surfaces (for example, deforestation or urbanization).
- **X2** - The point identified by the distance from the Golden Gate Bridge where salinity at the bottom of the water column is about two parts per thousand. Keeping X2 within a range of positions around Suisun Marsh (by managing fresh water outflows as needed) is considered supportive of the health of the estuarine food web. X2 serves as a metric for both the extent of native fish habitat in the low salinity zone in the San Francisco Estuary and the salinity standard in the state's water quality control plan.
- **EXTREME EVENTS** - One of the most visible consequences of climate change is an increase in the intensity and frequency of extreme weather events. Weather and climate extremes include hurricanes, tornadoes, heavy downpours, heat waves, and droughts that affect all sectors of the economy and the environment, impacting people where they live and work.
- **NOVEL ECOSYSTEMS** - A novel ecosystem can be identified by its origins rooted in human agency, the ecological thresholds it has crossed, a significantly altered species composition, and a capacity to sustain itself. In 2013 Hobbs and co-authors defined a novel ecosystem as "a system of abiotic, biotic, and social components (and their interactions) that, by virtue of human influence, differ from those that prevailed historically, having a tendency to self-organize and manifest novel qualities without intensive human management."
- **SEA LEVEL RISE** - An increase of the global volume of water in the oceans, resulting in receding shorelines and increased flooding. Sea level rise is often discussed in the context of climate change (such as thermal expansion of ocean waters and the melting of glaciers and ice sheets).
- **RESILIENCE** – Resilience is a means by which ecosystems, habitats, and species are likely to successfully adapt and thrive over time. The concept of resilience in conservation focuses on creating systems that are robust enough to persist and adapt over the long term, in order to manage ecosystems for an uncertain future. Resilience can also refer to non-ecological systems, such as agriculture.
- **RECONCILIATION ECOLOGY** - Reconciliation ecology seeks to improve conditions for native species while recognizing that most ecosystems have been altered irrevocably by human use and will continue to be used to support human goals. Improving ecosystem conditions for native species must therefore happen in a context of continuing use of land and water by humans and continuing physical and biological change.[28]

Footnotes: The Delta Conservation Framework footnote and endnote references can all be found in Appendix 1 online by section.

Introduction

Throughout the Delta, a multitude of stressors impair ecosystem processes and discourage the persistence of native species.[1,2,3,4,5,6,7] Ecosystems are most resilient and functional when they are interconnected at various scales.[8,9] To achieve lasting resilience, it is important to understand how ecological processes function across time and space within a mosaic of wildlife-friendly land management approaches and agriculture in the Delta.[10,11] In addition, sustaining functional ecosystems, native species, agriculture and other human land uses will become much more difficult with the projected increase in environmental extremes over the coming decades.[7, 12, 14] It may become necessary to shift the focus from managing "native" or "natural" systems to managing for "reconciled" or "novel" ecosystems.[13,14] (See also Key Terms p.108.)

Understanding such complexities, and the reverberating impacts on the use of the Delta by both people and native species, requires collaborative multi-interest science, long-term monitoring, and adaptive management based on this research and monitoring. Without science-based conservation practices that support rapid responses to crises and provide long-lasting solutions, Delta conservation may not be successful in the long term.[15,16,17]

This section offers an overview of science capacity in the Delta, including current and upcoming scientific research and progress made toward comprehensive adaptive management programs. (The relationships among some of these programs, however, is still in the process of being clarified.) Several such programs are addressing the needs of upcoming conservation and mitigation actions under California EcoRestore,[18] state and federal water project operations, and California WaterFix, [19,20,21] as well as those of restoration programs outside these mandates.

The *Delta Conservation Framework* supports these and other efforts to tailor Delta science to current conditions and future challenges. The Framework, in its push for science-based restoration on a landscape scale, recognizes the value and intent of the Delta's existing collaborative science and management programs. In following up on Framework goals and strategies, regional partnerships should tap this strong existing capacity to monitor progress and manage conservation outcomes.

One Delta – One Science

The most comprehensive recent effort to organize the Delta's diverse regional science and monitoring programs, and to increase transparency, integration, and collaboration, is the *Delta Science Plan*.[20] The *Delta Science Plan* sets the vision for "One Delta, One Science," a collaborative and open science community that contributes to a shared body of scientific knowledge to inform future water and environmental decisions.

The Delta Stewardship Council's Delta Science Program has coordinated a set of collaborative documents that make up a Delta Science Strategy[20,21] aimed at achieving the vision of One Delta, One Science:

- The Plan offers a cooperative science-oriented approach that extends across multiple agency and program authorities.
- The Strategy prioritizes and aligns near-term science actions to inform management actions and achieve the objectives of the *Delta Science Plan*.
- The State of Bay-Delta Science reports synthesize scientific knowledge about the Delta, including progress made on key research questions and remaining knowledge gaps.



Fish and food web sampling under the Interagency Ecological Program. Photo: IEP

Connecting Agency-Driven Science to Future Science

One Delta One Science is a broadly focused, program in a constellation of Bay-Delta science and monitoring endeavors. The region has a 60+-year history of data collection for management purposes, and one of its longest running programs is the Interagency Ecological Program (IEP). IEP was established in the 1970s to "provide and integrate relevant and timely ecological information for use in the management of the Bay-Delta ecosystem and the waters that flow through it." The IEP currently conducts research, monitoring, and synthesis to address high-priority management and policy needs in order to fulfill responsibilities established under various water rights decisions, the state and federal Endangered Species Acts, and the Clean Water Act. The mission directives are carried out by multi-disciplinary teams composed of agency, academic, nongovernmental organizations, and consultants.[21,22]

Multi-Layered Science, Monitoring, and Adaptive Management

Increasingly, Delta science is undertaken in teams combining agency or policy driven science with socio-economic or ecosystem-based science. These teams are supported by regional or area wide monitoring programs and linked to adaptive management programs. In addition to those mentioned above, some of these active teams are involved in the Collaborative Science and Adaptive Management Program, the Fish Restoration Program Monitoring Team, and the Delta Regional Monitoring Program. Other significant scientific contributions to conservation and land management in the Delta include cross-cutting projects such as the Delta Region Area-wide Aquatic Weed Project (see Section III), the Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary[23] and various research programs conducted by the San Francisco Estuary Institute and the UC Davis Center for Watershed Sciences. The Public Policy Institute of California, meanwhile, helps communicate science to decision-makers to inform public policy.

Science Enterprise

Collectively, all the science programs and activities in the Delta region that inform and serve managers and stakeholders in decision-making are referred to as the "Science Enterprise."[19] Collectively, the Science Enterprise was a joint Delta Stewardship Council-US Geological Survey effort that recognized a need for additional levels of collaboration and integration, particularly in the context of conservation planning, implementation, and adaptive management. Those initiatives or plans spearheading increasing cross-cutting science coordination include the Science Action Agenda and its development process, the Delta Independent Science Board, IEP's science agenda process, and the *Delta Plan* Interagency Implementation Committee's Delta Agency Science Workgroup.

> *"Big changes are always impractical for those deeply embedded in existing practices that are failing us."*
>
> RICHARD NORGAARD, UC BERKELEY
> DELTA INDEPENDENT SCIENCE BOARD

A Framework for Conservation Science

Available ecological and socioeconomic studies in the Delta should inform conservation-related decision-making. The *Delta Conservation Framework* encourages priority setting throughout the Delta Science Enterprise to support long term monitoring and adaptive management and acquire the data needed to evaluate the effectiveness of conservation-related actions over time. Using this information to improve on ineffective management actions will help keep costs down and avoid unnecessary impacts.

Strategic science and action priorities will also help elicit competitive and informed grant solicitations, agency budget change proposals, coordinated multi-agency efforts, updates to individual science programs within federal and state governments, and integration with outside science. Having a common direction and a strong science-based infrastructure for conservation, management, and policy decisions will be especially useful in light of upcoming challenges related to climate change, and public support for action on that front.

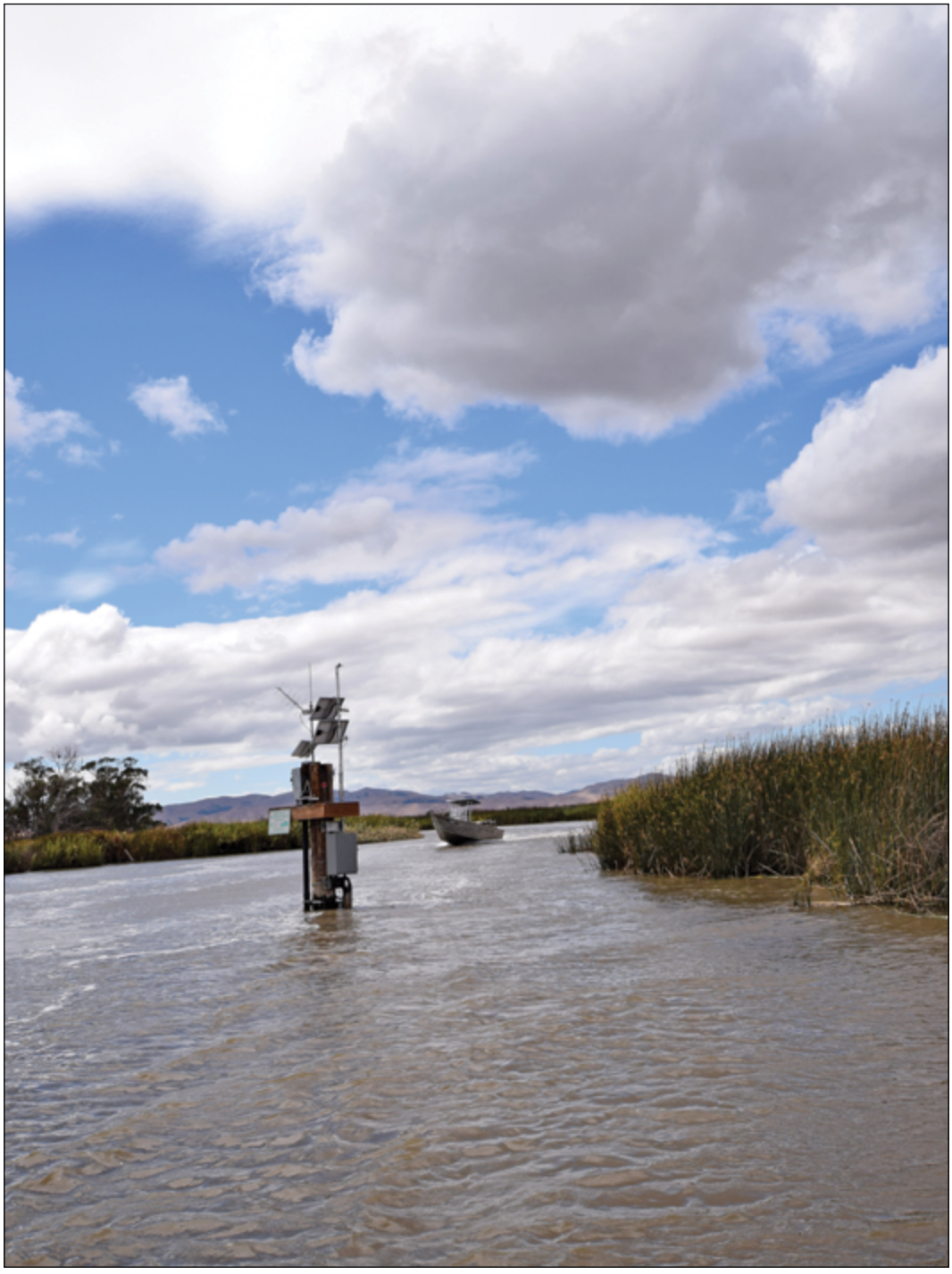
More details about these science programs are presented in the following pages under Goal E, Strategies 1 and 2, and in the Guide to Related Plans and Programs on pp. 128-132.

Framework in Depth: Goal E

Assessing Conservation Progress and Informing Effective Management

Decisions about individual conservation project design and long-term management should be based on the best-available science and a commitment to long-term monitoring and evaluation.

This *Delta Conservation Framework* goal supports the strong existing science capacity available in the Delta to inform decisions. Goal E also supports multi-agency, cross-cutting, coordinated science priorities to inform conservation and restoration planning, among other science, monitoring, and adaptive management strategies and objectives.



A USGS monitoring station in Suisun Marsh, one of 35 in a network spread throughout the Delta monitoring hydrodynamics, salinity, chlorophyl (base of the food web for fish), and other biogeochemical variables. These stations report remotely, offering gigabytes of real time information on Delta conditions to help optimize management for ecosystem health and beneficial uses of the state's waters. Photo: Amber Manfree



Illustration: Akoon Razavi

GOAL E

Evaluate conservation progress and address climate change stressors and other drivers of change by implementing the science strategies and priorities of the Delta Science Program and Interagency Ecological Program, the adaptive management program for Biological Opinions related to state and federal water project operations, and adaptive management recommendations emerging from interagency integration teams.

STRATEGY E1

Implement and increase communication of established priority research, science, and monitoring actions and needs.

- Reference the Delta Science Strategy and Science Action Agenda.
- Consider the Interagency Ecological Program Science Agenda.
- Consult the *Delta Smelt Resiliency Strategy* and the *Sacramento Valley Salmon Resiliency Strategy*.
- Utilize the Tidal Wetland Monitoring Framework.

STRATEGY E2

Assess conservation progress, as well as the status and trends for species and habitats of interest, using existing Delta adaptive management approaches and programs.

- Consider the guidance in the Adaptive Management Program for the California Water Fix and Current Biological Opinions on the Coordinated Operations of the Central Valley and State Water Projects.
- Support the Collaborative Science and Adaptive Management Program.
- Support the Delta Stewardship Council's Interagency Adaptive Management Integration Team.

STRATEGY E3

Evaluate best practices to maintain and increase ecosystem and species resiliency to projected climate change.

- Develop and recommend best practices to enhance the resilience of Delta ecosystems and species to climate change effects such as sea level rise, salinity intrusion, precipitation and temperature changes (in air and water), and extreme weather events.
- Include climate change in regional conservation partnership planning processes.

FRAMEWORK IN DEPTH: GOAL E - CONTINUED

Priority Science Actions

Strategy E1 under Goal E supports implementation of priority science actions identified by the 2017-2021 Science Action Agenda, the Interagency Ecological Program, the salmon and Delta smelt resiliency strategies, and related socioeconomic research.[19,21,24,25,26,27] In response to declining native species populations and reduced ecosystem health, efforts are accelerating to restore ecological processes and recover ecosystem functions in the Delta.[25,26] Advanced scientific methods and tools such as computer models are needed to plan and implement projects in an integrated, consistent, and systematic way and to improve implementation of adaptive management over the long term.[28,29,30,31,34,35,36,37] Efforts to set meaningful, collaborative priorities should be supported and strengthened.

As mentioned earlier in this section, one important reference for the *Delta Conservation Framework* in terms of identifying Delta science action priorities that support Framework conservation and restoration goals is the 2017-2021 Science Action Agenda (SAA).[19] The Agenda, a collaborative document coordinated by the Delta Science Program, "identifies science actions that fall between the mission statements and priorities of a single group, program, or agency but are otherwise recognized as cross-agency and multi-group priorities, as feasible to implement and perform, and as opportunities to promote collaborative efforts. In this way, the SAA fills gaps and serves as the glue for synergistic and multi-benefit science to support important management needs." [19]

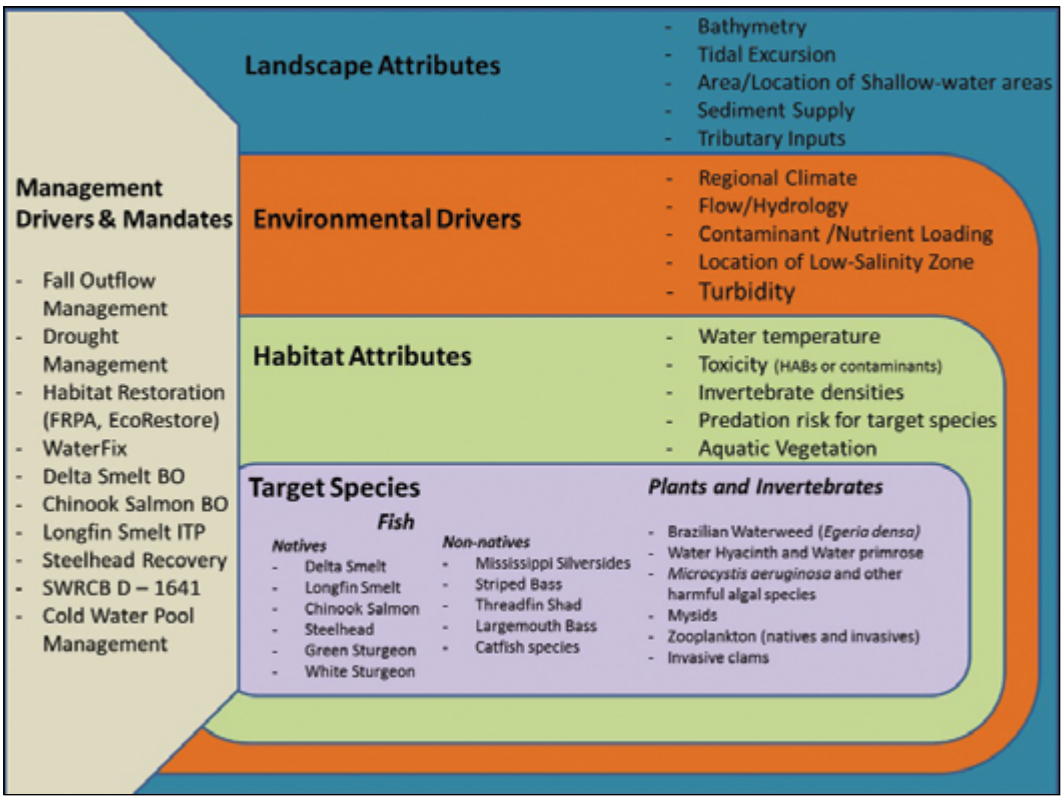
The *Delta Conservation Framework* references the SAA because it is founded on the latest Bay-Delta science and earlier efforts to identify high impact priorities. It also expands upon the critical activities of existing collaborative efforts, including IEP and the Delta Regional Monitoring Program (Delta RMP). It further advances the vision of One Delta, One Science and the broad Delta Science Enterprise.

Of particular relevance to the *Delta Conservation Framework* is the priority placed on understanding the human dimension of conservation[27] in the SAA, as well as the management needs outlined in the SAA addressing landscape-scale practices to evaluate the functionality of restored areas, conduct effective planning, and assess potential cumulative effects. SAA priority science actions focused on these management needs include: 1) developing methods for evaluating long-term benefits of habitat restoration based on current understanding of how species use restored areas and how use changes over time as habitats evolve (such as outlined in the Tidal Wetland Monitoring Framework;[23] and 2) estimating and assessing the system-wide effects of location and sequence of tidal marsh habitat restoration projects in areas that are impacted by sea level rise and climate change.



San Joaquin Restoration Program biologist holds first fall run Chinook salmon reintroduced to the river.

FRAMEWORK IN DEPTH: GOAL E - CONTINUED



IEP Science Strategy conceptual model.

A second important resource for the *Delta Conservation Framework* and regional conservation partnerships is the Interagency Ecological Program Science Strategy.[21] This agenda guides IEP agencies as they select studies for the IEP Work Plan and employ strategies to achieve the goals of the 2014 Strategic Plan.[24] Other planning efforts, including the Delta Science Program's SAA, are taken into consideration in the setting of the IEP's science agenda, and vice versa. By institutionalizing a science agenda, the IEP serves evolving priority management needs, policy needs, and diverse perspectives.[32] The IEP Science Agenda uses a conceptual model (see above) and emphasizes five areas of near-term science: effects of climate change and extreme events; the ecological contribution of restored areas; the impacts of non-native species; food webs; and the restoration of native species and communities. For each of these topic areas, the Science Agenda lays out the current knowledge base and lists priority science questions to inform management of needs for monitoring, focused studies, data synthesis, and coordination. The *Delta Conservation Framework* supports this kind of strategic approach to key science questions in the San Francisco Estuary.

Another important strategic science initiative that can inform decision-making by regional conservation partnerships and the *Delta Conservation Framework* is the Collaborative Science and Adaptive Management Program (CSAMP).[33] The CSAMP is coordinating a research program to investigate to what extent increased Delta outflow can positively affect environmental drivers and habitat attributes important to Delta smelt resiliency.[26] The CSAMP will determine appropriate research methods for evaluating management actions in the *Delta Smelt Resiliency Strategy* (details in Section III, p. 88) individually and synergistically, and will also oversee implementation and synthesis of results to inform subsequent management actions. In addition, those entities implementing the *Sacramento Valley Salmon Resiliency Strategy* will consult with CSAMP regarding designs for research, monitoring, and evaluation to assess action performance, review of proposed research or monitoring, and progress reporting.[25] These collaborative efforts can help inform regional conservation strategies and actions targeting endangered fish.

The Delta Ecosystem Integrated Modeling Steering Committee is another collaborative science and management effort, supported by the Delta Stewardship Council. This effort aims to integrate Delta ecosystem modeling, model users, and decision makers, and to build capacity by sharing data sets and equations that are required for integrated modeling. The committee effort seeks to demonstrate the value of integrated models for management decisions by creating and

documenting transparent, repeatable processes for addressing complex Delta issues.

In addition to these collaborative science and management efforts, tools for integrated computer modeling are also important resources for planning within the *Delta Conservation Framework*. Well-established modeling tools commonly used to analyze Delta hydrodynamics, water quality and ecological conditions include CalSim 2 and DSM2.[30,34] Additionally, the State Department of Water Resources' Fish Restoration Program has initiated and begun developing another modeling effort that can help regional conservation managers ensure consistency with other restoration goals. With the help of this effort, the Department can work collaboratively with other tidal restoration practitioners to better understand how collective restoration efforts are impacting salinity and the tidal prism on a system-wide scale (see Quick Links p. 132).



Longfin smelt in lab. Photo: DWR

Good science and strong models benefit from consistent data from monitoring programs, another important component of *Delta Conservation Framework* efforts to support successful outcomes with data-based results. One cornerstone new monitoring program is the Tidal Wetlands Monitoring Framework (TWMF) for the Upper San Francisco Estuary.[23] This monitoring framework will develop scientifically sound, project-specific plans to monitor the effectiveness of tidal wetland restoration in providing benefits to at-risk Delta fish species. TWMF will serve as a model for preparing similar frameworks for the assessment of other conservation actions in the Delta. It includes recommendations for data management, analysis, quality assurance, and reporting protocols for compliance with various regulations and policies. Regional conservation partnerships can learn from the protocols and the results of the TWMF.

Finally, to achieve the multi-benefit — float all boats — approach embraced by the *Delta Conservation Framework*, all this biological and physical science research must also be integrated with social science evaluations of how human uses of Delta landscapes directly influence conservation opportunities.[27] The *Delta Conservation Framework* supports strong consideration of the needs and opinions of landowners and the public, both of which are essential to long lasting conservation success. When designing and adaptively planning for future Delta landscapes, regional conservation partnerships should consider specifics on local cultures, local economies, and human interactions with restored landscapes revealed by socioeconomic research. This should help ensure that conservation projects fit within a broader cultural context that supports the "Delta as an evolving place", as outlined in the Delta Reform Act (CA Water Code §85054).

A generalized water resources modeling system for evaluating operational alternatives of large, complex river basins, CalSim 2 is used by California's state and federal water projects to simulate operations. DSM2, a second modeling package, is used by water managers, engineers, and scientists for analysis of complex hydrodynamic, water quality, and ecological conditions in riverine and estuarine systems.[30,34]

Many of the Delta's science programs also highlight the importance of considering the human impacts of natural resource management decisions and the big picture effects of changing land use in the Delta when planning for conservation. In order to integrate these factors into conservation planning and decision-making, a variety of tools and processes are available.[33,34,35,38,39,40]

See Guide to Related Plans and Programs pp.128-132 for more detail on initiatives described above.

FRAMEWORK IN DEPTH: GOAL E - CONTINUED

Conservation Status and Progress

Strategy E2 under Goal E suggests using adaptive management, including coordinated area wide monitoring programs, as an integrated part of conservation management. Adaptive management involves a series of cyclical steps that include: defining the problem; establishing measurable goals and objectives; modeling linkages between objectives and proposed actions; selecting actions and related performance measures; designing and implementing actions and developing an associated monitoring plan; analyzing, synthesizing, and evaluating new data; disseminating learned information; and adapting practices to incorporate what was learned. [16]

Adaptive management allows land, water and wildlife managers to proactively look ahead to potential sources of uncertainty such as drought, deluge, earthquakes, invasive species, or restoration timelines and budgets, and to use accumulated knowledge in a structured approach to management and decision-making. For Delta conservation partnerships to evaluate progress on conservation projects or programs, they must be able to determine baseline ecosystem conditions, quantify the efficacy of conservation actions, and assess progress towards landscape-scale goals and objectives.

As a science-based, flexible approach to resource management decision-making, adaptive management programs offer the opportunity to make and implement decisions while simultaneously conducting research to reduce the ecological uncertainty of a decision's outcome.[35,36,37] This approach also facilitates resource management that is transparent, collaborative, and responsive to changes in scientific understanding. Multi-stakeholder collaboration, decision-support, scenario-evaluation tools, and conceptual and simulation models, are available to help plan and implement this assessment process (see Section V1).

This strategy of the *Delta Conservation Framework* recognizes the need for landscape scale adaptive management of conservation projects and programs, and the current programs underway to support it. In the Delta three prominent adaptive management programs are already in place to plan, assess, and evaluate the progress of conservation in meeting initial goals and objectives.

1. **The Collaborative Science and Adaptive Management Program**[33] (CSAMP) for the Delta was established in 2013 to inform sound decision-making regarding the implementation and revision of the current US Fish and Wildlife (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions on the operations of the State Water Project (SWP) and Central Valley Project (CVP). A management team (CAMT) under the CSAMP is designed to answer a set of prioritized scientific questions, and identify new initiatives based on the results of these studies.
2. **The Adaptive Management Program for the California WaterFix and Current Biological Opinions on the Coordinated Operations of the Central Valley and State Water Projects**[35] (the AMP) was established by DWR, CDFW, the NMFS,



UC Davis and USGS collaborate on sampling for the Complete Marsh Project in the Rush Ranch National Estuarine Research Reserve in Suisun Marsh. Photo: Amber Manfree



A blue-green algae bloom producing cynobacteria that killed fish in this reservoir. Photo: CDFW

USFWS, and the Bureau of Reclamation (a.k.a five agencies) in 2017. Collectively, the intention is for the five agencies commit to ongoing adaptive management in implementing the current BiOps, as well as future operations under California WaterFix.[48] The aim is to decrease uncertainty and improve the performance of CVP and SWP water operations in protecting listed species and maintaining water supply reliability.

3. **The Delta Stewardship Council Interagency Adaptive Management Integration Team**[37] (DSC-IAMIT) formed in 2016 to address the gaps and inefficiencies associated with having multiple, distinct adaptive management programs. The DSC-IAMIT is currently focused on providing technical and scientific recommendations on how adaptive management of restoration projects in the Delta and Suisun Marsh can be developed and implemented.[39]

The *Delta Conservation Framework* recommends that the goals and objectives of conservation planning efforts, and program or project budgets, be woven into a strong adaptive management approach as appropriate, given the high level of uncertainty of desired outcomes in the Delta. Adaptive management actions must inform the planning and implementation of regional conservation strategies, or similar bottom-up collaborative partnership approaches. In addition, regional conservation partnerships should use adaptive management to test best management practices for projects designed to benefit Delta ecosystems and for multi-benefit projects linked to Delta agriculture and communities.

Conducting adaptive management across larger landscapes or to address multi-interest mandates will always be challenging. The Review of Research on the Sacramento-San Joaquin Delta as an Evolving Place by the Delta Independent Science Board[40] and the Delta Science Program SAA suggests that more research and interdisciplinary science is needed to inform decisions on when, where, and how adaptive management can be integrated into larger planning, design, and management frameworks.

Nutrients are one current challenge for Delta adaptive management programs. Nutrients are increasingly affecting water quality in the San Francisco Estuary and its watershed due to changing environmental conditions (turbidity, runoff, water temperature, etc.). Since 2015, the Central Valley Regional Water Quality Control Board and a stakeholder advisory group have worked on a collaborative nutrient research plan and management strategy. Concerns include cyanobacteria blooms, invasive aquatic macrophytes, nutrient forms and ratios, numeric modeling, and drinking water.

For more information on the programs mentioned under this strategy see Guide to Related Plans and Programs, p. 128-132.

FRAMEWORK IN DEPTH: GOAL E - CONTINUED

Climate Change Effects

Strategy E3 under Goal E emphasizes developing resources and recommending best practices for increasing wildlife and ecosystem resiliency to climate change. Climate change is already affecting California ecosystems, biodiversity, and agricultural land throughout the state.[41,42,43,44,45,46,47,48,49,50] Case studies have shown that climate change has increased temperatures, altered hydrology, changed precipitation levels, increased drought-induced water stress and adverse effects on wildlife habitats, and impacted agricultural production in the Delta and Central Valley watersheds.

The *Delta Conservation Framework* recommends that more resources and best practices be developed to address projected climate change effects and maintain or increase the resiliency of ecosystems, wildlife, and conservation projects.

Climate change impacts will continue to increase over time in coastal and estuarine systems, including the Delta.[49,50,51,52,53] During the next century, California winters will likely become wetter and warmer, with more extreme weather events earlier or later in the season, reduced snow packs in the Sierra Nevada, earlier snowmelt, more precipitation falling as winter rain than snow, and increases in run-off quantity and velocity during storm events.[49,53,54]

Accordingly, summers will be longer, hotter, and drier. This will likely result in warmer summer water temperatures, changes in water quality, and increases in water demand by people and wildlife.[55,56,57,58,59] The Delta region is expected to experience more intense winter flooding and storm events, causing greater erosion of riparian areas and increased sedimentation in wetlands.[49] In the summer there will be increased likelihood of saltwater intrusion farther upstream in the Delta, disrupting ecosystem processes, food webs, agriculture, and local water supplies.[45,49]

Globally, sea level is projected to increase between 0.22-1.5 meters (0.72-5 feet) in the 21st century, or even to as high as three meters (10 feet).[41,49] Sea level rise (SLR) combined with more extreme storm events and tidal action will put additional pressures on Delta levees.[50] Assuming a 1.5-meter SLR by 2050 under a scenario in which there are no significant global efforts to limit or reduce emissions (RCP 8.5)[50] it is anticipated that the acreage of flood prone land (during a 100-year flood event) in Solano County will increase from 15,241 to 69,877 acres.[49] In Contra Costa County, flood-prone land is expected to increase from 847 to 8,607 acres.[49] In Sacramento County it is expected to increase from 171.4 to 411 acres.[49] An additional more extreme climate scenario (H++) that incorporates the likelihood of extreme SLR of up to 10 feet in San Francisco by 2100 (see Figure 4.1), should be consid-

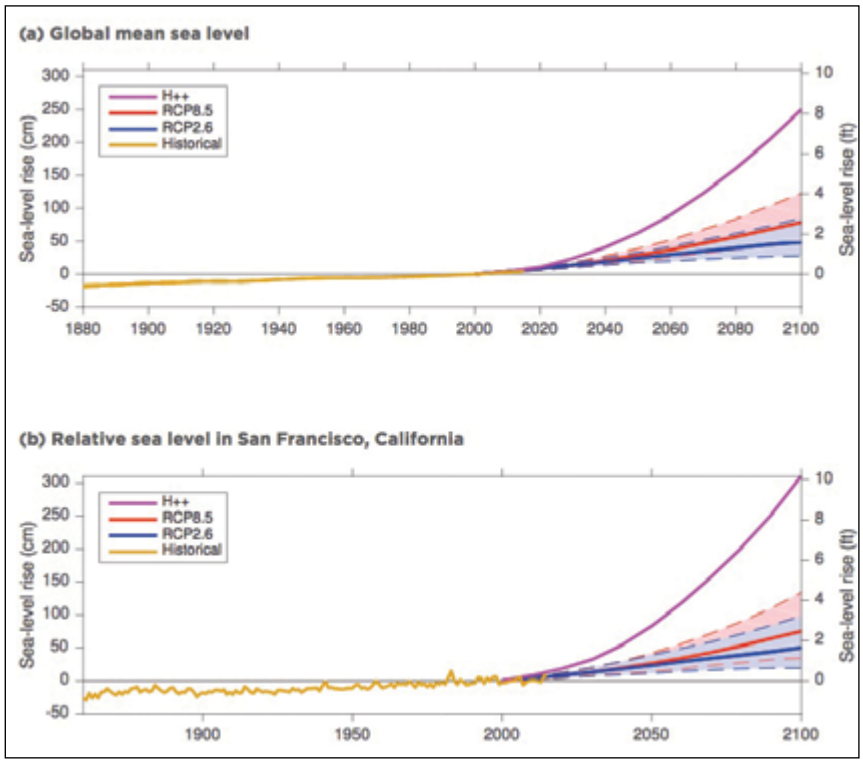


Figure 4.1
Comparison of the projections of (a) Global mean sea level, and (b) Relative sea level in San Francisco, CA. Source: Griggs et al 2017.[50] A "Representative Concentration Pathway" (RCP) represents a greenhouse gas (GHG) concentration trajectory, adopted by the Intergovernmental Panel on Climate Change (IPCC).[41] The IPCC recognizes four RPCs, or projected scenarios, for climate change. They are: RCP 2.6 (global annual GHG emissions peak between 2010 and 2020 then decline); RCP 4.5 (emissions peak around 2040 then decline); RCP 6 (emissions peak around 2080 then decline); and RCP 8.5 (emissions continue to rise throughout the 21st Century). RCP 8.5 is the scenario with the highest amount of human-generated emissions.

ered alongside the probability distributions for other scenarios (RCPs 2.6, 4.5, and 8.5).[49] At this point, however, it is scientifically premature to estimate the probability that the more extreme scenario will come to pass and, if so, when the world will move onto that trajectory. [49]

Looking ahead, the *Delta Conservation Framework* recognizes that climate change impacts must be given immediate and sustained consideration if the region is to adapt without serious hardship or ecological losses. Regional conservation partnerships and resource managers need to develop actions that integrate Delta climate change adaptation into ongoing Delta conservation management practices. Creating more redundancy, interconnectivity, diversity, and complexity of landscape features and land stewardship will help increase resiliency and sustain wildlife and ecosystems.[60] Conservation managers must also consider how the ongoing need to maintain water supply reliability for human use, and impending climate change impacts, will continue to put pressure on Delta ecosystems, levee systems, and agricultural operations. Over the long term, the *Delta Conservation Framework* supports regionally integrated management of water, energy, food, and related ecosystem processes to better adapt to global climate change at the regional scale.

The Framework also recommends that regional conservation partnerships including climate change in project planning examine a range of scenarios and tradeoffs. Scenario evaluation is essential for long term, science-based decisionmaking.

Anticipated Climate Change Effects on Delta Ecosystems[46,498,49,50,51,52,53,54,55,56,57,58,59,60]

Distribution of Delta Ecosystems: The location, extent, and composition of Delta ecosystems currently at or below sea level will change as a result of increased sea level, saltwater intrusion, and shifts in the tidal hydrologic system. Tidal wetland ecosystems will become more deeply inundated, unless they can accumulate additional layers of sediment or organic matter and "migrate" upslope. Wetlands protected by levees will be submerged if levees are overtopped, unless strategies are implemented to raise the elevations. Salt marsh and freshwater marsh are among the natural communities most exposed and vulnerable to climate change. The Delta also supports species that have been identified as climate vulnerable such as salt marsh harvest mouse and Delta smelt. Fluctuations in the size of wildlife populations will occur at different rates, because individual species will respond differently to changes in ecosystems. While some species will adapt in place, others will move to more suitable areas or become locally extinct.

Flood risk: Rising sea levels, increased tidal range and winter river flows, and more intense winter storms will significantly increase the hydraulic pressure on levees in areas where current farming practices continue and subsidence increases over time. If key levees collapse during a storm or seismic event, it could lead to catastrophic seawater intrusions and flooding throughout the Delta. Portions of the Suisun Marsh are particularly vulnerable to these anticipated stressors and tidal marsh drowning.

Water quality: Changes in the timing and volume of freshwater inflows and the projected increase in sea level make it possible the Delta will experience higher salinities, requiring increased intervention to maintain water quality standards . Additionally saline water will continue to seep into subsided areas. Stream temperatures throughout the region could also increase with climate change as ambient air temperatures rise and inflow changes. For example, projections for estuarine inflows are expected to be 20 percent higher on average October through February, and 20 percent lower March through September.

Average temperature and precipitation: The Delta region is expected to experience increases in average ambient air temperatures. January average temperatures are expected to increase by 4.5-4.9°F by 2070; average July temperatures are projected to increase by 6.6-6.9°F by 2070. Annual mean precipitation is expected to increase in Solano County (from 19.4 to 25.4 inches), Contra Costa County (from 18.4 to 23.1 inches), Yolo County (from 19.4 to 25.1 inches), Sacramento County (from 18.4 to 22.2 inches), and San Joaquin County (from 13.8 to 16.8 inches) by 2100 (RCP 8.5 emission scenario). Upland areas of the Delta, including portions of Contra Costa, San Joaquin, and Sacramento counties, are also projected to experience increased risk of wildfire.

Ecosystem services: The phenology of animal migration, flowering, and insect emergence is expected to shift in response to increased temperatures. Shifts in phenology that cause plants and pollinators to be out of sync, could disrupt pollination timing and associated natural and agricultural plant production. The structure and function of transition zones and upland ecosystems are also likely to be disrupted by shifts in temperature and precipitation, and increased frequency of extreme weather events. Resulting droughts and extreme storms will directly affect water availability and quality, and increase flood risk for Californians in the Delta and associated watersheds.

California's Fourth Climate Change Assessment: 2018[60]

Since California's last state-led climate change assessment in 2012, the Golden State has experienced a litany of natural disasters. This includes four years of severe drought from 2012 to 2016, an almost non-existent Sierra Nevada snowpack in 2014-2015 costing $2.1 billion in economic losses, widespread Bay Area flooding from winter 2017 storms, and extremely large and damaging wildfires climaxing with the 2018 Camp Fire that destroyed Paradise. California's most recent climate assessment, predicts the state can expect even more in the future.

The results are alarming for our state's future: an estimated four to five feet of sea level rise and loss of one to two-thirds of Southern California beaches by 2100, a 50 percent increase in wildfires over 25,000 acres, stronger and longer heat waves, and infrastructure like airports, wastewater treatment plants, rail and roadways increasingly likely to suffer flooding.

California's latest assessment dives into climate consequences on a regional level. Academics representing nine California regions spearheaded research and summarized the best available science on the variable heat, rain, flooding and extreme event consequences for their areas.

The following is some information largely excerpted from the assessment's regional sections on the Sacramento Valley and the San Joaquin Valley, which encompass the Delta.

Sacramento Valley:

- In terms of agriculture, climate change will bring about longer growing seasons; insufficient cold for some tree crops; low elevation flooding; changes in productivity of current crop varietals; and conversion of agricultural land to other land uses.
- In terms of floods, climate change will bring about more extreme floods; greater floodplain vulnerability; pressure to expand flood bypasses, levees, and flood storage in reservoirs; and higher Delta water levels.
- In terms of water supply, the region will experience more extreme droughts; pressure to reduce water supply storage due to larger floods; and possibly greater water demands from higher crop and landscape water use. In the Delta, saltwater will intrude into areas from which water is pumped for agricultural and municipal uses.
- In the Delta, higher sea levels, levee subsidence, and greater floods will threaten levees. By 2050-2080, some Delta levees may no longer meet federal standards.
- In terms of the ecosystem, climate change will produce higher temperatures that threaten native species, make reservoirs less effective for sustaining salmon populations, and increase Delta water levels.

Some of the more promising ways to reduce climate change risks to the Delta region related to conservation and agriculture include: climate-smart buildings and more accessible "cooling centers" for heat waves; strategic forest thinning, controlled burning, and fire reduction practices; enhanced emergency preparedness with a focus on disadvantaged communities; increased land use planning to prepare for extreme floods and drought, including innovations to levees, bypasses, and reservoir capacity; increased water availability and attention to integrated water supply management within the entire watershed; improved management for climate-adaptive native species and assisted migration to protect ecosystem services, including outdoor recreation; and incorporation of climate risks into regional plans for energy, water, transportation, land use and conservation.

San Joaquin Valley:

In the San Joaquin Valley, the problems and solutions related to climate change challenges are similar but different. In general however, the agricultural sector may see shifts in cropping patterns and repurposing of fallowed lands. Regulatory and physical constraints on water supply for agriculture, and environmental factors such as warmer temperatures and more variable precipitation, new pests, and reduced chill hours will, affect agricultural decision-making and implementation. Managing sustainable agro-ecosystems in the San Joaquin Valley will require a systems approach that accounts for resource linkages to other economic sectors, such as water for cities and the environment.

Ecosystems in the San Joaquin Valley are highly vulnerable to climate change given existing stressors and the lack of organization of landscape-scale science, funding, and mitigation of adverse impacts within the region. This is particularly the case during prolonged droughts when scarce water supply disproportionately impacts ecosystems. Building resilience in ecosystems through active management, developing physical and biological connectivity, and restoring key biophysical processes will greatly improve ecosystem response to acute extreme climate events and chronic anthropogenic stressors.



Photo: Carson Jeffres



CONSERVATION OPPORTUNITY REGION

Balancing Conservation and Development in the West Delta

Dutch Slough. Photo: Christina Sloop

Like many areas of the Delta, prime farmland and wildlife habitats are threatened by urban development in the West Delta. All along the Contra Costa County shore open spaces and habitats are feeling the squeeze – landward from populations seeking more affordable homes and lives in the ever more expensive Bay Area, and seaward from rising sea and salinity levels pushing in from the upper estuary. Add noxious invasive species and impacts from agricultural operations and the West Delta region faces many conservation challenges.

Current West Delta conservation efforts reflect *Delta Conservation Framework* goals for forward-thinking regional partnerships and strategies. The Framework also highlights the West Delta as a "conservation opportunity region" where a critical mass of natural landscapes, public lands, potential conservation opportunities, conservation-minded people, and existing partnerships occur in one place. The Framework seeks to support such regions and partnerships in strategic conservation planning. Together these regions will one day add up to a healthier Delta – both for people and wildlife.

Regional Setting

The West Delta conservation opportunity region is located in northeastern Contra Costa County. The area roughly extends along Highway 4 between Bay Point and Discovery Bay, and reaches north to Bethel Island. While much of the area adjacent to the highway is developed, the more eastern and northern portions of the West Delta are mainly a rural mosaic of farms, ranches, and open space. Public lands include the Antioch Dunes National Wildlife Refuge and Big Break Regional Shoreline. These lands offer recreational and educational opportunities to the public, and provide wildlife habitat. The adjacent Dow Chemical plant manages the 472-acre Dow Wetlands Preserve of tidal marshes and beaver ponds. Other public lands in the region include potential regional park sites (identified in the *East Bay Regional Park District Master Plan*), Jersey Island (owned by the Iron Horse Sanitary District) and creek and riparian habitats (owned by the Contra Costa County Flood Control and Water Conservation District). Due in part to its proximity to the San Francisco Bay Area, the population in the area is growing. Forecasts predict a population increase of 127,000 people in Contra Costa County between 2007 and 2025, with a significant portion of this urban growth occurring in the West Delta. The West Delta is also home to over 150 rare species, however (see At a Glance sidebar). The potential loss of habitat for these species could create conflicts between conservation and economic development.

Planning Context

Conservation planning in the West Delta region is currently most strongly guided by the *East Contra Costa County Habitat Conservation Plan/Natural Community Conservation Plan* (ECCC HCP/NCCP).[1] These plans provide a framework for comprehensive species, wetlands, and ecosystem conservation that contributes to the recovery of threatened and endangered species while clearing regulatory obstacles to continued economic development. They help to avoid costly and time-consuming project-by-project permitting and uncoordinated, biologically ineffective mitigation. The HCP/NCCP enables multiple stakeholders — including Contra Costa County, the Contra Costa County Flood Control and Water Conservation District (Flood and Water District), the East Bay Regional Park District, and the Cities of Brentwood, Clayton, Oakley, and Pittsburg — to coordinate endangered species permitting for activities and projects in their respective management areas. The City of Antioch, on the western edge of the West Delta, originally elected not to participate in the ECCC HCP/NCCP; however, as of 2017, they began developing their own HCP/NCCP, modeled after the ECCC HCP/NCCP.

At the state level, the California EcoRestore initiative, a comprehensive suite of habitat restoration actions to support the long-term

West Delta At A Glance

Size: 100,000-110,000 acres

Location: Northeastern Contra Costa County

Elevation Range: 91 feet below sea level to 436 above sea level

Zoning: 30-35 percent agricultural; 20-25 percent public or conservation lands

Other Primary Land Uses: urban, flood management

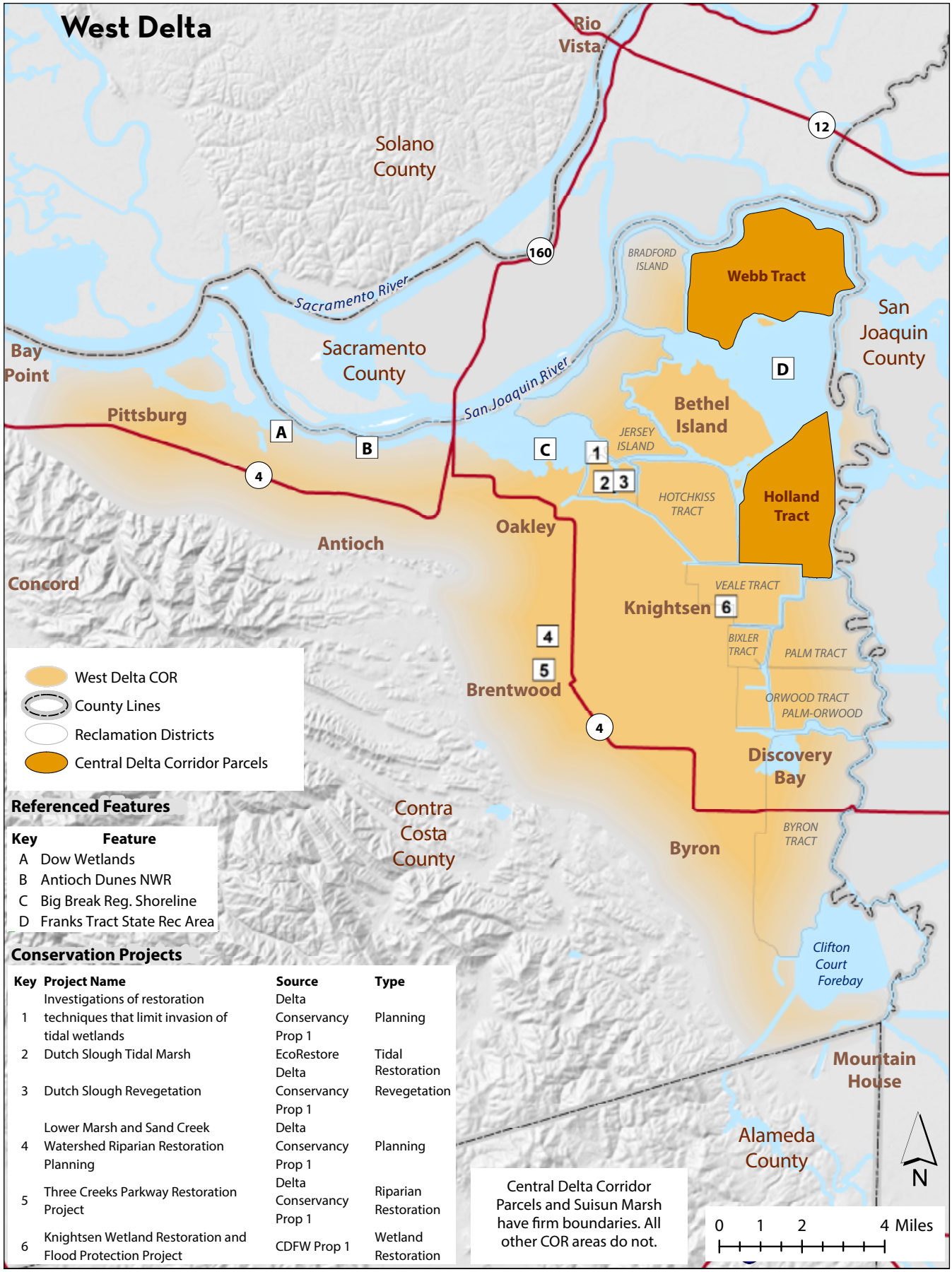
Urban Population: 243,000-283,000

Rural Population: 9,000-20,000

Recreational Opportunities: Trails, wildlife observation, boating, picnicking, nature study

Sampling of Listed Species: Delta smelt, longfin smelt, Chinook salmon, Central Valley steelhead, giant garter snake, Swainson's hawk, salt-marsh harvest mouse, San Joaquin kit fox, California black rail, California tiger salamander, California red-legged frog, vernal pool fairy shrimp, soft bird's beak, Antioch Dunes evening primrose, Contra Costa wallflower.

CONSERVATION OPPORTUNITY REGION



Map: CDFW, 2018

health of the Delta and its native fish and wildlife species, supports a number of projects situated in the West Delta including the Dutch Slough and Winter Island Tidal Marsh Restoration projects.

At the county level, voters approved an Urban Limit Line (ULL) for Contra Costa County in 1990, which was extended in 2006. The limit line restricts urban development to no more than 35 percent of the County, requiring in turn that at least 65 percent of the County be preserved for agriculture, open space, wetlands, parks, and other non-urban uses. The ULL helps to prevent urban sprawl, provide more infill housing development near transit and existing urban infrastructure, and ensure that schools, fire, and police services are not overburdened.

Opportunities for Conservation

Several major conservation opportunities for the West Delta region were identified in the ECCC HCP/NCCP. These include the Three Creeks Parkway Restoration Project, the Dutch Slough Tidal Marsh restoration project, and enhanced habitats and connections along the Contra Costa shoreline containing Antioch Dunes National Wildlife Refuge, Dow Wetlands Preserve, and Big Break Regional Shoreline. Other conservation opportunities in the region include the restoration of part of Franks Tract to tidal marsh (also a feature in the Central Delta Habitat Corridor of public lands, see p. 63).

Planned or existing conservation projects include the following:

DUTCH SLOUGH TIDAL MARSH RESTORATION

This critical, large-scale habitat restoration project broke ground in 2018 two decades after it was first conceived. The site, located in Oakley on land formerly slated for urban development, offers suitable soil types and elevations for the creation of 1,187 acres of tidal marsh and complex intertidal channels favored by native Delta species. The site encompasses three leveed parcels to be restored to a mosaic of tidal marsh, riparian woodland, open water, and managed marsh (see Figure 5.1, p. 139).[2] Native grasslands and riparian forests will also be restored in the upland portions of the site. The Dutch Slough project is adjacent to Big Break Regional Shoreline and Marsh Creek and consequently provides landscape-scale connectivity benefits for the Delta ecosystem.

WINTER ISLAND TIDAL HABITAT RESTORATION

This 589-acre project will restore tidal action to the interior of Winter Island. The island, once farmed by handful of socialist utopians in the 1890s, is located just north of Pittsburg. The current goal is to breach the perimeter levee to create both aquatic habitat at intertidal and shallow subtidal elevations, as well as associated high marsh and riparian habitats, to benefit native fish species.



Dutch Slough. Photo: Christina Sloop

KNIGHTSEN WETLAND RESTORATION AND FLOOD PROTECTION

This project will restore a mosaic of habitats on a 645-acre property near Knightsen, and provide flood protection for the community. The project will convert agricultural and fallow fields to habitat for special status species (including giant garter snake, western burrowing owl, among others). This multi-benefit project also improves Delta water quality and provides new recreational opportunities. The project is a partnership with the ECCC Habitat Conservancy, EBRPD, and the Knightsen Community Services District.



Burrowing owls. Photo: Rick Lewis

Potential Solutions to Recognized Challenges

The primary conservation challenges in the West Delta relate to habitat loss due to housing development, impacts from agricultural operations and noxious invasive species, and projected flooding of shoreline ecosystems and infrastructure due to climate change.

WILDLIFE-FRIENDLY AGRICULTURE

Agriculture has been the main way of life, industry, and cultural linkage to the land in the West Delta for several generations. According to the 2015 *Economic Contributions of Contra Costa County Agriculture Report*,[2] agriculture in the county provides 2,277 jobs and contributes approximately $225 million to the local economy. With such strong cultural ties to the land, local landowners are concerned about livelihoods and lifestyles being displaced by restoration and habitat protection activities. Wildlife-friendly farming can provide a welcome link between these two beneficial uses of Delta landscapes, however. Wildlife-friendly agricultural practices include farming crops that also benefit wildlife — for example rice or irrigated pasture — and providing drainage ditches, hedgerows, and trees for habitat value.[3] The Central Valley Farmland Trust (CVFLT), formerly Brentwood Agricultural Land Trust, is a land trust that works with West Delta farmers and the agricultural community to protect fertile orchards and farms permanently. By partnering with local agencies, and using agricultural easements, CVFLT has helped to secure properties such as the 520-acre Cecchini property near Discovery Bay. Such projects have helped preserve farmland at risk of development[4] and provide habitat for the Swainson's hawk, burrowing owl, and the Western long-eared bat.

RECREATIONAL OPPORTUNITIES

Recent acquisitions by the East Bay Regional Parks District (EPRPD) in the West Delta conservation opportunity region include future potential parklands. On several of these properties, the intent is to provide multiple benefits including restored habitat for special status species and new trail links and recreational opportunities. Such efforts are also creating new collaborations. The EBRPD is collaborating with the Ironhouse Sanitary District, for example, to evaluate sites on Jersey Island for not only recreation and education opportunities, but also opportunities to use reclaimed water for farming and restoration. The District's 3,520-acre property on Jersey Island uses recycled water to irrigate fields of hay.

INTEGRATED FLOOD MANAGEMENT

In the West Delta, reclamation districts maintain the levees that provide flood protection for agricultural operations. The

CONSERVATION OPPORTUNITY REGION - CONTINUED

Contra Costa County Flood Control and Water Conservation District (the District) serves all of the West Delta conservation opportunity region. The District owns property throughout the County for the purpose of constructing and maintaining regional flood control basins, channels, and creeks. Since 1951 when it was formed (funded primarily through property taxes and developer fees), the District has worked to protect local communities from flooding. Today, the District offers regional flood protection and environmental resources stewardship in District-owned creeks. Within the West Delta conservation opportunity region, the District is actively seeking opportunities to have their facilities function as a combination of flood control and habitat, including along Marsh Creek, Walnut Creek, Pinole Creek, and other areas.

The District's $10 million Upper Sand Creek Basin flood protection and habitat restoration project in Antioch offers an example. The project will expand the basin to store eight times more storm water than before and build an 1800-foot-long dam, ranging in height from one to 40-feet. The project will also restore 3,500 linear feet of Sand Creek. The expansion will include planting over 2,500 willow trees, creating 10 acres of wetlands inside the basin, and installing an innovative trash capture device to help clean up the creek. This integrated habitat and flood management project is an important part of the District's Marsh Creek regional flood protection master plan, which significantly reduces the flood risk for Antioch, Brentwood, and Oakley residents living downstream along Sand Creek and Marsh Creek.

The District is also working with partners on the Three Creeks Parkway, a multi-benefit flood control, creek restoration, and public access project. The project will improve approximately 4,000 linear feet of Marsh Creek[1] in Brentwood by widening the channel with a floodplain bench and planting with native vegetation. Begun in 2015, this multi-agency public-private partnership project will transform some of the Marsh Creek flood control channel into high quality salmon and riparian habitat. Such efforts within existing infrastructure projects offer opportunities to enhance and connect surrounding conservation projects.

CLIMATE CHANGE AND ADAPTATION OPPORTUNITIES FOR LONG-TERM SUSTAINABILITY

In general, the Delta region is expected to experience more intense winter flooding and storm effects due to climate change, causing greater erosion of riparian areas and increased sedimentation in wetlands.[5,6,7] In the West Delta, as in other Delta regions, more intense winter storms with increased winter river flows will likely significantly increase the hydraulic pressure on levees which could lead to catastrophic flooding. In the summer, lower river



Three Creeks Parkway Project at the confluence of Sand and Marsh Creeks. Photo courtesy Contra Costa County Flood Control and Water Conservation District

flows could increase the possibility of saltwater intrusion farther upstream in the Delta, disrupting ecosystem processes, food webs, agriculture, and local water supplies along the Contra Costa shoreline. Annual mean temperatures and precipitation are expected to increase in the West Delta by 2100.[8]

Climate change is also expected to affect the range and habitat needs of special status species. The *Delta Conservation Framework* notes that the West Delta conservation opportunity region is located in an important transition zone between the Delta, the San Joaquin Valley, and the Mount Diablo ecosystems. The area supports the northern and westernmost extent of some species. As summers become dryer, conservation partnerships should work to create and restore habitats and protect movement corridors for species migrating to cooler, wetter areas. For example, as reduced rainfall leaves vernal pools in the area dry, species may need alternative seasonal wetlands and pools during the hydro-period of their life cycle. Species will also need safe movement corridors to new ranges.

Looking Ahead

The *Delta Conservation Framework* supports current and planned conservation efforts and partnerships in the West Delta, and suggests that more may need to be done to increase transition zones for wildlife as the climate changes and to link current habitat planning and preservation to the future. A regional partnership could develop a regional conservation strategy that considers all conservation opportunities in the West Delta region, including flood management and wildlife-friendly agricultural efforts that link the ECCC HCP/NCCP preserve area to surroundings.

The partnership base and vision for the West Delta region is already strong. Signatories to the Implementing Agreement of the ECCC HCP/NCCP include ECCC Habitat Conservancy, County of Contra Costa, City of Brentwood, City of Clayton, City of Oakley, the Flood and Water District, EBRPD, USFWS, and CDFW. For Dutch Slough and Winter Island, the state's DWR and CDFW are already strong partners in tidal marsh restoration efforts. For the Three Creeks Parkway Restoration Project, partners include American Rivers, the Contra Costa County Flood Control and Water Conservation District, Friends of Marsh Creek Watershed, and City of Brentwood. The *Delta Conservation Framework* supports the expansion of these early partnerships to better integrate conservation, flood management, and sustainability planning in the West Delta.



Swainson's hawk. Photo: Rick Lewis

QUICK LINKS

Dutch Slough Tidal Restoration Project
https://water.ca.gov/Programs/Integrated-Regional-Water-Management/Delta-Ecosystem-Enhancement-Program/Dutch-Slough-Tidal-Restoration-Project

East Contra Costa County Habitat Conservation Plan and Natural Community Conservation Plan (ECCCHC 2006).
www.co.contra-costa.ca.us/depart/cd/water/HCP/documents.html

For more detailed descriptions of these conservation opportunity regions, see Appendix 2.

Guide to Related Plans and Programs

Adaptive Management Program for the California WaterFix and Current Biological Opinions on the Coordinated Operations of the Central Valley and State Water Projects (the AMP)

STRATEGY E2

The Delta Reform Act of 2009 identified adaptive management as the desired approach to reduce ecological uncertainty related to the management of the Sacramento-San Joaquin Delta ecosystems. The federal and state water operations agencies (Reclamation and DWR) and the state and federal fisheries agencies (USFWS, NMFS, and CDFW) (collectively, the Five Agencies) agree that adaptive management is the tactic best suited to advance the management of the Delta and its resources. However, there were differences among agencies regarding the definition of adaptive management and how and when to implement it. Under the AMP, the intention is for the five agencies to commit to ongoing adaptive management in implementing the current biological opinions, as well for future operations under California WaterFix. The aim is to decrease uncertainty and improve the performance of the Central Valley Project and State Water Project in protecting listed species and maintaining water supply reliability. To do this, significant new investments in related research, monitoring, and modeling are needed, with the understanding that all efforts (existing and new) will build on each other. The AMP relies on Collaborative Sciences Workgroups to develop priority science needs to support decision making. A new Interagency Implementation and Coordination Group (IICG) is to be formed to coordinate science and management recommendations coming out of the workgroups, and to support implementation of those recommendations. The IICG will make its recommendations to the Five Agencies for a decision by the agency or agencies with final decision-making authority. The AMP will also integrate with existing adaptive management plans or programs that are more focused on specific conservation goals or regions within the Delta.



Photo: Amber Manfree

Collaborative Science and Adaptive Management Program/ Collaborative Adaptive Management Team

STRATEGY E2

The CSAMP and CAMT were formed as part of a federal and state proposal to modify the court-ordered remand schedule for the salmon and Delta smelt biological opinions for the water export facilities. CSAMP is comprised of state and federal resource agencies, other public water agencies, and nongovernmental organizations. It was established in 2013 to promote the collaborative development of scientific information to inform sound decision-making regarding the implementation and revision of the current USFWS and NMFS biological opinions on the operations of the State Water Project and the Central Valley Project. Although CSAMP originated during litigation related to the biological opinions, the legal requirement for the program ended in 2015.

In addition to its focus on the initial scientific investigations, the program has served as a forum for discussion and consideration of emerging topics such as the effects of proposed drought operations, the efficacy of proposed seasonal Delta outflow augmentations, and implementation of the *Delta Smelt Resiliency Strategy*.

The CAMT's mission is to complete studies designed to answer a set of prioritized scientific questions, and identify new initiatives based on the results of these studies. CAMT has two scoping teams, one focused on Delta smelt (DSST), and the other focused on juvenile salmon (SST). Products currently being developed by the scoping teams and principal investigators include analysis and synthesis tools and reports concerning Delta smelt entrainment, potential biases in fish survey data, fall Delta smelt habitat effects, and juvenile salmonid survival.

See Quick Links p. 132 to access above plans and programs.

Delta Independent Science Board

ONE DELTA, ONE SCIENCE, STRATEGY E1

The Delta Independent Science Board (Delta ISB) provides independent oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Delta through periodic program reviews. The Delta ISB is composed of nationally or internationally prominent scientists with expertise to evaluate the broad range of scientific programs that support adaptive management of the Delta.



Zooplankton sampling in the Delta. Photo: CDFW

Delta Nutrient Research Plan

STRATEGY E2

This plan (the DNRP) is currently being developed by the Central Valley Regional Water Quality Control Board. A Stakeholder and Technical Advisory Group (STAG) was formed in 2015 to develop the DNRP as part of a Delta Nutrient Management Strategy, representing interests including water supply, drinking water, waterways, irrigated agriculture, environmental justice, wastewater, storm water, and resource management. To inform the DNRP, the STAG provides research recommendations that fill knowledge gaps in understanding the potential effects of nutrients in the Delta. A set of white papers now reflects information gathered through discussions among scientific working groups, and from a public workshop (CA EPA 2017). These white papers (available online) represent five topic areas: cyanobacteria blooms, invasive aquatic macrophytes, nutrient forms and ratios, numeric modeling, and drinking water. The STAG developed initial prioritization criteria and overall ranking of research for each topic area. Regional Water Board staff are now in the process of writing the *Nutrient Research Plan*, based on findings from the white papers, documents from scientific working groups, the public workshop, and the initial prioritization and overall ranking developed by the STAG.

Delta Regional Monitoring Program Science Enterprise

STRATEGY E1

This program monitors pesticides and toxicity, nutrients (nitrogen and phosphorous), mercury in fish, water, sediment, and pathogens. The mission of the Delta RMP is to produce objective and cost-effective scientific information critical to understanding regional water quality conditions and trends in the Delta. Results inform decisions on how to protect, and where necessary, restore beneficial uses of water in the Delta. The Central Valley Regional Water Quality Control Board, the San Francisco Estuary Institute-Aquatic Science Center, and other scientists and interested parties collaborate to conduct the Delta RMP. Representatives of publicly owned treatment works, municipal stormwater programs, irrigated agriculture, water suppliers, and state and federal agencies are participants in the program. Since state and federal laws require dischargers to monitor waters downstream of their discharge, coordinated regional monitoring allows them to pool their funds, as well as to share expertise to provide data for improved water quality management and informed policy decisions facing the Delta.

To skip these references go to p. 133

Guide to Related Plans and Programs - continued

Delta Science Program

ONE DELTA, ONE SCIENCE, STRATEGY E1

The Delta Science Program works to achieve the One Delta, One Science mission by funding research to fill critical gaps, conducting and facilitating science synthesis and independent peer review, coordinating agencies, and interpreting and communicating scientific information to decision-makers, stakeholders, scientists, and the public. Information gathered and evaluated by the program must be unbiased, independently peer-reviewed, relevant, authoritative, integrated across state and federal agencies, and communicated to Bay-Delta decision-makers such as agency managers, stakeholders, the scientific community, and the public. In 2018 the Delta Science Program coordinated the development of the *Delta Science Plan*,[32] which is a framework for conducting science that organizes and integrates Delta science activities and builds an open collaborative science community known as One Delta, One Science. Established by the Delta Reform Act of 2009, the Delta Science Program is the replacement for and successor to the CALFED Science Program.

Delta Science Action Agenda 2017-2021

ONE DELTA, ONE SCIENCE, STRATEGY E1

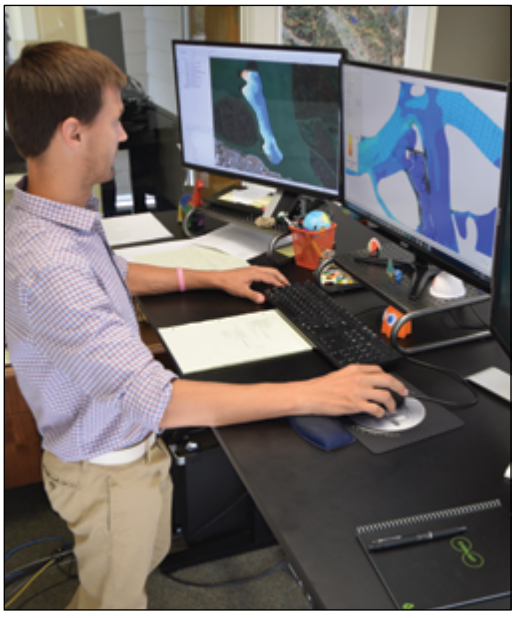
The Delta SAA prioritizes and aligns near-term science actions to inform management needs and achieve the objectives of the *Delta Science Plan*. The State of Bay Delta Science's (SBDS) past (2008 and 2016) and future publications synthesize the current scientific knowledge in the Delta, including science topics of high management concern in the Bay-Delta system. The knowledge gaps identified in the SBDS are used to guide updates to the SAA, and integrate science actions across multiple agencies and their science programs. The 2017-2021 Science Action Agenda identifies 13 science actions organized under five priority action areas that address knowledge gaps and build scientific infrastructure and capacity on a four-year implementation cycle:

1. Invest in assessing the human dimensions of natural resource management decisions.
2. Capitalize on existing data through increasing science synthesis.
3. Develop tools and methods to support and evaluate habitat restoration.
4. Improve understanding of interactions between stressors and managed species and their communities.
5. Modernize monitoring, data management, and modeling.

Delta Stewardship Council Interagency Adaptive Management Integration Team (DSC-IAMIT)

STRATEGY E2

The Interagency Adaptive Management Integration Team (IAMIT) aims to help achieve habitat restoration goals and increase restoration success for the benefit of the long-term health of the Sacramento-San Joaquin Delta and Suisun Marsh's native fish and wildlife species. The California Natural Resources Agency asked the Delta Science Program to convene an interagency technical team to develop recommendations to support adaptive management for the EcoRestore initiative. The focus was broadened in 2018 to support existing habitat restoration efforts besides EcoRestore, such as the Proposition 1 and 68 restoration grants programs. The goal is to create a strong foundation for habitat restoration adaptive management in the Delta, Yolo Bypass, and Suisun Marsh. The IAMIT supports both system-wide adaptive management and individual habitat restoration projects by identifying gaps, improving coordination, and providing technical assistance.



Data driven information sharing and scenario modeling helps inform collaborative adaptive management of a complex system with multiple interacting variables derived from both human actions and natural processes. Photo: Amber Manfree

See Quick Links p. 132 to access above plans and programs.

Fish Restoration Program

SCIENCE ENTERPRISE, STRATEGY E2

A collaborative effort between California Departments of Fish and Wildlife and Water Resources, the Fish Restoration Program (FRP) aims to restore 8,000 acres of tidal wetlands in the Delta and Suisun Marsh required by the 2008 USFWS Biological Opinion on the long-term operations of the state and federal water projects. The collaboration was established via the FRP Agreement in 2010. CDFW provides assistance to DWR in planning and implementing restoration and in monitoring the biological effectiveness of restoration. The program's monitoring team (the FRPMT) is responsible for assessing the biological effectiveness of the restoration project. The team coordinates the IEP's Tidal Wetland Monitoring Project Work Team that developed and recently published online the Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary, Standard Operating Procedures for recommended sampling methods, and the Effects of Tidal Wetland Restoration on Fish (an IEP technical report). The Fish Restoration Program's pilot monitoring studies are currently included in the IEP work plan. The FRPMT writes project-specific adaptive management and monitoring plans, conducts on-the-ground work to inform the work group products, and actually does the monitoring for FRP projects.

Interagency Ecological Program

STRATEGY E1

This program promotes collaborative and scientifically sound monitoring, research, modeling, and information synthesis for the Bay-Delta ecosystem. The IEP mission addresses high-priority management and policy needs in order to fulfill responsibilities established under various water rights decisions, the State and Federal Endangered Species Acts, and the Clean Water Act. The mission directives are carried out by multidisciplinary teams composed of agency, academic, nongovernmental organizations, and private scientists. The IEP consists of nine member agencies, including the Department of Water Resources, the Department of Fish and Wildlife, the State Water Resources Control Board, U. S. Fish and Wildlife Service, Bureau of Reclamation, U.S. Geological Survey, U. S. Army Corps of Engineers, National Marine Fisheries Service, and the Environmental Protection Agency. The IEP also partners with the San Francisco Estuary Institute and Aquatic Science Center, the Delta Science Program, and the Central Valley Regional Water Quality Control Board.[67]

Public Policy Institute of California

SCIENCE ENTERPRISE, STRATEGY E2

As a nonprofit, nonpartisan think tank, the Public Policy Institute of California (PPIC) is dedicated to informing and improving public policy in California through independent, objective, and nonpartisan research. PPIC includes three policy centers that integrate science information at the policy level to inform decision makers. Most relevant to the Delta is the PPIC Water Policy Center, which recommends water management solutions that support a healthy economy, environment, and society. Other PPIC capacities include the PPIC Higher Education Center, advancing practical solutions that enhance educational opportunities for all of California's students. Topics that may be relevant to the Delta include Climate Change/Energy, Economy, and Political Landscape. PPIC multidisciplinary research staff include experts in economics, demography, political science, sociology, and environmental resources. PPIC was established in 1994 to conduct research without partisan or ideological biases, encourage productive dialogue, and inspire the search for sustainable solutions in Sacramento and across the state.



Water supply and gentrification in the Delta continue to be major public policy issues for the region, and are often seen as at odds with conservation initiatives. Photo: Amber Manfree

To skip these references go to p. 133

Guide to Related Plans and Programs - continued

San Francisco Estuary Institute

DELTA LANDSCAPES PROJECT
SCIENCE ENTERPRISE, STRATEGY E1

SFEI is an aquatic and ecosystem science institute that aims to "provide independent scientific support and tools for decision-making and communication through collaborative efforts". SFEI's Resilient Landscapes Program focuses on assessing and improving the health of the waters, wetlands, wildlife, and landscapes of the San Francisco Bay Area and the Delta, which included the completion of the Delta Landscapes Project in 2016. Rather than attempting to recreate the Delta of the past, given the nature and scale of documented changes, the project instead highlights the services that altered Delta ecosystems currently provide and could provide in the future. Recommendations are based on extensive research that analyzes how the Sacramento-San Joaquin Delta used to function, how it has changed, and how it could evolve given implementation of a suite of conservation and management actions that focus on providing enhanced ecological function of Delta ecosystems into the future. Its recommended approaches to reestablishing or mimicking certain natural processes aim to establish an appropriate functional configuration of habitat types at the landscape scale, and they aim to use multi-benefit management strategies to create a more viable Delta ecosystem that can adapt and continue to provide valued functions as the climate and land uses change. The recommended approaches are also designed to integrate with the human landscape to provide ecosystem improvements that also benefit the agricultural economy, water infrastructure (and diversions), and urbanized areas in the Delta. The recommendations provided in *A Delta Renewed* directly inform a number of *Delta Conservation Framework* overarching goals, strategies, and objectives (see Section III).

State of Bay-Delta Science

ONE DELTA, ONE SCIENCE, STRATEGY E1

The State of Bay Delta Science is a regularly updated collection of synthesis reports on scientific topics that emphasize progress made on management-relevant science topic areas during the past decade, and identify remaining knowledge gaps. The 2016 SBDS report includes insights from recent scientific research regarding multiple stressors that impact the continuing existence and resilience of native species. These stressors include: habitat loss, increased frequency of extreme weather conditions linked to climate change, sea level rise, anthropogenic changes in flow regimes, potential for heightened importance of nutrients in Delta waterways (related to the spread of floating aquatic invasive plants, and influence the growth of phytoplankton at the base of the food web); and an ever-changing mixture of contaminants derived from agricultural, urban, and industrial discharges.[3, 71] The reports cover the status and population dynamics of endangered and threatened fish species; the Delta as a changing landscape; food web dynamics, climate change impacts, agricultural and urban water supply reliability; dynamics of water contaminants and their transportation; multi-dimensional models on distribution and movement of fish and food organisms; levee system vulnerability; nutrient dynamics, and contaminant effects in the Delta.

UC Davis Center for Watershed Sciences

SCIENCE ENTERPRISE, STRATEGY E2

Dedicated to the interdisciplinary study of critical watershed challenges, the UC Davis Center for Watershed Sciences (Center) was founded in 1998 by geologist Jeffrey Mount and fish biologist Peter Moyle. The original focus was to develop more integrated and imaginative approaches to water science and policy; over time, the Center grew in size and disciplinary breadth to stay ahead of potential water crises associated with climate change and increased water demands. It is now one of California's leading water management academic institutes. Today, the Center utilizes expertise from physical, biological, social, and engineering sciences to conduct quantitative analyses of ecological, economic, and social aspects of water management systems and to evaluate critical uncertainties in watershed, riverine, riparian, floodplain, and tidal marsh restoration efforts. Center scientists partner with agencies and conservation groups to conduct problem-solving research and data syntheses on topics such as restoration and water resource management. The Center also conducts non-partisan research supported primarily by foundations, public agencies, and conservation groups.

QUICK LINKS

Delta Nutrient Research Plan Stakeholder and Technical Advisory Group
www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/delta_nutrient_research_plan/index.html

Fish Restoration Program
www.wildlife.ca.gov/Conservation/Watersheds/FRPA

Interagency Ecological Program
www.water.ca.gov/Programs/Environmental-Services/Interagency-Ecological-Program

Public Policy Information Center
Water Policy Center: www.ppic.org/water
Delta-relevant publications:
www.ppic.org/publications/#t1

San Francisco Estuary Institute
www.sfei.org/projects/delta-landscapes-project

Science Action Agenda
http://scienceactionagenda.deltacouncil.ca.gov

State of Bay-Delta Science
http://stateofbaydeltascience.deltacouncil.ca.gov

SECTION V

Facilitating Permitting and Funding for Delta Conservation



Illustration: Afsoon Razavi

Common Permits, Agreements & Disclosures 134

Goal F: Improve agency and regulatory capacity for permitting Delta conservation projects..... 136

Goal G: Secure long term funding for Delta conservation 144

Suisun Marsh Conservation Opportunity Region..... 149

Guide to Related Tools, Permits, Requirements and Programs 157

KEY TERMS

COMMON PERMITS, AGREEMENTS, AND DISCLOSURES REQUIRED FOR CONSERVATION PROJECTS

- **CALIFORNIA DEPARTMENT OF FISH & WILDLIFE LAKE AND STREAMBED ALTERATION AGREEMENTS** (CDFW-LSA): A project proponent is required to notify CDFW before starting any project that may divert or obstruct the natural flow of any river, stream, or lake; change or use any material from the bed, channel, or bank of any river, stream, or lake; or deposit debris, waste, or other materials that could pass into any river, stream, or lake under Fish and Game Code sections 1600-1603.
- **CALIFORNIA ENDANGERED SPECIES ACT AUTHORIZATION FOR INCIDENTAL TAKE:** Take of a threatened, endangered, or candidate species (listed species) is defined as "hunt, purse, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill" in Fish and Game Code Section 86. Take is generally prohibited without a permit under section 2081 of the Fish and Game Code.
- **CENTRAL VALLEY FLOOD PROTECTION BOARD ENCROACHMENT PERMITS:** The Board requires an encroachment permit for any project that is within an area for which there is an Adopted Plan of Flood Control.
- **CLEAN WATER ACT SECTION 402 CONSTRUCTION GENERAL PERMIT:** Required for all construction sites greater than one acre, which discharge wastewater or stormwater from a point source into a surface water of the U.S.
- **CLEAN WATER ACT SECTION 404 PERMIT:** Regulates the discharge of dredge or fill material into waters of the U.S., including wetlands.
- ***DELTA PLAN* CONSISTENCY:** If a project determines that it meets the conditions outlined in Water Code section 85057.5 as a Covered Action under the Delta Reform Act, it must submit a certification for consistency with the *Delta Plan* to the Delta Stewardship Council.
- **EIS/EIR UNDER CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) AND NATIONAL ENVIRONMENTAL POLICY ACT (NEPA):** Each require a lead agency and a process to evaluate impacts of a project on environmental resources, including air quality, water quality, and biological, archeological, cultural, and other resources.
- **NATIONAL HISTORIC PRESERVATION ACT SECTION 106 LETTER OF CONCURRENCE:** Project proponents must consider potential effects of a project on historic properties before acquiring a permit under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act.
- **MCATEER-PETRIS AND MARSH DEVELOPMENT PERMITS:** Projects within the Primary or Secondary Management Areas in Suisun Marsh should work with the San Francisco Bay Conservation and Development Commission to secure permits needed for compliance with the Suisun Marsh Preservation Act and the McAteer Petris Act.
- **PORTER-COLOGNE ACT SECTION 401 WATER QUALITY CERTIFICATION AND WETLANDS PROGRAM:** Regulates discharge of fill and dredged material into state waters under the Clean Water Act Section 401 and waste discharge under California's Porter-Cologne Water Quality Control Act.
- **RIVER AND HARBORS ACT SECTION 10 PERMIT:** This requires authorization of the U.S. Army Corps of Engineers (USACE) to construct any structure in or over a navigable water of the United States or alter the course, condition, location or capacity of a navigable water of the U.S.
- **RIVERS AND HARBORS APPROPRIATION ACT SECTION 408 PERMIT:** USACE issues permits to projects that alter civil works projects such as levees or other flood control infrastructure.
- **US ENDANGERED SPECIES ACT (ESA) AUTHORIZATIONS:** U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) share responsibilities of administering the ESA. The ESA directs all Federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the ESA. Section 7 of the ESA is the mechanism by which Federal agencies insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of designated critical habitat. The term "take" means to harass, harm, pursue, hunt, shoot, would, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Section 9 of the ESA prohibits activities affecting plants and animals designated as endangered or threatened, and the habitats in which they depend, unless authorized by a permit from the USFWS and NMFS or exempted through section 7. The basic permit types are section 10(a)(1)(A), which include Recovery Permits and Interstate Commerce permits, and section 10(a)(1)(B) Incidental Take Permits and Enhancement of Survival Permits (including Safe Harbor Agreements and Candidate Conservation Agreements with Assurances)."

See also Guide to Related Tools, Permits, Requirements and Programs p. 157-164, as well as Ideas for Tackling Two Common Permitting Challenges, Table 5.1, pp. 104-105.

Footnotes: The Delta Conservation Framework *footnote and endnote references can all be found in Appendix 1 online by section.*

Introduction

Whether it's restoring a few acres of wetland or planting riparian vegetation on levees or removing invasive weeds, most conservation projects on Delta landscapes require permissions and permits from government regulators. Myriad regulations reflect federal, state, regional and local goals for environmental quality, wildlife protection, public safety, land use, and other areas of public interest and common good. Faced with the many layers of regulatory oversight governing Delta projects – not to mention sometimes conflicting definitions and directives – any first time project manager undertaking a Delta conservation project might feel overwhelmed. Indeed even the most seasoned engineers, resource managers, biologists, and advocates for conservation projects complain of the complexity and cost of moving projects through planning, permitting, compliance, and construction. By the time projects are approved and shovel-ready, the dollars and equipment required to do the job may have already evaporated.

During the 2016 stakeholder workshops held as part of the development of this *Delta Conservation Framework*, participants repeatedly voiced frustration about the number and complexity of permits required for a single restoration project. Many stakeholders commented on the challenges of working with such a variety of agencies, each with different authorities, and on the length of time and amount of documentation required to apply for, and obtain permits for, each component of a conservation project. According to stakeholders, it can take years, even decades, before permits are granted and conservation projects are authorized for implementation. This has inherent drawbacks, especially when degraded environmental conditions are left to linger until conservation actions move forward. Delays can also increase the costs of conservation, and undermine timelines for mitigation or compliance.

Another major challenge for conservation success is the lack of long-term funding for maintenance, monitoring, and adaptive management of projects after construction. Planning and implementing conservation projects is most often based on short-term government or donor funding cycles that grant funds over the course of three- or five-year contracts. Longer term funding can be harder to come by, and neighbors and communities in the Delta remain concerned about adequate ongoing stewardship of public lands and conservation initiatives.

The *Delta Conservation Framework*, as an overarching framework for coordinating large scale conservation, recognizes that these are major challenges to the timely and cost-effective implementation of conservation projects in the Delta, and offers strategies and solutions for how to facilitate permitting and funding for conservation.



One recurring comment voiced in the stakeholder workshops held to develop the Delta Conservation Framework in 2016 was the extraordinary complexity of the permitting process for conservation projects. Schedules and budgets are often stretched by efforts to meet the array of regulatory requirements in the Delta. Photo: Christina Sloop

Framework in Depth: Goal F

Improve Agency Capacity for Permitting Conservation Projects

Infrastructure, habitats, waterways, communities, and agriculture all occur side-by-side in the Delta landscape, and each can be undermined by neighboring activities, construction, or factors ranging from weeds and floods to disturbance and disaster. To guard against negative impacts, agencies across all levels of government—federal, state, regional, and local—have regulatory responsibilities concerning the review of potential impacts of new projects on the infrastructure and environment in the Delta, the Yolo Bypass, and Suisun Marsh.

Potential project impacts to infrastructure (including roads, bridges, flood protection structures, transmission lines, and natural gas lines) must be reviewed to minimize negative effects on public facilities and services, and to preserve public safety. Potential project impacts on sensitive species, water quality, and the environment must also be reviewed and mitigated as necessary, even if there are projected long-term project benefits to wildlife or ecological health.

Despite the best intentions of each agency, the process of complying with regulatory requirements and implementing conservation projects in the Delta can be daunting. Goal F of the *Delta Conservation Framework* identifies some opportunities and strategies for improving the permitting process.



In the Delta, where rivers connected to 40 percent of the state flow through myriad channels and sloughs, impacts on sensitive native species migrating through, such as Chinook salmon, add to the permitting complexity of conservation projects. Photo: CDFW



Illustration: Afsoon Razavi

GOAL F

Improve resource agency and regulatory capacity for permitting Delta conservation projects.

STRATEGY F1

Find ways to improve the permitting process through direct engagement with regulatory agencies and existing venues aimed at greater efficiencies.

- Build on the efforts of the Collaborative Science and Adaptive Management Program and the Delta Plan Interagency Implementation Committee.
- Make the most of regional partnerships and relationships to increase collaboration and efficiency.
- Dedicate staff in permitting agencies to liaison with conservation partnerships and managers
- Use planning tools to help project proponents better understand permitting processes.

STRATEGY F2

Support the development of planning tools for permitting, in coordination with regulatory agencies, to provide high-level guidance for project proponents and agency staff issuing permits for individual projects in the Delta.

STRATEGY F3

Support the development of regional programmatic permits for conservation projects in the Delta.



Innovative and rapid permitting of multi-benefit flood protection habitats and blue infrastructure - such as the Yolo Bypass — will be increasing important in protecting cities like Sacramento, and their agricultural surroundings, from increased flooding due to climate change. Photo: Carson Jeffres

Coordination Among Regulators and Project Proponents

Strategy F1 under Goal F highlights the need to improve the efficiency of permitting for conservation projects in a way that meets the regulatory requirements of federal, state, regional, and local permitting agencies. The complexities of permitting conservation projects can discourage proponents of high-value projects. In addition, the steep costs associated with protracted permitting processes can drain the already limited funds available for conservation projects.

Under this strategy, the *Delta Conservation Framework* provides three recommendations. These recommendations are based on proven solutions that have improved coordination and expanded resources in support of efficient permitting and implementation of Delta conservation efforts.

The *Delta Conservation Framework's* first recommendation under this strategy is to continue to support the existing executive-level coordination position established by the California Natural Resources Agency in 2015. This position was created to coordinate and facilitate landscape-level and project-specific Delta habitat restoration actions that further multiple state objectives, including but not limited to regulatory obligations and voluntary restoration goals, consistent with the California Water Action Plan and California EcoRestore. The person in this position represents California's Secretary of Natural Resources and Governor in matters concerning the restoration of ecosystems within the Delta and associated regions in order to accelerate and maximize the ecological impact and scope of state restoration efforts. If institutional challenges for permitting conservation projects are identified through normal regulatory review and permitting processes, the person in this position is a resource for facilitating high-level collaboration and overcoming roadblocks along the way.

The *Delta Conservation Framework's* second recommendation under this strategy is to support the funding of new staff positions at regulatory agencies that are dedicated to permitting conservation projects located within the Delta. Dedicated staff will improve permitting efficiency by creating one consistent point of contact at each regulatory agency to communicate with project proponents and participate in regular coordination meetings. Over the long term, dedicated staff will also have the opportunity to develop expertise in a specific area, making them more efficient at permit review and processing. A current example of the effectiveness of this approach are staff at the California Department of Fish and Wildlife dedicated to permitting Delta restoration and levee projects under the state's Fish



Dutch Slough restoration site in early 2018, two decades of negotiation, planning, design, and permitting after first being identified as a likely, higher elevation, freshwater marsh restoration site. Photo: Christina Sloop

Restoration Program Agreement. These dedicated positions have successfully facilitated project compliance with state environmental laws and regulations.

The *Delta Conservation Framework's* third recommendation under this strategy is to support the development of planning tools to help project proponents better incorporate permitting processes into their plans. As a general practice, incorporating permitting and compliance monitoring into project timelines, implementation plans, and overall budgets allows more accurate planning and more complete funding over the life cycle of each project. Alternatively, to improve cost-effectiveness, long-term projects implemented or managed over decades could take a phased approach to planning, permitting, and implementation with separate budgets and timelines for each phase.

Conservation practitioners also need easily accessible online resources to explain permitting requirements and guidelines clearly. Specific Delta-wide, general resources could include:

1. A permitting guide book and training workshops that summarize steps to take and lessons learned from past projects;
2. A decision tree and table that show all the permits required for conservation projects and their associated timelines;
3. A regularly updated list of points of contact within each regulatory agency to assist project proponents during the process of applying for required permits.

Combined, these resources should help practitioners better incorporate permitting processes in project planning and foster interagency coordination ahead of, and during, planning and construction.

The Guide to Related Tools, Permits, Requirements and Programs at the end of this section, starting on p.157, contains examples of commonly required permits, disclosures, or notifications, among other resources for navigating the complexities of Delta conservation work. Further examples are provided under Key Terms, "Common Permits" on p.134. In addition, the CDFW Habitat Conservation Planning Branch website explains the state permitting options available.[9]

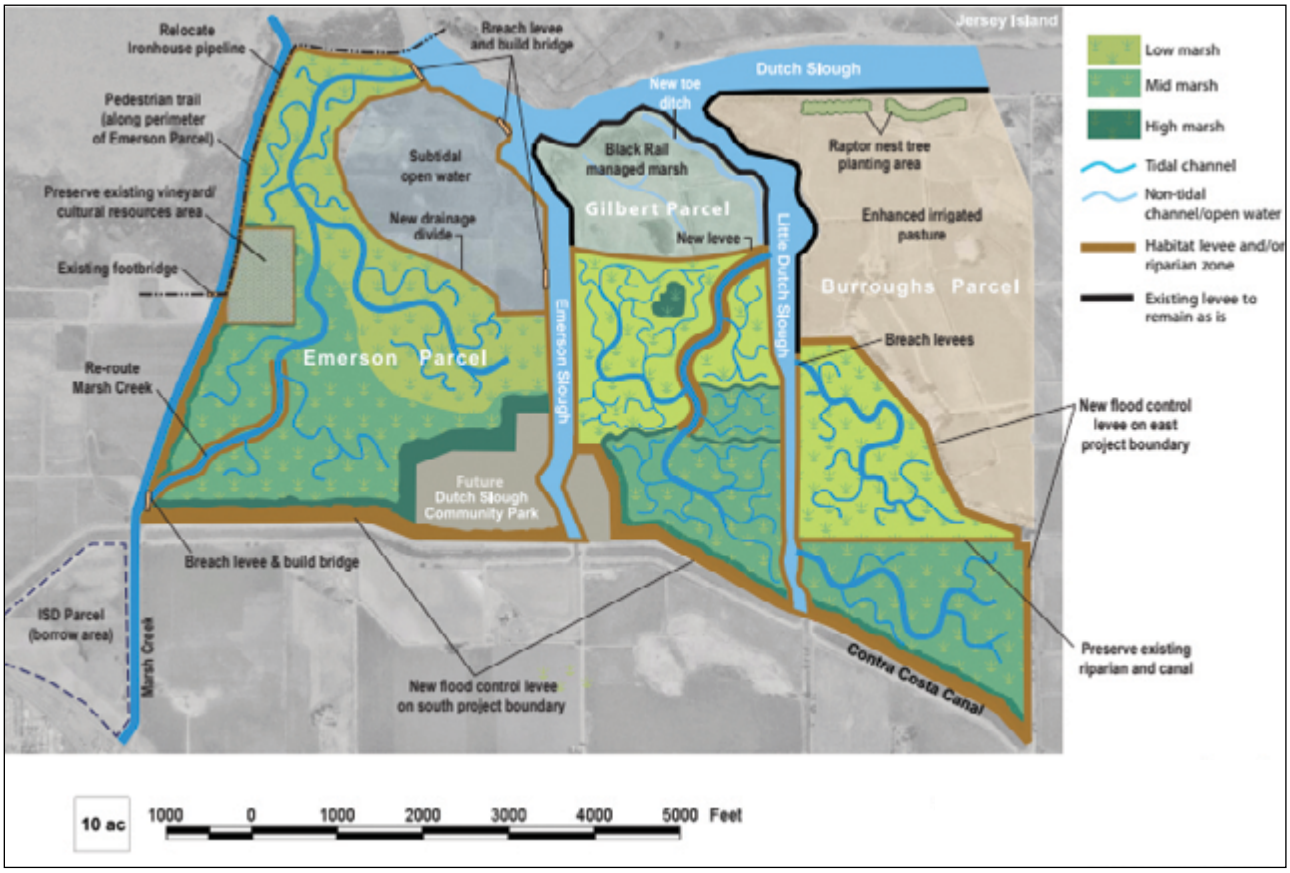


Figure 5.1: The Dutch Slough restoration plan includes several experiments to test conservation outcomes. Rendering: ESA Assoc.

Table 5.1: Ideas for Tackling Two Common Permitting Challenges

Incidental Take & Long Term Funding for Mitigation Sites

The following section highlights six options for tackling two common permitting challenges: the incidental take of listed species, and the requirement that long term funding and monitoring be available for mitigation sites. Options identified include: 1) pursuing permits exempt from mitigation requirements; 2) planning for advanced mitigation; 3) negotiating consistency among state and federal requirements; 4) mitigating through on-site restoration; 5) expanding the state's advance mitigation sites and banks; and 6) requesting take authorization for management purposes. The *Delta Conservation Framework* offers this short-list of options as a first step to implementing Goal F, and as an introductory guide to navigating the regulatory environment for Delta conservation.

As project proponents may be well aware, construction of restoration projects designed to benefit a species listed as endangered or threatened under the California Endangered Species Act (CESA) or US ESA (listed species) may result in incidental take of that species. In some cases, restoration targeted to benefit one listed species can result in take of other listed species. Take may trigger the need to work with California Department of Fish and Wildlife (CDFW) and federal agencies or only one regulatory agency. In either case, incidental take of listed species triggers regulatory requirements for projects, potentially including requirements to mitigate for impacts off-site and guarantee long-term funding to support the mitigation site. Although the decision to seek take authorization for state-listed species through an incidental take permit with the CDFW is at the discretion of the project proponent, take authorization under CESA is generally requested if even the potential for take is low. Even in instances when a project provides on-site mitigation for impacts to listed species, the area set aside for mitigation is required under CESA to have long-term funding and monitoring in place. It can be challenging for projects initiated with short-term funding to demonstrate financial assurances over the long term. Options 1-5 below suggest ways to approach incidental take challenges, while options 6-7 tackle long term funding and monitoring challenges for mitigation sites.

Option 1: Pursue permits that are exempt from mitigation requirements.

Incidental take of listed species under CESA: Within CESA, Fish and Game Code Section 2081(a) allows CDFW to authorize public agencies to take listed species for management purposes through a Memorandum of Understanding (MOU). Projects that qualify for an MOU under Section 2081(a) would be exempt from mitigation requirements because the benefit of the management action offsets the take of individuals.



Safe Harbor Agreements: A federal Safe Harbor Agreement (SHA) is a voluntary agreement between cooperating non-federal property owners and the US Fish and Wildlife Service (USFWS) or the National Oceanic and Atmospheric Administration (NOAA), that authorize take resulting from ordinary activities when actions of the landowner contribute to the recovery of the species listed as threatened or endangered under ESA.[1] For example, see p. 143 for a description of the Lower Mokelumne River Programmatic Safe Harbor Agreement.[2]

The California Safe Harbor Agreement Program Act was introduced to Fish and Game Code in 2009 to encourage landowners to voluntarily manage their lands to benefit listed species.[3] Through state SHAs, CDFW may authorize incidental take of a listed species if implementation of the agreement is reasonably expected to provide a net conservation benefit to the species, among other provisions (Fish and Game Code, §2089.6). California SHAs are analogous to the federal safe harbor agreement program. CDFW has the authority to issue a consistency determination (CD) based on a federal safe harbor agreement for species that are listed under both ESA and CESA (Fish and Game Code, §2089.22). A CD is issued when the federal authorization is consistent with the requirements of CESA (Fish and Game Code §208.1, §2081). California SHAs do not require mitigation; although, there must be sufficient funding to determine baseline conditions on the property and to carry out the management action and monitoring for the duration of the agreement (Fish and Game Code, §2089.6 (g)). However, SHAs cannot be entered into with state or federal entities (Fish and Game Code, §2089.4(d)).

Completed California Safe Harbor Agreements include:

- Rock Creek, Shasta County, Shasta crayfish (2016)
- Rock Creek Upper Pool, Shasta County, SHA CD, Shasta crayfish (2015)
- Carrington Coast Ranch, Sonoma County, Townsend's big-eared bat (2014)
- Fireworks America, San Joaquin County, large-flowered fiddleneck (2014)
- Morrison Ranch, Alameda County, large-flowered fiddleneck (2014)
- Kerns Pond, Shasta County, SHA CD, Shasta crayfish (2012)
- Agriculture and Land Based Training Association, Monterey County, California tiger salamander (2012)

Habitat Restoration and Enhancement Act (Act): Assembly Bill 2193 established a permitting process for landowners, state and local government agencies, and conservation organizations to implement small-scale voluntary habitat restoration projects in California.[4] Habitat restoration projects, as defined by the Act, are projects that have a primary purpose of improving fish and wildlife habitat, meet the eligibility requirements of Clean Water Act Section 401, avoid and minimize incidental impacts, and result in measureable ecosystem benefits. Projects approved by CDFW, pursuant to the Act, will not require additional permits from CDFW, such as LSA Agreements or Incidental Take Permits.

Habitat Conservation Plans (HCP) and Natural Community Conservation Plans (NCCP): If a project is located within the boundaries of an existing or developing HCP and/or NCCP planning area, take of listed species could be covered by the conservation plan if it is considered a covered activity and may not result in additional mitigation requirements. Siting the project within an approved and operating conservation plan may require strategically planning the restoration project far in advance of its initiation, but would streamline regulatory requirements. Projects may also be eligible to participate in an existing, approved conservation plan under provisions for special entities (see p. 33 for Delta related HCPs/NCCPs).

Photo p. 135 tiger salamanders; p. 136 giant garter snake. Photos courtesy CDFW

Environmental impacts analyzed under CEQA/NEPA: Mitigation for project impacts under CEQA can be avoided by designing conservation projects to meet certain categorical exemptions. For example:

- Small restoration projects (less than five acres) can be sited so that there are no significant impacts on listed species or their habitats (Cal. Code Regs., tit. 14, §15333).
- Projects that are designed to not result in a serious or major disturbance to an environmental resource, and that are designed for the purpose of collecting information before construction or during adaptive management, may be exempt under Class 6 (Cal. Code Regs., tit. 14, §15306).
- Conservation actions other than construction may be taken by regulatory agencies so that they protect natural resources (exemption Class 7) and protect the environment (exemption Class 8) (Cal. Code Regs., tit. 14, §15307-§15308).

If a conservation project does not meet categorical exemptions under CEQA, a Negative Declaration can be prepared if an initial study is conducted and clearly shows no substantial evidence that the project may have a significant effect on the environment (No Effect Determination).[5] If the initial study shows potential for significant environmental impacts, revising the project proposal and design to avoid or mitigate those impacts could enable the lead agency to issue a Mitigated Negative Declaration and avoid preparing an Environmental Impact Report. NEPA also has categorical exclusions that can be met through careful project planning. In general, designing projects that avoid or have negligible impacts on wildlife or their habitats simplifies the process of developing a CEQA/NEPA document and decreases or eliminates the associated mitigation requirements.

Option 2: Explore advance mitigation.

Advance mitigation[6] could enable conservation project proponents to purchase credits from mitigation banks[7] to meet regulatory requirements prior to project implementation, after potential impacts have been identified and proponents have received the respective permit or agreement. This approach avoids temporary loss of habitat that can result in higher mitigation ratios, because the mitigation is purchased and habitat is restored and protected before the immediate need occurs. If designed and placed on a landscape scale that considers the needs of multiple target species (including daily and seasonal migratory movement distances), mitigation banks could potentially improve ecosystem function more effectively than small, scattered mitigation projects. In many instances, mitigation credits are available for purchase through the services of firms that broker project credits with mitigation banks approved by regulatory agencies. For example, the Burke Ranch Conservation Bank, just west of the Cache Slough Complex, provides mitigation banking for California tiger salamander, Swainson's hawk, and vernal pool species.Mitigation credits with CDFW could also be developed through the Regional Conservation Investment Strategies Program (see p.157).



Option 3: Negotiate consistency among state and federal requirements.

Conservation projects may address potentially conflicting permit requirements for species listed under both ESA and CESA, present at a given project site, through negotiated consistency. For example, CDFW could issue a consistency determination on a federal ESA authorization, if CESA mitigation requirements are fully met by the ESA authorization. Otherwise, mitigation requirements can be negotiated and agreed upon ahead of time. These requirements can be included in the project description and conditions of the federal authorization to meet the CESA requirements and ensure that incidental take and impacts of the taking are minimized and fully mitigated. The more consistent the authorizations are, the faster they can be processed.

Option 4: Mitigation through on-site restoration.

Occasionally, the needs of listed species conflict, and restoration targeted to benefit one species can result in take of another listed species. For example, habitat restoration activities to benefit Delta smelt at Dutch Slough will likely result in take of Swainson's hawk when restoration of tidal marsh habitat removes known nest trees and associated foraging habitat. In this specific case, the project proponent met with CDFW to develop a project design that benefits and fully mitigates impacts to both species through on-site restoration, habitat enhancement, and long-term conservation. This meets the CESA requirement because the incidental take of Swainson's hawk can be fully mitigated within the project area.

Option 5: Expand the state's advance mitigation sites, banks, and credits.

Expand the number or size of advance mitigation sites established by state agencies and make them more affordable as a way to establish "credits" before a given project is launched. Existing mitigation banks are managed and monitored by third parties over the long term, which relinquishes project proponents from the requirement to secure and document their own long-term funding source.

Option 6: Request take authorization for management purposes.

Under Fish and Game Code, §2081, subdivision (a), there is the option for CDFW to authorize public agencies to take listed species for management purposes. Projects that qualify for a SHA or a Memorandum of Understanding (MOU) under Fish and Game Code, §2081 (a), would be exempt from the requirement to establish a long-term funding source because take of individuals is offset by the benefit of the management action to the listed species. For example, a 2081(a) MOU[8] was issued to the Los Molinos Water Company in 2015 for the rescue and relocation of Chinook salmon and increasing instream habitat to benefit salmon. This MOU was established to provide a framework for cooperative activities and monitoring in Mill Creek, eastern Tehama County, that includes or addresses issues of importance to Central Valley spring-run Chinook salmon, listed as threatened under CESA. The MOU provides authorization for take associated with actions by either party to rescue and relocate the salmon, or assist with increasing flows in the creek to benefit salmon, as management activities under authority of California Fish and Game Code section 2081(a). General MOU elements include fish rescue efforts, designated fish passage flows, changes in the timing of diversions to provide improved instream flow and water temperature conditions that would minimize the need to rescue fish, and the monitoring and evaluation of management actions. Further specific items of the program, tailored by stream, as well as the effective time of the agreement, are also outlined in the MOU.

FRAMEWORK IN DEPTH: GOAL F CONTINUED



CDFW crews dipnet at Jepson Prairie Preserve to monitor health of California tiger salamanders. Photo: Mandy Culpepper.

Common Guidelines

Strategy F2 under Goal F recommends that individual regulatory agencies establish common planning tools for evaluating and permitting conservation projects in the Delta. In addition to the general, delta-wide planning tools and checklists identified in Strategy F1, the efficiency of permitting (for both project proponents and agency staff) could be improved by developing permit planning toolkits within each agency tailored to conservation projects in the Delta, Suisun Marsh, and the Yolo Bypass. These specific toolkits could be developed by individual agencies, based on their expertise wth their specific regulatory responsibilities, vetted internally, and used to help agency staff efficiently review and make decisions about permits for individual projects. For example, guidelines could include consistent definitions of key terms such as temporary impact, permanent impact, and listed species habitat characteristics, as well as suggested procedures for project evaluation, consultation, and mitigation (if relevant) in the Delta, Suisun Marsh, and the Yolo Bypass. These Delta-focused guidance documents should be designed to facilitate internal communication within regulatory agencies and helpful, time-saving, informed discussions between project proponents and agency staff. In the end, this would likely require less time and fewer staff resources than developing a formal programmatic or regional permit. Regardless, any work completed could also provide a useful foundation for developing any eventual, more formal, regional or programmatic permit as suggested below.

Strategy F3 under Goal F supports the development of regional and programmatic permitting frameworks for the Delta. In general, these kinds of authorizations provide a pre-approved region-specific (Delta) or problem-specific (pollution or habitat loss or levee maintenance, for example) umbrella of priorities and parameters under which individual projects can gain approval.

While regulations and permitting requirements applicable to conservation projects are likely to vary based on site-specific conditions in the Delta, Yolo Bypass, and Suisun Marsh, the result can be burdensome. Except in areas where HCPs and NCCPs have been developed (see Section 1 Guide, pp. 31-37), permits are currently issued on a project-by-project basis by a variety of federal, state, regional, and local agencies. This individual project approach requires new analyses of impacts and associated mitigation for each project by each regulatory agency — a very complex, costly, and lengthy process for all involved, as described above.

Based on stakeholder suggestions during the 2016 workshops, the *Delta Conservation Framework* supports the development of regional regulatory frameworks, or "programmatic permits," to 1) provide clear guidance to project proponents regarding characterization of impacts and associated mitigation requirements (if any), 2) allow for better integration of individual projects into a regional planning vision. Agencies can process permit applications more quickly for projects that apply through a regional permit (generally Clean Water Act related) or under a programmatic authorization (generally ESA-related).

Programmatic permits, or regional regulatory authorizations, could improve the efficiency of conservation project implementation in the Delta by clearly defining eligible project types and associated mitigation upfront. This information can help project proponents better plan project budgets and timelines, and help agency staff process permits.

Programmatic permits or regional regulatory authorizations are nothing new. There are many California examples of programmatic biological opinions that authorize incidental take of species listed under the federal Endangered Species Act (ESA) for multiple similar projects within the same region. Their purpose is to expedite consultation under ESA Section 7 for proposed projects that have limited impacts on the listed species.[10]

"Regional" permits are more often water related. In one example, the San Francisco Bay Regional Water Quality Control Board issued a regional municipal permit for stormwater discharge (under the Clean Water Act) under which 76 cities and counties throughout the Bay Area are collectively reducing impacts on Bay water quality.

Conservation actions that may be suitable for programmatic or regional permitting and compliance with state and federal regulations include: planting native vegetation, restoring historic features (such as channel alignment), controlling invasive species, managing watersheds to control runoff, removing barriers to fish passage and unnatural hard points within and along channels, and undertaking minor vegetation or tree removal, among others.[11]

The Guide on p. 157 offers examples of state and federal programmatic or regional permits in the Delta, including the new CDFW Regional Conservation Investment Strategy Program that enables agencies in a region to conduct conservation projects that could serve as mitigation for other projects within the same region.

Safe Harbor Agreement for the Lower Mokelumne

Efforts to protect the valley elderberry longhorn beetle without imposing burden on neighbors and farmers along the Mokelumne River offer one well-known example of the benefits of programmatic permits. The 2006 Lower Mokelumne River Programmatic Safe Harbor Agreement (SHA) between the California Association of Resource Conservation Districts and the US Fish and Wildlife Service promotes ecosystem restoration and conservation of the federally-listed valley elderberry longhorn beetle. The agreement is accomplished through the voluntary restoration, enhancement, and management of native riparian habitat in the lower Mokelumne watershed under ESA Section 10(a)(1)(A) (Policy 64 FR 32717 and regulation 64 FR 32706). The SHA provides certain regulatory assurances to landowners participating in conservation activities by authorizing take of valley elderberry longhorn beetle that occurs during the course of normal farming operations. The SHA details specific "enrolled properties" in the watershed the agreement pertains to, and lists the baseline determination, responsibilities, and management activities for each participating property. The SHA is based on a collective conservation benefit derived from all enrolled properties and parties. The SHA also outlines how adjacent landowners may secure incidental take authorization through a Neighboring Landowner Agreement if they maintain current farming practices.



Valley longhorn elderberry beetle. Photo courtesy Jon Katz and Joe Silveira, USFW

Framework in Depth: Goal G

Securing Lasting Conservation Funding

It is not feasible to protect, enhance, restore, and manage Delta ecosystems for the benefit of people and wildlife without committed, long-term financial support. Strategies to provide long-term funding for conservation planning, implementation, research, and adaptive management of conservation lands are vital to realizing the goals of the *Delta Conservation Framework*, as well as other Delta conservation initiatives.

In general, there are four existing sources for funding conservation.[12]

- **Government Funding** – including federal, state, and local government programs.
- **Donor-based Funding** – including nongovernment organizations, private foundations, and individuals.
- **Payments for Ecosystem Services** – including greenhouse gas reduction, outcome-based bonds (green bonds or Environmental Impact Bonds), water rights, tourism fees, and habitat exchanges.
- **Mitigation Funding** – including endowments through Business Biodiversity Offset Programs[13,14] or other mechanisms to create and manage protected areas as mitigation for impacts to environmental resources.

In addition to these existing funding sources new voter-approved fees, taxes, fines, or dedicated bonds could provide funding for conservation projects. A centralized source of information about available funding streams and mechanisms is needed to align conservation practitioners with available funding methods, solicitations, and programs.



Illustration: Alison Razavi

GOAL G

Optimize use of existing short-term funding and support current and new mechanisms to secure long-term funding for continued conservation implementation and management.

STRATEGY G1

Optimize use of existing short-term state funding for conservation by updating grant solicitation language to improve project consistency with existing regional plans and Delta Conservation Framework goals.

STRATEGY G2

Support the development of long-term funding for Delta conservation, monitoring, and adaptive management of conservation lands.

STRATEGY G3

Support the development of online resources to publicize available funding for planning and implementing conservation in the Delta



This retrofitted offloader helped save money, meet "least cost" permit requirements, and move a lot of mud to increase elevations at the Cullinan Ranch wetland restoration site in the San Francisco Estuary. Finding the right equipment for the job, and in this case aided by engineering innovations undertaken by the operator Curtin Maritime to become more competitive in the construction bidding process, can facilitate conservation. Photo: Curtin Maritime

Short Term Funding

Strategy G1 under Goal G seeks to optimize use of short term funding opportunities for conservation. The *Delta Conservation Framework* supports direct referencing of Framework goals in current and future state grant solicitation language. Current short-term funds via government and donor grants are a first step to achieve long-term goals for the *Delta Conservation Framework*. Short-term funding is ideally suited for some projects, such as fee-title acquisitions of conservation lands, tree-planting programs, research, or targeted short-term agricultural assistance to promote wildlife-friendly practices. However, this approach is not sufficient to support functional ecosystem outcomes that may take decades to unfold. In cases where longer-term programmatic funding is needed after short-term funding is used to initiate a project, usually for operations and management of passively restoring lands, reliable financing is hard to come by.

Implementing the larger scale, ecosystem process-based, and multi-benefit goals of the *Delta Conservation Framework* will require a shift away from the project-by-project and parcel-by-parcel thinking that pervades short term funding models. This shift — and how to make it work — is something the Delta needs to start developing and testing now within agencies, NGOs, and public-private partnerships. Experimenting now with ways to make short term funding more flexible and amenable to innovation will be critical as Delta managers and conservation proponents move from crisis management of droughts, floods, and species declines to long-term, community-based stewardship of the Delta.

Long Term Funding

Strategy G2 under Goal G focuses on developing and advocating for more long term funding opportunities for Delta conservation. Unfortunately, conservation projects often fail to reach their objectives when they are implemented without long-term financial support for operations, management, and evaluation.[16] Such failures can even jeopardize the projects' initial—often substantial—conservation investments. The *Delta Conservation Framework* supports the development of more long term funding commitments for conservation. Long-term support would provide for more effective land management, for the evaluation of progress and resulting adaptive management, for focused scientific research to ensure past, present, and future Delta conservation projects succeed, and for local community integration into project planning and long term stewardship.

The constraints that often come with accepting funding from government bonds, or other time-limited sources and grant programs with a specific shelf life (typically 10 years), create a fundamental limitation on project implementation and long-term success. In many cases, once short-term funding is gone, work on the project ends or the project languishes—either during the planning stage or after initial project implementation—until a new source of funding can be secured. Just as often, emerging conservation projects fail to gain traction with stakeholders and reach the planning stage because of the lack of sustained funding for project planning, permitting, implementation, and management. Many valuable initiatives—such as sustained management of ecosystems in the

face of climate change — fail or aren't fully realized over the long term because support for long term monitoring and adaptive management isn't available. Such follow up activities are not only critical to conservation success, but also save money and make future conservation activities more effective — just like any business practice that plans ahead, prepares for change, and corrects actions based on outcomes so as not to lose initial investments.

Participants in the 2016 workshops held to develop the *Delta Conservation Framework* encouraged agencies to do more to explore innovative funding opportunities to ensure long-term success of habitat projects, including tapping the emerging carbon market and environmental trust funds supported by enduring endowments, as well as developing new bond measures and securing allocations from the state's general fund for long term, Delta-specific conservation. All of these may be needed to implement regional conservation strategies supported by the Framework.

"State and federal funding remains insufficient to address land subsidence that threatens the California water system, and carbon market revenues could help fill the funding gap. The new American Carbon Registry methodology provides an incentive to landowners in the Sacramento-San Joaquin Delta, Suisun Marsh and other historically natural wetland areas in California to convert their most subsided and marginal agricultural lands to wetlands, or to produce wetlands crops such as rice, which will stop land subsidence and reverse it over time."

CAMPBELL INGRAM,
DELTA CONSERVANCY

A direct state budget allocation could be used to support implementation of adaptive management at the project-scale, or to contribute to larger, landscape-scale "programmatic" adaptive management monitoring that informs the evaluation of progress across the entire Delta, such as the Tidal Wetland Monitoring Framework.[16] Direct budget allocations could also provide funding to support multi-benefit projects that promote agricultural practices and optimize ecosystem services, for example wildlife-friendly farming, as highlighted in Section II.

Workshop participants also called for a focused and consistent messaging campaign to the California legislature from state and local agencies, stakeholders, and NGOs, to highlight the need for additional long-term funding for the implementation and ongoing management of conservation lands (a campaign that should be coordinated with other outreach efforts described in Section II, Goal B). They suggested that a portion of California's general funds should be dedicated to Delta conservation efforts, with the premise that Delta ecosystem conservation is a public benefit that provides essential ecosystem services to Californians.

Short-Term Delta Conservation Funding Sources

Short-term public funding to support Delta conservation is available from government grant programs administered by the California Department of Fish and Wildlife (CDFW), the Wildlife Conservation Board, the Delta Conservancy, the Coastal Conservancy (Suisun Marsh), the Delta Science Program, the California Department of Conservation, and California Department of Water Resources. For example, of the 30,000 acres of conservation included in the California EcoRestore initiative, 5,000 acres of habitat enhancement and restoration projects will be implemented through public funding from Proposition 1, the Wetlands Restoration for Greenhouse Gas Reduction Grant Program, and grants to local governments, nonprofit organizations, and other entities. The CDFW Proposition 1 funding also supports scientific research in the Delta. Funding may also be obtained for agricultural easements under the California Farmland Conservancy grant program.[15] A few examples of current grant programs follow (see Guide p. # for more detail).

California Department of Fish and Wildlife

- Proposition 1 - Delta Water Quality and Ecosystem Restoration Grant Program
- Wetland Restoration for Greenhouse Gas Reduction Grant Program (California Climate Investments – AB 32 Greenhouse Gas Reduction Fund)
- Fisheries Restoration Grant Program
- Environmental Enhancement Fund (near waters of the state)

Wildlife Conservation Board

- Proposition 1 – Stream Flow Enhancement Program

Sacramento – San Joaquin Delta Conservancy

- Proposition 1 - Ecosystem Restoration and Water Quality Grant Program
- Other state or regional grants may be available through the Interagency Ecological Program and the Delta Stewardship Council, and from other state agencies. Federal programs are also an important source of conservation funding but remain outside state control.

In terms of the *Delta Conservation Framework*, the goal of this new campaign would be to maximize the effectiveness of limited government conservation funds by simultaneously considering the larger planning context of Delta conservation and the Delta as Place, contemplating restoration of ecosystem function on a landscape scale, and recognizing the value of implementing projects in phases driven by available funding and ongoing insights from adaptive management. Without public support, and transparent reporting to the public on the results of these conservation investments, little progress can be made.

While long term public funding is a necessary goal, it may be difficult to obtain. In the meantime, donor-based funding, market-based opportunities involving private-public partnerships, pay-for-ecosystem services or performance contracting, environmental impact or "green" bonds, mitigation credit agreements, and additional mechanisms for leveraging new funding sources all offer other pathways to progress.

Funding Information Exchange

Strategy G3 under Goal G aims to create a conservation funding information exchange. To attract the best possible conservation projects for implementation as part of regional conservation strategies, or as individual projects that address *Delta Conservation Framework* goals, it is essential to advertise available Delta conservation funds effectively. Strategy G3 calls for a lead organization and tools to publicize available funding opportunities relevant to the Delta in one place. Information about funding opportunities could be advertised on an independent website or organization webpage, where funding entities broadcast current and upcoming solicitations. The San Francisco Bay Joint Venture's Funding Opportunities webpage[18] provides an example for this type of funding clearinghouse. Any such clearinghouse for the Delta might include tools for portraying the landscape-scale picture of currently funded projects, and links to funded project reports. This could help applicants understand how their projects might "fit" into the wider landscape of Delta conservation. Information could also be organized to reflect and inform the Delta stakeholder community about the status of ongoing conservation efforts.



In the future, to keep communities and habitats safe from flooding, the Delta will need a combination of bigger, better maintained, rock-lined levees and multi-benefit landscapes capable of absorbing overbanking. All of these steps will require assurances of long term funding to protect restoration and conservation investments, and to adapt to changes in the climate. Photo: TNC

Sustaining Carbon Farming on Sherman Island

Recent efforts to restore wetlands on Sherman Island offer a model of how new climate change mitigation funds can support Delta conservation in the long term. The state's Greenhouse Gas Reduction Fund supported the Sherman Island project, which aims to restore approximately 1,700 acres of permanent wetlands on the island. The project is a collaboration of the University of California, Berkeley, the Department of Water Resources' (DWR) Division of Flood Management, DWR's Delta Ecosystem Enhancement section, and Reclamation District 341. The project encompasses two DWR-RD341 project sites on Sherman Island.

Once the wetlands are mature, they are projected to sequester approximately 11.5 metric tons carbon dioxide-equivalent per acre per year, or nearly 20,000 metric tons carbon dioxide-equivalent per year for the entire project. The project includes critical monitoring components that will help assess future success in meeting goals. For example, the island is included in a Delta wide monitoring program for carbon dioxide, methane, and nitrous oxide, which builds upon data collected already. These data sets will support the further development and calibration of models allowing greenhouse gas (GHG) predictions of both baseline and treatment results from wetland restoration Delta-wide. The project is also closely coordinated with other Delta efforts to develop a GHG protocol for both the voluntary and regulatory cap-and-trade markets. Additionally, DWR biologists monitor and assess native plant species annually within the restoration areas, conduct biannual bird surveys, and compare observations to pre-project conditions. DWR engineers are also monitoring subsidence reversal rates.

This multi-objective project isn't just trying to reduce greenhouse gases and earn credits for it. Additional objectives include restoring connectivity among west Delta habitats, enhancing nesting and foraging habitats for native wildlife, improving flood protection, protecting climate refugia, and minimizing establishment of non-native species, among others.

Project proponents are recommending a Regional General Permit for rejuvenation maintenance of carbon farming wetlands every 5-10 years. Maintenance under this proposed permit would involve turning over and thinning out dense patches of tules that become less productive over time. Although the permitting of the original project is straightforward and takes advantage of uplift in wetland habitat types, this type of maintenance may require work within high value wetlands and a temporary loss of wetland values, resulting in a greater mitigation burden. State and federal Safe Harbor Agreements may also be feasible here.[17]

Increasing the quality and quantity of key wetlands in California will provide measurable carbon sequestration benefits consistent with the most recent climate change adaptation and mitigation strategies, and wildlife and fisheries management and recovery plans. Delta wetland conservation, in particular connected to subsidence reversal as an additional benefit, closely aligns with implementation of *Delta Conservation Framework* overarching goals and strategies (Goals D-E).



Sherman Island. Photo: Christina Sloop



CONSERVATION OPPORTUNITY REGION

Optimizing Stewardship and Management of Suisun Marsh for Greater Delta Conservation Goals

Photo: Carson Jeffres

Suisun Marsh encompasses more than 100,000 acres of open space and rural lands, about half of which is fresh and brackish water wetlands long managed to attract ducks and support waterfowl hunting. In addition to it's established value to duck hunters, such a large swath of high-functioning wetlands between the metropolitan regions of Sacramento and the San Francisco Bay Area is very unusual and increasingly valuable for nature-based recreation, native species habitat, and future adaptation to rising sea levels. Both federal and state wildlife agencies consider Suisun Marsh a prime area to advance habitat conservation in the Delta and San Francisco Estuary. Likewise, leading conservationists and biologists increasingly see a connected North Delta habitat "arc" – ranging from Cache Slough in the north to Suisun Marsh in south – as a singular opportunity to carve out one place in the Delta for native species that is big enough, and at the right elevations in relation to sea level, to substantially contribute to ecosystem health.

The objectives of the existing 2013 *Suisun Marsh Habitat Management, Protection and Preservation Plan* embody many other important Delta planning and habitat goals and collaborative public-private partnerships around conservation. The *Delta Conservation Framework* supports such forward-thinking regional plans. The Framework also highlights Suisun Marsh as one of seven "conservation opportunity regions" where a critical mass of public lands, potential conservation opportunities, and conservation-minded people and existing partnerships occur in one place. Together these regions will one day add up to a healthier Delta – both for people and wildlife.

Regional Setting

Suisun Marsh is located in Solano County between the Carquinez Strait and the Delta, and adjacent to Suisun Bay, an important mixing zone for the fresh and salt waters of the San Francisco Estuary. The "Marsh" encompasses 116,000-acres of brackish and managed wetlands long recognized as a region of special conservation opportunities with a sustained history of wetland protection, conservation, and stewardship of natural resources. In 1974, legislators passed the Suisun Marsh Preservation Act directing the San Francisco Bay Conservation and Development Commission and the Department of Fish and Game to prepare a Suisun Marsh Protection Plan to "preserve the integrity and assure continued wildlife use" of the Marsh, as well as to maintain habitat for waterfowl. Suisun Marsh now comprises about 12 percent of California's wetland habitat, and is the largest contiguous brackish marsh remaining on the Pacific Coast of the United States.

Land use in Suisun Marsh is primarily focused on conservation of 52,000 acres of waterfowl management areas and duck clubs. These managed marshes are a mosaic of public and privately owned lands. The largest public landowner is the California Department of Fish and Wildlife, which oversees 15,000 acres wildlife management areas and refuges on the Grizzly Island complex.

Suisun Marsh is separated from full tidal action by exterior levees. These levees not only prevent salinity intrusion into parts of the Delta water supply but also protect the ecological and aesthetic values of the Marsh, as well as extensive private and public infrastructure. Significant examples of infrastructure in the Marsh include Solano County roads, Southern Pacific rail lines, Amtrak Capitol Corridor rail lines, and various petroleum product pipelines, natural gas production wells and transmission pipelines, and electrical transmission lines. The levees also protect water conveyance facilities managed by the Department of Water Resources, the U.S. Department of the Interior, and the U.S. Bureau of Reclamation.

Suisun Marsh At A Glance

- **Size:** 100,000 – 110,000 acres
- **Location:** West of the legal Delta between the confluence of the Sacramento and San Joaquin Rivers and the Carquinez Strait (and near the cities of Fairfield, Cordelia and Benicia)
- **Elevation range:** Up to five feet below sea level
- **Zoning:** 4–6 percent agriculture; 15- 20 percent public lands
- **Other Primary Land Uses:** Flood protection, wildlife habitat, recreation, duck clubs
- **Natural Communities:** Managed wetlands, tidal wetlands, vernal pools, mudflat, tidal perennial aquatic (tidal bays and sloughs), grassland, riparian
- **Rural Population:** 300 – 350
- **Recreational Opportunities:** Wildlife observation, boating and water excursions, fishing, hunting, hiking, interpretive services



Photo: Carson Jeffres

Planning History

In 1974 the California Legislature passed the Nejedly-Bagley-Z'berg Suisun Marsh Preservation Act, with the support of Suisun Marsh landowners. This Act placed various restrictions on development within the Marsh, and required preparation of a *Suisun Marsh Protection Plan* (SMPP) by the San Francisco Bay Conservation and Development Commission and the state Department of Fish and Wildlife. When complete, the SMPP components were formally adopted as part of the enactment of the 1977 Suisun Marsh Preservation Act. The 1977 Act provided a mechanism to preserve and enhance the wildlife habitat of the Marsh, and assured retention of upland areas adjacent to the Marsh for uses compatible with its protection. The Suisun Marsh Preservation Act names the Bay Commission as the state regulatory agency responsible for overseeing permitting and development in the marsh.

To meet the legislative requirements of the 1977 Act and the state's 1978 Suisun Marsh salinity standards (under water rights decision 1485), the US Bureau of Reclamation prepared the 1981 Suisun Marsh Management Plan and the Department of Water Resources prepared the 1984 Plan of Protection for the Suisun Marsh, including an EIR. The plans shared four key elements: 1) Delta outflow, 2) physical facilities, 3) monitoring program, and 4) the employment of efficient management, operation, and maintenance activities of public and private managed wetlands in Suisun Marsh.

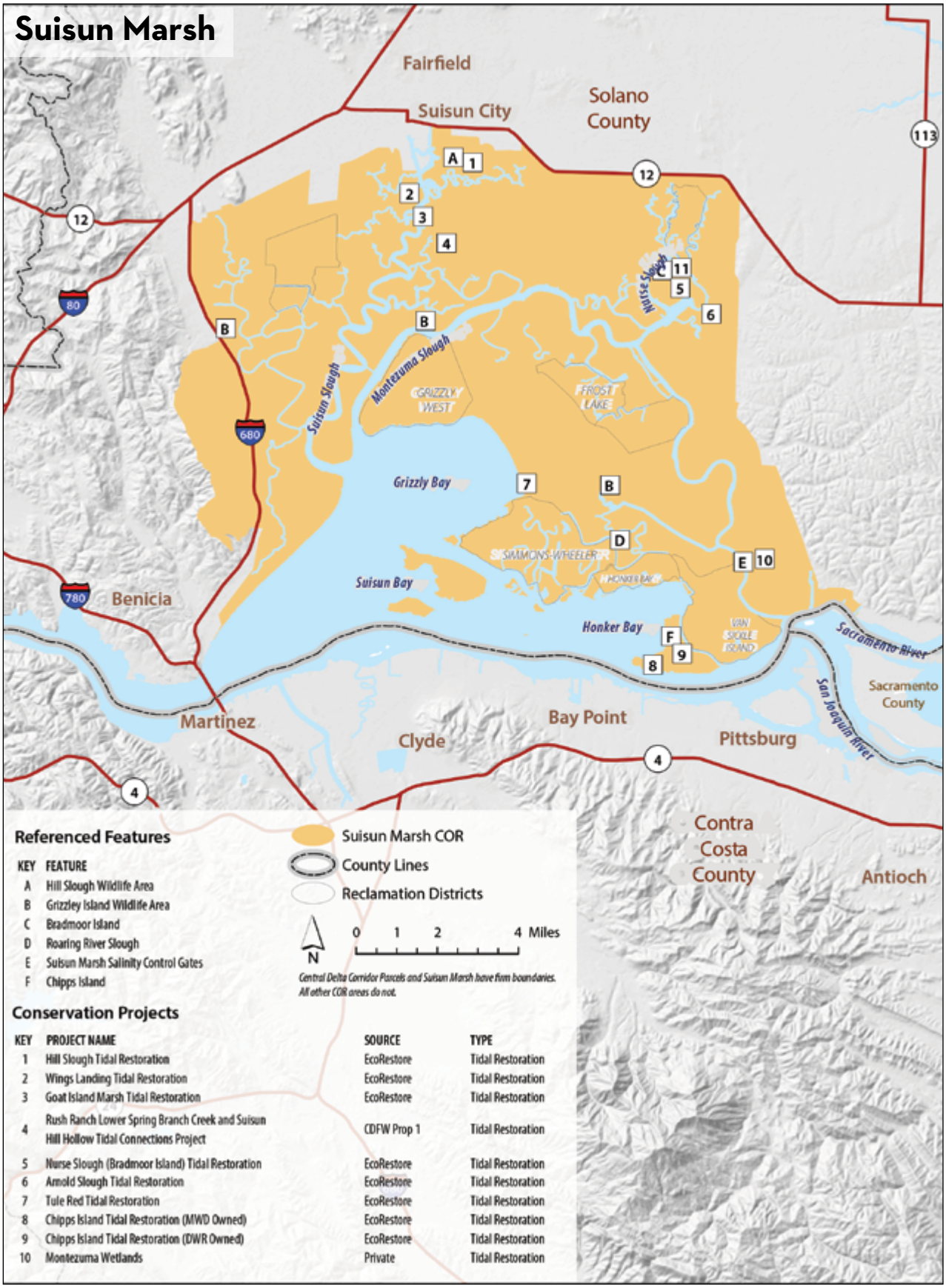
Over the next twenty years, various activities were undertaken to preserve, protect and enhance the quality and diversity of Suisun Marsh habitats, and to maintain the waterfowl carrying capacity of the managed wetlands. This included efforts by the resource agencies, the Suisun Resource Conservation District, and private landowners to implement provisions of the various preservation acts and protection plans.

In 2001, the principal agencies involved with Suisun Marsh management were directed to develop another plan for Suisun Marsh, this time to balance various values and uses of this special region. Under this directive, the agencies produced the 2013 *Suisun Marsh Habitat Management, Preservation, and Restoration Plan* (Suisun Marsh Plan) and companion EIR/EIS. The Suisun Marsh Plan is a 30-year comprehensive regional implementation plan addressing various conflicting uses of Suisun Marsh resources and aimed at achieving a multi-stakeholder approach to the restoration of tidal wetlands and the maintenance of managed wetlands. The Plan provides a vision for managing habitats and ecological processes, public and private land use, levee system integrity, and water quality. As such, the Plan is



Biologists attach radio tracking device to mallard duck to monitor habitat usage. Photo: Cliff Feldheim

CONSERVATION OPPORTUNITY REGION

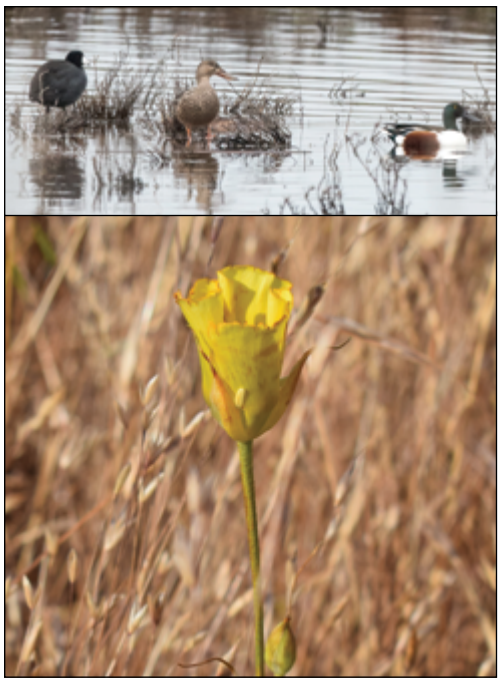


Source: CDFW, 2018

the most current, most science-based management plan for Suisun Marsh to date. The Plan is designed to be consistent with the revised Suisun Marsh Preservation Agreement, the CALFED Bay-Delta Program, and the Delta Stewardship Council *Delta Plan*. The Plan also provides a strong foundation for any further conservation actions in Suisun Marsh related to *Delta Conservation Framework* goals and objectives.

Opportunities for Conservation

Suisun Marsh is well-suited to tidal habitat restoration because of its elevations, location in the San Francisco Estuary, abundance of undeveloped existing managed wetland habitats, high turbidity, productivity within the aquatic food web (primary and secondary), and use by Delta smelt, Chinook salmon, and other native fishes. Throughout Suisun Marsh, land subsidence has been relatively modest due to a history of wetland conservation and limited agricultural practices, increasing the prospects for further tidal habitat restoration. The hydrodynamic, habitat, and salinity variability in the region supports a range of aquatic and terrestrial native species.



Coot, shoveler and teal. Photo: Cliff Feldheim

Mariposa lily, Jepson Prairie. Photo: Amber Manfree

In addition, the gradual alluvial slopes of the surrounding uplands may accommodate sea level rise through lateral marsh expansion. The undeveloped grasslands of Jepson Prairie also span the short distance between Suisun Marsh and the Cache Slough complex, creating a wildlife corridor between the two areas.

Current & Planned Tidal Habitat Conservation Projects

- **Hill Slough** (750 acres tidal restoration)
- **Tule Red** (610 acres tidal restoration)
- **Bradmoor Island** (382 acres tidal restoration)
- **Meins Landing**
- **Goat Island Marsh** (80 acres tidal restoration)
- **Rush Ranch Lower Spring Branch Creek and Suisun Hill Hollow** (67 acres tidal connections)
- **Wings Landing** (approximately 270 acres of tidal and subtidal marsh restoration)
- **Arnold Slough**

In addition, Suisun Marsh's proximity to Cache Slough, Lindsey Slough and Liberty Island, as well as to the lower Sacramento River and the western Delta, allows the Marsh to benefit from natural flood pulse flows. These flows provide seasonal migration, spawning, and rearing habitats for adult and juvenile native and anadromous fish. In addition, the seasonal flooding of managed wetlands produces food for fish during the winter and spring. The degree of ecological benefits from flows and flooding in this region could, however, be affected by actions further upstream, especially any modifications resulting from state and federal water conveyance operations, local water district use, the location of X2 where salt and freshwater meet (see p. 108), salt water intrusion, and restoration projects elsewhere in the Delta.

There are a number of tidal habitat restoration projects currently being planned in Suisun Marsh through California Ecorestore and the Department of Water Resources' Fish Restoration Program Agreement (see sidebar). In the meantime, the proximity of Suisun Marsh's biologically rich areas to important ecotones and ecological corridors should favor

these and other efforts to boost terrestrial and aquatic wildlife. Indeed, conservation biologists have included Suisun Marsh in a grand strategy to create an interconnected series of habitats for native species, mostly tidal and managed wetlands, referred to as the North Delta Habitat Arc (see map p. 72).

Potential Solutions to Recognized Challenges

The *Delta Conservation Framework* recognizes the value of historical planning and preservation efforts in Suisun Marsh, and the value of the current Suisun Marsh Plan in addressing ongoing challenges related to proposed changes to the Marsh and future conservation goals.

Detailed information on how the Suisun Marsh Plan addresses future challenges, and how it meshes with various existing plans and agreements, can be found in the Plan itself. In brief, and in general, the Suisun Marsh Plan has the following objectives:

- Restore 5,000 to 7,000 acres of tidal marsh, and protect and enhance of 40,000 to 50,000 acres of managed wetlands in Suisun Marsh (implementing targets established in the CALFED Ecosystem Restoration Program Plan)
- Maintain the heritage of waterfowl hunting and other recreational opportunities and increase awareness of the ecological values of Suisun Marsh in surrounding communities.
- Maintain and improve the integrity of the Suisun Marsh levee system to protect property, infrastructure, and wildlife habitats from catastrophic flooding.
- Protect, and where possible improve, water quality for beneficial uses in Suisun Marsh, including estuarine, spawning, and migrating habitat uses for fish species as well as recreational uses and associated wildlife habitat.

The Suisun Marsh Plan requires that these interrelated and interdependent objectives be implemented concurrently and in parallel over the 30-year planning period. As such, both restoration and managed wetland activities could proceed simultaneously. One aim is to provide adequate restoration to both mitigate impacts related to managed wetland activities and to contribute to recovery of listed species. A few more specific challenges and potential solutions related to Suisun Marsh planning in the future include climate change, land use conflicts, invasive species, and the need for long term funding for adaptive management and monitoring of restoration success.

CLIMATE CHANGE AND ADAPTATION OPPORTUNITIES

The Suisun Marsh region will be affected by climate change induced sea level rise within the next 30-100 years. The region's diked managed wetlands are protected by nearly 200 miles of exterior levees and are currently in intertidal zone. The increased pressure of rising water levels and flooding will threaten levee system integrity and the long-term viability of managed wetlands. In some areas, current managed



Windmills in Montezuma Hills, uplands near Suisun Marsh, generate clean energy. Photo: Carson Jeffres



Heritage hunting program at Grizzly Slough, Suisun Marsh. Photo: Robinson Kuntz

wetlands will be lost and shorelines or tidal wetland habitats submerged. In others, levee widening, reinforcement, and maintenance may affect duck club operations and hunting activities and encroach on restoration sites.

In terms of hydrodynamics, sea level rise will also increase salt-water intrusion into Suisun Marsh. Coupled with prolonged droughts and changes in the timing of fresh water inflows from the Central Valley, climate change could significantly increase salinity levels in the Marsh. In addition, Susiun Marsh will be exposed to more frequent, more extreme storm and rainfall events and associated flood events from surrounding watersheds. All these changes will affect wetland diversity, species composition, and existing habitat functions and values in Suisun Marsh.

Today's exterior levees are maintained primarily by private landowner assessments, local Reclamation Districts, and public agencies such as California Department of Fish and Wildlife. Currently there is little state or federal funding for maintenance. A long term levee maintenance program and fund (similar to the Delta Levee Subvention Program or Delta Investment Strategy) is necessary to sustain marsh values and protect Delta water quality.

Suisun Marsh could benefit from a scenario planning effort to help project likely climate change impacts on ecosystems and species (see Guide p.185). This type of planning could also evaluate salinity changes resulting from restoration, over the near and long-term, and allow for adaptive management, adjustments, and short and long term cost evaluation.

LAND USE CHANGES

Of the 100,000 acres of Suisun Marsh, the Suisun Marsh Plan has set goals of restoring 5-7,000 acres (5-7 percent) to tidal marsh within the next 30 years. In the process, conflicts will no doubt arise between existing managed wetland/waterfowl hunting club land uses (the legacy way of life for the region) and future habitat restoration goals. Restoration projects could displace existing land uses and decrease the number of wintering waterfowl in Suisun Marsh. Conversion could also potentially increase mercury contamination, require additional mosquito control measures, create conflicts due to expanded public access, and impact salt marsh harvest mouse populations. The net effect of restoration projects on overall salinity levels and the future of the Marsh remains unclear. Potential solutions detailed in the Suisun Marsh Plan include requirements for: regional distribution of tidal habitat restoration projects; detailed environmental commitments; avoidance and minimization measures; and salinity modeling to ensure that local and regional conditions are protected as part of restoration design and project development, including post-construction verification. Additionally, the Plan requires that all land acquisitions for tidal restoration must be from willing sellers.

INVASIVE SPECIES CONTROL

Non-native invasive species have colonized most of the wetland and upland habitats of the Suisun Marsh. Control of invasive species is very labor intensive, costly, and requires diligence over the long-term. Complete eradication is unlikely, but ignoring existing conditions will ensure continued degradation of current habitat and likely failed restoration of targeted habitats. Limited resources exist for invasive plant species management once a site has been breached. As a solution, restoration projects should incorporate control mechanisms (such as the ability to dry out a site, or ongoing weed management programs) into adaptive management plans.

Looking Ahead

The *Delta Conservation Framework* views the Suisun Marsh Plan as the foundational existing regional conservation strategy for the Suisun Marsh conservation opportunity region. The Plan is also consistent with the CALFED Ecosystem Restoration Program Implementation Strategy, the 2013 *USFWS Recovery Plan for Tidal Marsh Ecosystems of the Northern and Central California*, and a number of other relevant plans and programs. The Suisun Marsh Plan was developed by the agencies with primary responsibility for Suisun Marsh management, and is intended to balance the benefits of tidal wetland restoration with other habitat uses in the Marsh by evaluating alternatives that provide a politically acceptable change in marsh-wide land uses.

The *Delta Conservation Framework* supports the efforts of the principal agencies involved in the development and implementation of the Suisun Marsh Plan. The principal agencies are: the US Fish and Wildlife Service, the US Bureau of Reclamation, the California Department of Fish and Wildlife, the Department of Water Resources, the National Marine Fisheries Service, the Suisuin Resource Conservation District, and the Delta Stewardship Council. Though the principals also consulted with numerous regulatory agencies in developing the Plan, implementation of individual projects would still require permits and approvals from the San Francisco Bay Conservation and Development Commission.

The *Delta Conservation Framework* also supports the development of a Suisun Marsh Plan adaptive management plan, as it provides a mechanism to collect and use information to optimize restoration activity benefits. To this end, a multi-agency Adaptive Management Advisory Team has been formed to review proposed projects and ongoing progress of restoration.

So much work has already gone into planning and organizing a restored and sustainable future for Suisun Marsh. What the *Delta Conservation Framework* hopes to add is a context for how current marsh plans fit into the larger, landscape scale picture of conservation throughout the Delta, in which large habitat patches and migratory corridors are all connected. Suisun Marsh, as the southwesternmost patch in this constellation, will play an important role in the Delta's future ecological riches and prosperity.

QUICK LINKS

Suisun Marsh Habitat Management, Preservation and Restoration

CDFW: www.wildlife.ca.gov/Regions/3/Suisun-Marsh

Bureau of Reclamation: www.usbr.gov/mp/nepa/nepa_project_details.php?Project_ID=781

For more detailed descriptions of these conservation opportunity regions, see Appendix 2.

Guide to Related Tools, Permits, Requirements and Programs

PERMITTING

California Department of Fish & Wildlife Regional Conservation Investment Strategies Program

STRATEGY F3, REGIONAL PERMITTING TOOL

In 2016, Assembly Bill (AB) 2087 was signed into law, enabling CDFW to initiate a new pilot Regional Conservation Investment Strategy (RCIS) Program.[9] This new program encourages a voluntary, non-regulatory, and non-binding regional planning process intended to result in high quality, regional-scale conservation outcomes throughout California. Yolo County was identified as one of four pilot Regional Conservation Investment Strategies in California. The RCIS Program consists of three components: [15]

1. **Regional Conservation Assessments** – An RCA is an assessment that provides information and analyses that document the ecosystems, ecosystem functions, species, habitat, protected and conserved areas, and habitat linkages within an ecoregion to provide the appropriate context for nonbinding, voluntary conservation strategies and actions. These assessments include information for the identification of areas with the greatest probability for long-term ecosystem conservation success incorporating co-benefits of ecosystem services, such as carbon cycling, water quality, and agricultural benefits. An RCA may be used to provide context at an ecoregional or sub-ecoregional scale to assist with the development of an RCIS. RCAs are intended to provide scientific information for the consideration of public agencies and their preparation is voluntary. RCAs are optional and not required to prepare an RCIS or MCA.
2. **Regional Conservation Investment Strategies** – An RCIS provides information and analyses that inform conservation and habitat enhancement actions. An RCIS offers non-binding, voluntary guidance for the identification of conservation priorities, investments in ecological resource conservation, or identification of priority locations for compensatory mitigation for impacts on focal species, habitats, and natural resources. An RCIS is intended to provide scientific information for the consideration of public agencies, to establish biological goals and objectives at the species level, and to describe conservation actions and habitat enhancement actions that, if implemented, will contribute to achievement of those goals and objectives. They may be used as a basis to provide advance mitigation opportunities through the development of credits (see 3 below) or to inform other conservation investments. Any public agency may develop an RCIS. RCISs are required if MCAs are to be developed.
3. **Mitigation Credit Agreements (MCA)** – RCISs and MCAs do not provide take authorization for individual projects. Rather, MCAs create credits that may be used as compensatory mitigation for impacts under CEQA, CESA, and the LSA Program. Any person or entity may enter into an MCA with CDFW to create credits, even if the person or entity was not involved in the development of the RCIS. People or entities may create and use, sell, or otherwise transfer mitigation credits upon CDFW's finding that credits have been created in accordance with the RCIS Program requirements.

The development of an RCA or RCIS does not create, modify, or impose regulatory requirements or standards, regulate land use, establish land use designations, or affect the land use authority of a public agency. An RCIS can be used, however, to streamline mitigation requirements through the development of credits through an MCA. If approved by CDFW, a RCIS may be valid up to 10 years. CDFW may extend the duration of an approved or amended RCIS for an additional 10 years, provided the RCIS is updated to include new scientific information and the RCIS continues to meet the program's requirements outlined in Fish and Game Code section 1850, et seq.



Photo: Amber Manfree

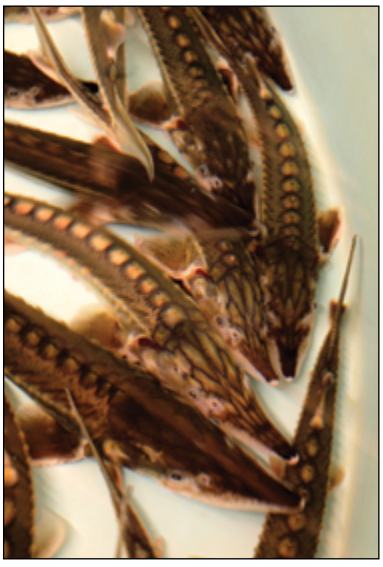
To skip these references go to p. 165

Guide to Related Tools, Permits, Requirements and Programs - continued

US Fish and Wildlife Service Guidance on Streamlining ESA Consultations for Restoration and Recovery Projects

STRATEGY F3, REGIONAL PERMITTING TOOLS

In 2016, the USFWS developed guidance for streamlining ESA Section 7 consultations for certain restoration and recovery projects (RRPs), with the primary purpose of facilitating and incentivizing projects that further habitat conservation and recovery of listed species.[22] To increase efficiency in permitting these projects, the USFWS developed template Biological Assessments and Biological Opinions for expediting the permitting process for RRPs that meet the standards outlined in the guidance. Criteria for RRP inclusion include projects or programs that have the primary purpose of conserving listed species in a manner that is consistent with the recovery needs of the species and that have a high level of certainty of producing a beneficial impact to the species. For example, restoration or conservation projects with small levels of adverse impacts, incidental take, and permanent loss of species' habitats may be eligible for the program.



Green sturgeon, a listed species. Photo: UC Davis

U.S. Army Corps of Engineers Nationwide Permit 27

STRATEGY F3, REGIONAL PERMITTING TOOL

In 2017, the U.S. Army Corps of Engineers issued Nationwide Permit 27 (NWP 27) to authorize aquatic habitat restoration, enhancement, and establishment activities in waters of the U.S., under Section 404 of the Clean Water Act (33 CFR Part 330).[20]

Specifically, activities eligible for authorization by USACE under NWP 27 include:

"Activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas, the restoration and enhancement of non-tidal streams and other non-tidal open waters, and the rehabilitation or enhancement of tidal streams, tidal wetlands, and tidal open waters, provided those activities result in net increases in aquatic resource functions and services."[20]

NWP 27 clearly defines specific activities that are eligible to be authorized through the nationwide permit, and lists reporting, notification, and general permit conditions required for authorized projects. Additionally, NWP 27 states that eligible projects are not required to conduct compensatory mitigation because they must result in net increases in aquatic resource functions and services. Combined, these definitions and consistent requirements provide clarity for both project proponents and staff reviewing permit applications of specific projects.

To account for regional variation within the U.S., the Sacramento District of USACE also issued region-specific conditions under NWP 27 for projects in the Delta.[21] Specifically, the Sacramento District requires all projects in the Delta applying under NWP 27 to provide a preconstruction notification, including:

"Sufficient justification to determine that the proposed activity would result in a net increase in aquatic resource functions and services. Functions and services to be considered in the justification include, but are not limited to: short- or long-term surface water storage, subsurface water storage, moderation of groundwater flow or discharge, of energy, cycling of nutrients, removal of elements and compounds, retention of particulates, export of organic carbon, and maintenance of plant and animal communities."[21]

The Sacramento District office also requires that the preconstruction notification includes: descriptions of how the project design minimizes adverse temporary and permanent effects to waters of the U.S., drawings and plans depicting the proposed project and its location relative to delineated waters of the U.S., delineation of aquatic resources consistent with Sacramento District standards, and proposed Best Management Practices during construction.

Section 401 of the Clean Water Act requires states to certify that projects permitted by a NWP meet all state water quality requirements; and under California's Porter-Cologne Water Quality Act, waste discharge requirements are also necessary. For NWP projects, the State Water Resources Control Board or Regional Water Quality Control Boards may streamline Section 401 and Porter-Cologne requirements by combining or even waiving them for small projects that meet certain CEQA exemptions. When taken together, the guidelines, definitions, and requirements outlined in NWP 27 and the Sacramento District NWP regional conditions provide clear guidance to project proponents and regulatory staff and should help improve the efficiency of conservation project planning and implementation.

See Quick Links p. 164 to access above tools and programs.

US Fish & Wildlife Service Programmatic Biological Opinion for US Army Corps of Engineers 404-Permitted Projects with Small Effects on Giant Garter Snake

STRATEGY F3, REGIONAL PERMITTING TOOL

In 1997, USFWS issued a programmatic biological opinion to USACE for individual projects permitted under Section 404 of the Clean Water Act with impacts on giant garter snake in northern and central California (USFWS Programmatic Biological Opinion).[22] Projects with less than three acres of permanent impacts, or less than 20 acres of temporary impacts to giant garter snake habitat were eligible to seek take authorization under the USFWS Programmatic Biological Opinion. It includes descriptions of procedures required to implement specific projects, mitigation required to offset impacts of individual projects, and clear definitions of key terms necessary to assess impacts to giant garter snake, including disturbance area, temporary impacts, and permanent impacts.

"The purpose of this programmatic consultation is to expedite Corps permitted projects, including activities which may qualify for authorization under nationwide permitting, with relatively small effects on the giant garter snake and its habitat. Projects, which exceed the programmatic threshold, will require individual biological opinions. The Service will re-evaluate this programmatic consultation annually to ensure that its continued application will not result in unacceptable effects on the giant garter snake or its habitat. Restricting this programmatic consultation to projects with permanent impacts of less than 3.00 acres (1.21 hectares) and temporary impacts of less than 20.00 acres (8.09 hectares) of giant garter snake habitat per project will limit the effects of the programmatic process on the giant garter snake and its habitat. Tracking and restricting project effects over time will serve to minimize cumulative effects at local and regional levels."[21]

The clear guidelines, definitions, and mitigation requirements in the USFWS Programmatic Biological Opinion enable USFWS and USACE staff to more efficiently discuss and permit individual projects that require take authorization for giant garter snake. Although this biological opinion has expired, USFWS staff continue to use it as a set of informal guidelines when evaluating individual projects with low-level impacts to giant garter snake habitat.



Giant garter snake. Photo: CDFW

SHORT-TERM FUNDING

California Department of Fish & Wildlife Wetlands Restoration for Greenhouse Gas Reduction Grant Program

STRATEGY G1, SHORT TERM FUNDING

In 2014, CDFW developed the Wetlands Restoration for Greenhouse Gas Reduction Grant Program[23] in response to the Global Warming Solutions Act of 2006 (Assembly Bill 32, Nunez, Statutes of 2006). California's Cap-and-Trade Program includes an auction system where a portion of the tradable greenhouse gas emission permits (called allowances) can be purchased at quarterly auctions.

"Cap-and-Trade is a market-based regulation that is designed to reduce greenhouse gases (GHGs) from multiple sources. Cap-and-trade sets a firm limit or cap on GHGs and minimize the compliance costs of achieving AB 32 goals. The cap will decline approximately 3 percent each year beginning in 2013. Trading creates incentives to reduce GHGs below allowable levels through investments in clean technologies. With a carbon market, a price on carbon is established for GHGs. Market forces spur technological innovation and investments in clean energy. Cap-and-trade is an environmentally effective and economically efficient response to climate change."[23]

Proceeds from the sale of state-owned allowances are deposited in the Greenhouse Gas Reduction Fund (GGRF). Appropriations from the GGRF support California Climate Investments that provide greenhouse gas reductions and other important co-benefits for California. CDFW is administering a portion of these funds, through this grant program, to support the restoration or enhancement of Sacramento-San Joaquin Delta wetlands, coastal wetlands, and mountain meadow ecosystems in order to reduce GHG emissions and provide co-benefits. To date, CDFW has received two appropriations that included local

To skip these references go to p. 165

Guide to Related Tools, Permits, Requirements and Programs - continued

assistance funds for grants (FY14-15 and FY17-18). Future funding is dependent upon GGRF budget appropriations enacted by the Governor and Legislature. Examples of potential co-benefits this program provides include enhancing fish and wildlife habitat, protecting and improving water quality and quantity, and helping California adapt to climate change. Public agencies, recognized tribes, and nonprofit organizations are eligible to apply.

Increasing the quality and quantity of key wetlands in California will provide measurable carbon sequestration benefits consistent with the most recent climate change adaptation and mitigation strategies, and wildlife and fisheries management and recovery plans.[23]. This is critical because wetlands have among the most efficient carbon sequestration rates per unit of all habitat types, allowing both effective and extensive carbon sequestration, and only about 10 percent of the wetlands that existed in California 200 years ago remain today. Funding such efficiencies will help optimize use of limited financial resources for conservation in the long term.

California Farmland Conservation Program Grants

STRATEGY G1, SHORT-TERM FUNDING

The California Farmland Conservation Program, under the California Department of Conservation, provides grants for farmers and landowners to enter into easements that maintain their properties' farmland values and agricultural production. These easements provide long-term protection of farmlands against development pressure and other land use changes (Pub. Resources Code, §§ 10211, 10237). Funding for easements may be granted to local governments, nonprofit organizations, resource conservation districts, or regional park or open space districts that have farmland conservation as a stated purpose of their easements (Pub. Resources Code § 10211). Under the federal Farm and Ranch Lands Protection Program, a survey found that farmers that enter into long-term easements to protect their agricultural practices often use the funding for multi-benefit purposes, such as wildlife-friendly habitat or the public benefits of protecting soil and water quality.[24]



Photo courtesy Delta Protection Commission

California Wildlife Conservation Board

STRATEGY G1, SHORT-TERM FUNDING

The WCB offers a number of funding programs in California aimed at ecosystem conservation.[25] These include programs for land acquisition; ecosystem restoration on agricultural lands; habitat enhancement and restoration; public access development; streamflow enhancement, rangeland, grazing land, and grassland protection; riparian habitat and inland wetlands conservation; and a Natural Heritage Preservation tax credit.

Through the **Land Acquisition Program**, WCB acquires real property or rights in real property on behalf of CDFW, or provides grant funds to other governmental entities or nonprofit organizations to buy real property or rights in real property. All acquisitions are made via a Department of General Services approved fair market value appraisal on a "willing seller" basis. The acquisition activities generally entail CDFW evaluating the biological values of property through development of a Land Acquisition Evaluation (used for a single property) or a Conceptual Area Protection Plan (used for multiple properties).

The WCB's **Ecosystem Restoration on Agricultural Lands** program provides funding to assist landowners in developing sustainable wildlife-friendly practices on their properties that can co-exist with agricultural operations.

The **Habitat Enhancement and Restoration Program** is WCB's general restoration program. It comprises all projects that fall outside WCB's and other mandated programs, and it includes native fisheries restoration and restoration of wetlands such as coastal, tidal, or fresh water habitats that fall outside the jurisdiction of the Inland Wetlands Conservation Program. It also contains other projects that improve native habitat quality within the state.

See Quick Links p. 164 to access above tools and programs.

The **Public Access Development Program** aims to improve public access to hunting, fishing, or other wildlife-oriented recreation throughout California. Financial assistance is available to develop public access facilities such as fishing piers or floats, access roads, boat launching ramps, trails, boardwalks, interpretive facilities, lake or stream improvements, and restrooms and parking areas.

The **Rangeland, Grazing Land and Grassland Protection Program** aims to protect the long-term sustainability of livestock grazing; ensure continued wildlife, water quality, watershed, and open space benefits to Californians as a result of livestock grazing; and support innovative uses of grasslands compatible with sustainability. The Program encourages projects to address regional landscape issues.

The **California Riparian Habitat Conservation Program** (CRHCP) aims to identify areas critical to riparian ecosystem maintenance; pinpoint areas in imminent danger of destruction or significant degradation; prioritize protection needs based on site significance and potential habitat loss or degradation; develop and fund project-specific strategies to protect, enhance, or restore significant riparian habitat; develop, administer, and fund a grant program for riparian habitat conservation; and provide a focal point for statewide riparian habitat conservation efforts.

The **Inland Wetlands Conservation Program** (IWCP) was created to help the Central Valley Joint Venture achieve its goal of increasing bird populations through land acquisitions, wildlife friendly agriculture, conservation easements, and restoration or enhancement of habitats within the CVJV basins, including Yolo, Suisun Marsh, and the Delta.



Pheasant hunting in the Delta. Photo: CDFW

The WCB's **Natural Heritage Preservation Tax Credit Program** (Public Resources Code Section 37000 et seq) provides state tax credits for donations of qualified land (fee title or conservation easement) and water rights. The program demonstrates the state's commitment to natural resources protection by rewarding landowners who perceive habitat as an asset rather than a liability. Initially implemented in 2001, the Tax Credit Program to date has resulted in the approval of $54.5 million in tax credits and the donation and transfer of ownership of more than 9,407 acres of critical parkland, open space, agricultural conservation easements, wildlife corridors, and archaeological resources.

Central Valley Project Improvement Act

STRATEGY G1 SHORT-TERM FUNDING

The Central Valley Project Improvement Act (CVPIA)[26] established certain actions to restore, protect, and enhance fish, wildlife, and associated habitats in the Central Valley—including the San Francisco Estuary (Bay-Delta) and Trinity River basins of California—and to address impacts of the Central Valley Project (CVP) on fish, wildlife, and associated habitats. To provide irrigation and municipal water to much of California's Central Valley, the CVP regulates and stores water in reservoirs in the northern half of the state and transports it to the San Joaquin Valley via a series of canals, aqueducts, and pumping plants. To offset CVP impacts, the CVPIA provides restoration funds available from Central Valley water and power users. This restoration fund may be appropriate to fund conservation projects in the Delta, Suisun Marsh, and Yolo Bypass.

To skip these references go to p. 165

Guide to Related Tools, Permits, Requirements and Programs - continued

Proposition 1 Water Quality, Supply, and Infrastructure Improvement Act —Delta Programs

STRATEGY G3, SHORT TERM FUNDING

The Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1; California Water Code §79700 - §79798) provides funding to implement the objectives of the *California Water Action Plan* (CWAP-see also p.31): more reliable water supplies, restoration of important species and habitats, and a more resilient and sustainably managed water infrastructure.[27] Chapter 6 of Proposition 1 authorizes funding, upon appropriation by the Legislature, for competitive grants for "Protecting Rivers, Lakes, Streams, Coastal Waters, and Watersheds." Delta-focused Proposition 1-funded grants, established by the California Department of Fish and Wildlife (CDFW) and the Delta Conservancy, offer short-term support for scientific studies; water quality improvement projects; and acquisition, planning, and implementation of projects that align with *Delta Conservation Framework* goals and strategies. California public agencies, nonprofit organizations, public utilities, Native American tribes recognized by federal and state entitites and listed on the Native American Heritage Commission's Tribal Consultation List, and mutual water companies are eligible to apply (California Water Code §79712[a]). Projects that are undertaken to meet mitigation obligations, or projects that are under an enforcement action by a regulatory agency, are not eligible for funding.

In 2015, CDFW established the Delta Water Quality and Ecosystem Restoration Grant Program to administer $87.5 million of Proposition 1 funds for projects that benefit the Delta (California Water Code §79738). CDFW will distribute these funds on a competitive basis through annual proposal solicitation notices issued over a 10-year period. The program focuses on water quality, ecosystem restoration, and fish protection facilities that benefit the Delta. Projects must be consistent with the purposes of Proposition 1 and contribute to implementation of the CWAP, *State Wildlife Action Plan, Delta Plan, Delta Science Plan*, Central Valley Flood Protection Plan Conservation Strategy, and/or California EcoRestore[28] (see Guide pp. 30-37). [29]

Also in 2015, the Delta Conservancy launched a grant program to award $50 million (identified in Chapter 6 of Proposition 1) over a five-year period "for competitive grants for multi-benefit ecosystem and watershed protection and restoration projects in accordance with statewide priorities" (California Water Code §79730 and §79731). Proposition 1 and the Delta Conservancy's enabling legislation both focus on projects that use public lands and maximize "voluntary landowner participation in projects that provide measurable and long-lasting habitat or species improvements in the Delta." To the extent feasible, projects need to promote state planning priorities and sustainable communities strategies consistent with Government Code 65080(b)(2)(B). Furthermore, all proposed projects must be consistent with statewide priorities as identified in Proposition 1, the CWAP, the Delta Conservancy's enabling legislation, the *Delta Plan*, and the Delta Conservancy's Strategic Plan.[30]

LONG TERM FUNDING

Conservation Easements for Mitigation

STRATEGY G2, LONG-TERM FUNDING

There are several types of state conservation easements used for project mitigation that provide for long-term monitoring and management funding provided by the project. A conservation easement is a grant by a landowner to an eligible easement holder, which restricts the use of the conserved property to natural, scenic, historical, agricultural, or open-space purposes in perpetuity (Civ. Code § 815.1). The state requires adequate funding to implement measures required by a CESA permit (14 CCR 783). Such measures often require monitoring and adaptive management for the duration of the easement. Some non-statutory easements may provide long-term mitigation funding but are more flexible for the landowner. Such easements may not provide funding in perpetuity, but they may provide longer-term funding than short-term grants, and they are generally used when mitigation requirements are compatible with existing land uses. These include open space easements (Civ. Code §§ 51070, 51075, 51080 - 51093); agricultural easements (Cal. Pub. Resources Code, § 10211, Civil Code section 815.1); or deed and covenant restrictions (Civ. Code §§ 1461, 1462, 1468, 1469, 1471). The U.S. Fish and Wildlife Service established mitigation guidelines to evaluate financial assurances for ESA mitigation that contain a landscape-scale approach to conservation and long-term monitoring and adaptive management (USFWS 2017).[32] Landowners engaged in regional conservation partnerships that are interested in entering into conservation easements for mitigation can do so through habitat exchange programs, becoming a mitigation bank sponsor, or other mechanisms specified by the regulatory agencies (see FR 81 95316, Section 6.2 – Eligible Lands).

See Quick Links p. 164 to access above tools and programs.

Donor-Based Funding

STRATEGY G2, LONG-TERM FUNDING

Delta conservation partnerships, such as the Yolo Basin Foundation-Yolo Bypass Working Group, Central Valley Joint Venture, and Migratory Bird Conservation Partnership, include a number of NGO partners (e.g., The Nature Conservancy, Audubon California, Ducks Unlimited, CalTrout, and American Rivers). These NGOs rely partially on donor funding for their programs, which ultimately benefit Delta conservation efforts. For example, over the past decade, the private David and Lucile Packard Foundation (Packard Foundation) has supported a number of NGOs to advance conservation and underlying science in the Delta.[33] The Packard Foundation has also been active in attempting to increase federal conservation funding for western states. The Resources Legacy Fund, with core funding from the Packard Foundation, is leveraging additional support from foundations and individuals to implement their California Conservation Innovations initiative (CCI).[34] This initiative focuses on:

1. Conservation policies that will "advance state climate change adaption and resiliency policies and will monitor and engage strategically in sea level rise and energy development policy areas, adapting its engagement to changing needs and opportunities;"
2. Conservation funding to "develop new, stable sources of conservation funding by identifying viable approaches at local, regional, and state levels; " and
3. Conservation constituencies to "engage with younger and more ethnically diverse populations on important CCI policy and funding priorities statewide and in Los Angeles, the Bay Area, and portions of the San Joaquin Valley."

The National Fish and Wildlife Foundation (NFWF) also use their programs to leverage public with private funds to achieve lasting conservation solutions across the nation. Through their Western Water Program, NFWF is currently working to develop freshwater restoration initiatives in the Sierra Nevada, Central Valley, and Bay-Delta watersheds of California.[35] With appropriate planning and coordination, these donor-related funding sources could be leveraged to support upcoming Delta-related conservation projects and implement *Delta Conservation Framework* goals.

> *"In a habitat exchange, landowners such as farmers and ranchers create, maintain and improve habitat on their property and earn credits for their efforts. Landowners sell these credits to offset impacts from development, such as roads, transmission lines and wind turbines, that impact species and habitat. An independent habitat exchange administrator monitors and verifies credit transactions and reports on progress to ensure species protection. Every credit sale makes species and habitat better off."*
>
> ENVIRONMENTAL DEFENSE FUND

Endowments for Conservation

STRATEGY G2, LONG-TERM FUNDING

Conservation trusts or environmental trust funds (ETF) created with an endowment are suited to be a long-term source of funding for conservation.[36] Most ETF that finance conservation are legally independent institutions (i.e., established outside of government) managed by an independent board of directors. Many existing ETF have a permanent endowment that has received grants from government and international donor agencies. They may also manage sinking funds, created through debt-for-nature swaps, in which a portion of a developing nation's foreign debt, for example, is forgiven in exchange for local investments in environmental conservation measures, or revolving funds financed through specially designated user fees or taxes that are only to be used for conservation. Environmental trust funds are an independent legal entity and investment vehicle to help mobilize, blend, and oversee the collection and allocation of financial resources for environmental purposes. It is a solution that facilitates strategic focus, rigorous project management, solid monitoring and evaluation, and high levels of transparency and accountability. The term encompasses conservation trust funds, wildlife trusts, climate and forest funds, and other funds established to deliver environmental, social, and economic benefits.

Participants in the *Delta Conservation Framework*'s 2016 workshops suggested endowments for the operation and management of conservation lands should be incorporated into the planning process in the early stages. Although they don't fund restoration projects, endowments required by CESA permits for other projects also contribute to perpetual management of conservation lands that may be interconnected across the landscape.

To skip these references go to p. 165

Guide to Related Tools, Permits, Requirements and Programs - continued

Market-Based Opportunities and Payments for Ecosystem Services

STRATEGY G2, LONG TERM FUNDING

Payments for Ecosystem Services (PES) have the potential to serve as long-term market-based revenue systems and supply long-term funding for Delta conservation. PES is the mechanism for payments when a beneficiary or user of an ecosystem service (such as a business) makes a direct or indirect payment to the provider of that service; in other words, whoever preserves or maintains the ecosystem (such as farmers, landowners, or other natural resource owners) gets paid for doing so. Opportunities through growing American Carbon Registry (ACR)37 carbon markets are emerging as another source of conservation funding, particularly in the context of implementing solutions to the land subsidence prevalent in the Delta (see Section II, p.57). In both voluntary and regulatory carbon markets, the ACR oversees registration of carbon offset projects, which pay for carbon credits to be used for emissions reduction in the Cap-and-Trade Program (including wetland restoration). The California Department of Fish and Wildlife's Wetlands Restoration for Greenhouse Gas Reduction Grant Program (see p.159) is based on this new marked-based model for funding conservation.[23]

Other ecosystem services related opportunities for Delta conservation include funding obtained from tourism fees. In the Delta, tourism fees can be collected, for example, from visitors to parks and refuges by California Department of Parks and Recreation, CDFW, and the Stone Lakes National Wildlife Refuge. These user fees may be, in part, utilized for operations and management of these parks and reserve lands.

Fitting under the broad umbrella of green bonds, environmental impact bonds (EIBs), are beginning to gain some traction with private-sector investors willing to bet on a "pay-for-success" bond offering. The EIBs are a new financial tool that ties rewards to water infrastructure or wetland restoration projects, for example, or other measurable social or environmental outcomes. Three key components must be present to make an EIB successful as a financing tool: 1) Returns must be determined by outcomes; 2) EIBs should generate savings on overall project cost; and 3) Performance metrics must be well defined.

Leveraging water markets is another financing concept developed by The Nature Conservancy, utilizing an innovative conservation and impact investment model called Water Sharing Investment Partnerships.[38] This investment partnership concept is focused on soliciting investor capital, as well as government grants and philanthropic donations, to acquire a water rights portfolio (similar to stocks or commodities). Most of the water rights are leased or sold back on the market, ensuring a financial return for investors and access to water for farmers and cities. A portion of these water rights are used to divert water back to natural ecosystems and to generate funds for ongoing ecological monitoring. This idea has been tested in a number of places, including San Diego. To know whether it can be applied to the Delta will take further investigation.

Emerging habitat exchanges also have the potential to provide an indirect long-term funding mechanism to support multi-benefit conservation activities. The Central Valley Habitat Exchange[39] (Exchange) is one example of a voluntary program that creates new financial returns for private landowners willing to engage in sustainable land management practices and restoration activities that have quantifiable benefits to the environment. The Exchange facilitates investment in conservation through private and public investors, managing the transactions of a market of habitat credits by leveraging wildlife habitat created by willing landowners. Through the Exchange, farmers are essentially paid to use management practices that provide habitat for wildlife, such as migratory birds. This new funding stream can create revenue landowners can earn by employing new strategies to manage or restore functional habitat. Habitat exchanges are being considered for other Delta wildlife—including riparian songbirds, shorebirds, waterfowl — and for sandhill cranes, monarch butterflies, and greater sage-grouse.[40]

QUICK LINKS

Environmental Trust Funds
www.undp.org/content/sdfinance/en/home/solutions/environmental-trust-funds.html)

Environmental Defense Fund Habitat Exchanges
www.edf.org/ecosystems/habitat-exchanges-how-do-they-work

Resources Legacy Fund
http://resourceslegacyfund.org/

Wildlife Conservation Board Grant Programs
https://wcb.ca.gov/Programs

CDFW Proposition 1 Restoration Grant Programs
www.wildlife.ca.gov/Conservation/Watersheds/Restoration-Grants

SECTION VI

Conservation Pathways to 2050



Illustration: Afsoon Razavi

Regional Approach 168

Individual Project Approach. 171

Lasting Sustainability. 172

The Way Forward 173

Delta in Common 174

North-South Delta Conservation Opportunity Region 175

Guide to Planning Tools. 184

KEY TERMS INDEX

Section 1, p. 14
Co-equal Goals
Conservation
Delta Stakeholders
Delta Community
Delta Ecosystem Services
Wildlife

Section 2, p. 40
Delta as Place
Landscape-scale Benefits
Multi-Benefit Projects
Wildlife Friendly Farming
Habitat Exchanges

Section 3, p. 78
Landscape Connectivity
Ecosystem
Habitat
Ecological Resilience
Ecological Sustainability

Section 4, p.108
Adaptive Management
Climate Change
X2
Extreme Events
Novel Ecosystems
Sea Level Rise
Resilience
Reconciliation Ecology

Section 5, p. 134
Common permits, agreements, disclosures required for conservation projects

Introduction

The *Delta Conservation Framework* is a guide for all Delta stakeholders suggesting how best to approach conservation planning and project implementation. The Framework builds on a strong foundation of existing plans and stakeholder feedback. As described in Section II, this critical feedback was gathered from a series of public workshops and comment letters in 2016 and 2017. The Framework also represents a careful vetting of myriad plans, programs and approaches, and a first-ever effort to combine and organize all these resources within a single framework and guide, in a summary style. All too often anyone launching a new conservation project can become overwhelmed by the complexities.

The Framework's strategic approach to conservation offers tools, processes, and opportunities for partnerships that can be used by any individual, landowner, agency, or organization on any scale (Sections II-V).

As the practice of conservation is inherently multi-disciplinary — relying upon expertise from ecology, engineering, sociology, agriculture, local land use, public policy and regulation, as well as on local knowledge of the landscape and its history — it requires regular communication and collaboration. Implementation of this ambitious 30-year vision must include every possible stakeholder, not just state agencies. In partnership, and with a commitment to honoring each others' perspectives, residents, businesses, stewards, and managers can all build a healthier, more sustainable Delta together.



Flowering willow, a riparian tree. Photo: Amber Manfree

Nationwide, conservation planners and advocates are wrestling with the same questions and hurdles we confront in the Delta. Many have developed tools to help structure difficult conversations and work together collectively to implement conservation. Descriptions and examples appear in the Guide to Planning Tools pp.184-187.

This following section of the Framework describes two approaches to strategic conservation planning and implementation— a regional approach and an individual project approach.

Both approaches require attention to monitoring and adaptive management based on conservation outcomes as described in Section IV, and to funding needs as described in Section V.



Workshops gathering stakeholder input to the Delta Conservation Framework in 2016. Photo: Christina Sloop

Regional Approach to Conservation

As described in prior sections, the *Delta Conservation Framework* suggests that a collaborative, regional approach to conservation planning is an important key to successful implementation on a landscape scale. To recap, regional partnerships can be initiated by any interested Delta stakeholder, with a purpose of developing and implementing a regional conservation strategy. The Framework identifies seven possible conservation opportunity regions within the Delta (see p. 170) though working on a sub-regional or individual project scale is also possible (see next sections)

Regional conservation partnerships should include all local stakeholders: local, state, and federal agencies, landowners, and business owners and others. Inclusivity from partnership inception ensures consideration of a diversity of perspectives and prevents unanticipated conflicts and challenges.

Regional conservation strategies should reflect the Framework's Guiding Principles (see p. 189) and align with the relevant goals and strategies described in Sections 2 - 5. In developing a regional conservation strategy, partnerships should evaluate regional datasets on vegetation, habitat quality, presence of species, agricultural and other land use patterns, water management, existing infrastructure (e.g., levees and water diversions), and other relevant socioeconomic information like land values, projected sea level rise, and flood risk. If regional partnerships overlap with existing plans (such as Regional Conservation Investment Strategies, Habitat Conservation Plans, or Natural Community Conservation Plans), they should include experts involved in implementing these plans and defer to plan goals and objectives within plan boundaries. Consideration of all of these factors should provide a comprehensive picture of where conservation will work or won't work on a specific Delta landscape.

Costs for engaging in a nine-month partnership-oriented process are estimated at $300,000 but could range widely. This includes administrative support and facilitation of twelve partner meetings and several workshops, technical expertise utilizing visualization tools and analyses, honoraria for participation as needed, and development of a regional conservation strategy report.

It is important to recognize that partnership work is not always easy. In some regions there is a foundational distrust between members of the Delta public and government agencies, or between special interest organizations and municipalities, regardless of their good intentions. Acknowledging this distrust and welcoming all participants to the planning table to achieve the most acceptable solution, despite differences in individual roles, is the foundation of a successful partnership. Participants should be ready to commit time and energy to build trust and

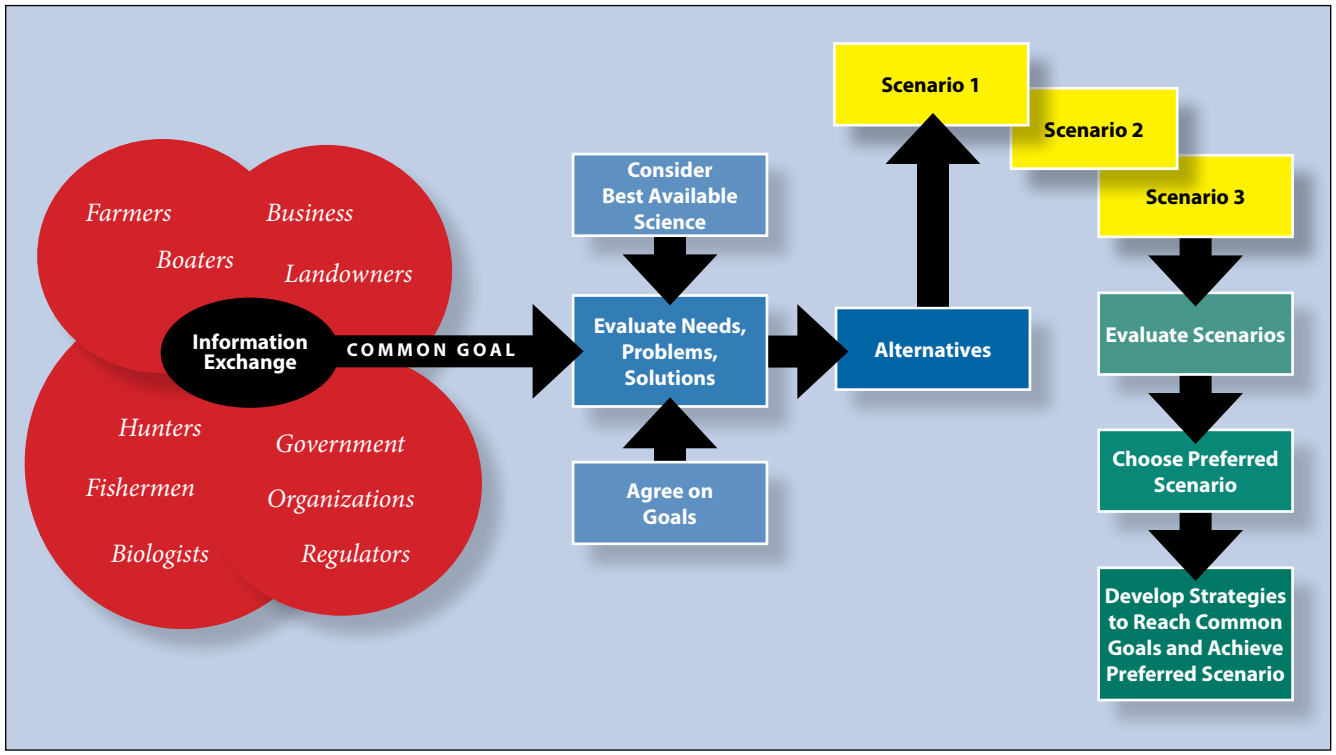


Figure 6.1: How a regional conservation partnership works, a sample process.

strong working relationships with diverse interests within their region.

See Figures 6.1 and 6.2 for suggested sample steps in any regional planning process.

A variety of tools and processes are available to help regional partnerships succeed. For starters, regional partnerships should engage independent facilitators familiar with these tools to guide the process. Available conservation tools include scenario planning,[1,2] the Open Standards for the Practice of Conservation,[3] and Structured Decision Making,[4] among a variety of others.[5,6,7,8,9,10,11,12,13] The Guide to Planning Tools at the end of this section provides short overviews of these three approaches.

Regional Conservation Planning Template

Stage 1- Partnership Initiation

A local champion, agency, non-profit organization or other stakeholder gathers support for initiation of a regional conservation partnership in a given Delta region. This small group of visionaries becomes a core planning team that launches and coordinates the partnership. As a first step, the team develops a scope of work and proposals to obtain funding to support the planning phases. Once funding is available, the team hires an independent facilitator to guide the planning process. The facilitator helps the team to conduct outreach to potential partners and to hold public meetings inviting interested stakeholders to join the partnership.

Stage 2-Scenario Planning

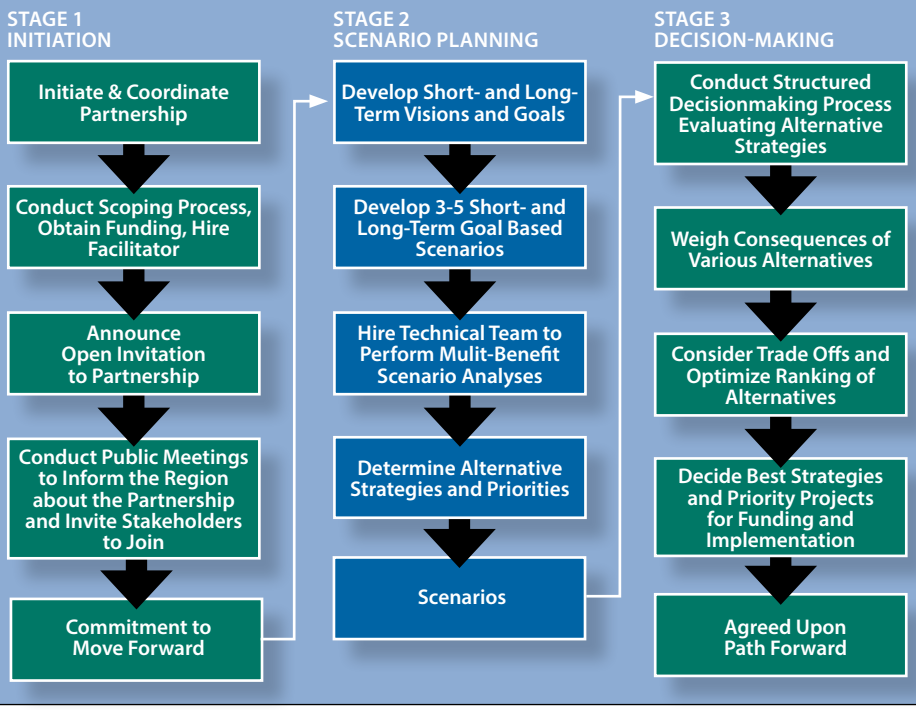
The newly formed regional conservation partnership develops two visions, one short-term, one long-term. Through a facilitated process, each partner can inform the visioning excercise by sharing their interests, mission, goals, and constraints. These factors all exert an important influence on each individual partner's respective level of cooperation and collaboration in the planning partnership. The partnership then creates a set of goals for each finalized vision, guided by the overarching goals of the *Delta Conservation Framework* and partner interests and constraints.

At this stage, the partnership is ready to hire a technical team which can perform goal-based scenario analyses using modeling, GIS overlays and other data sets and tools. For each goal, the partnership, with help from the technical team, then develops three to five possible outcome scenarios for evaluation. These scenarios capture various combinations of important actions to reach the desired outcome for a given goal. The technical team then offers a set of alternative scenarios to the regional conservation partnership for prioritization.

Stage 3- Decisionmaking

The regional conservation partnership uses a structured decision making process to decide which scenarios and related actions to prioritize for implementation. With help from the technical team, the partnership develops criteria to weigh the consequences of the various alternatives, produce an initial ranking of alternatives, consider trade-offs, and optimize the ranking. As a final step, the regional conservation partnership identifies priority projects and best scenario actions needed to reach each of the outlined goals. Ultimately, the technical team develops work and adaptive management plans as final deliverables that enable the partnership to find funding for high priority projects. If all proceeds as planned, most regional conservation partnerships can complete all three stages of this example process in six to twelve months, depending on individual partner availability.

Figure 6.2 Sample Planning Steps



Conservation Opportunity Regions

Each section of the Delta Conservation Framework *includes on-the-ground examples of the different conservation opportunities to be found in various sub-regions of the Delta.*

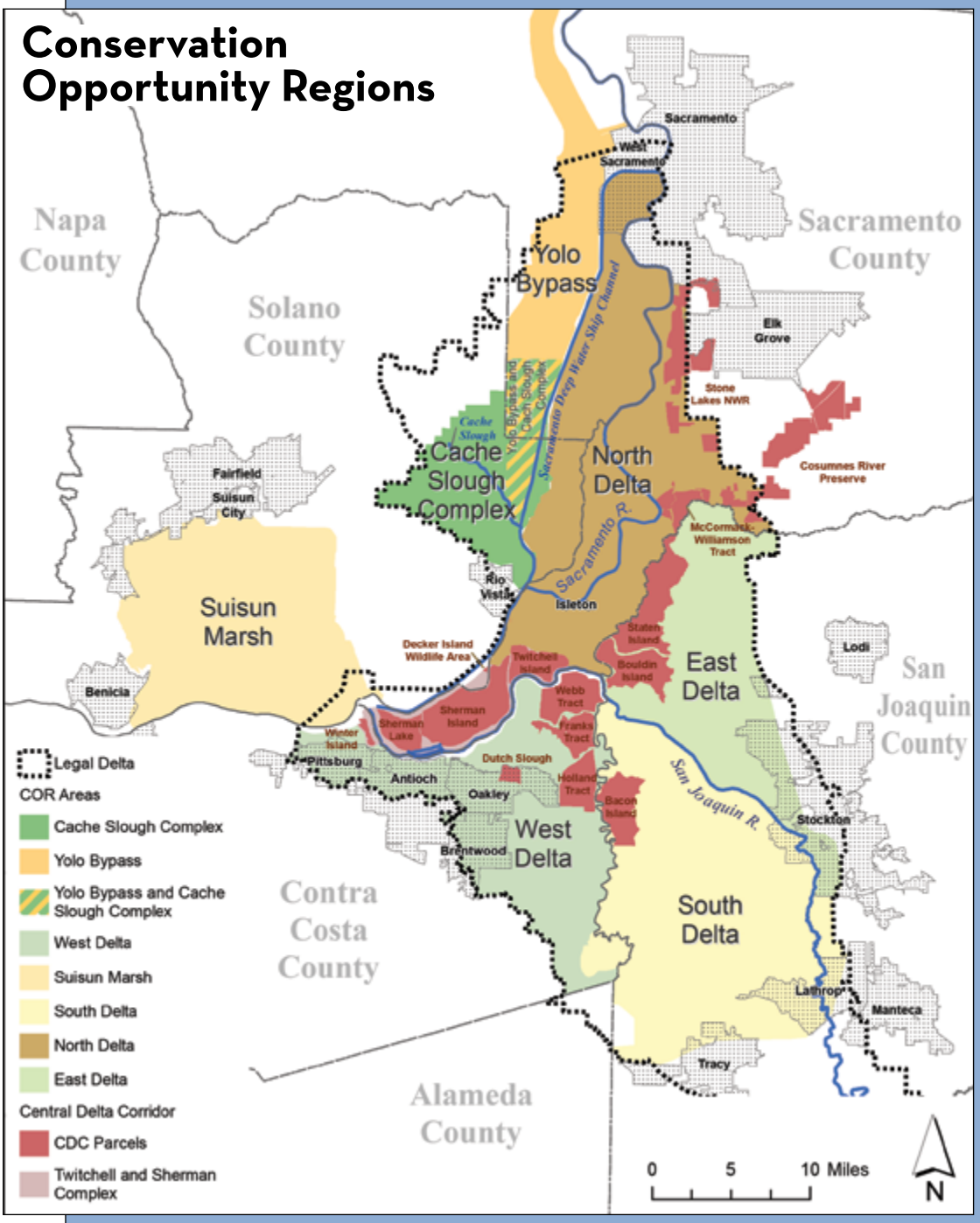
These regional sub-divisions – as a planning tool – were vetted during the 2016 Delta Conservation Framework public workshops. Divisions were loosely based on variation in local land use, communities, ecosystem types, and the location of existing publicly owned lands.

While the result of this process was eight sub-regions, only seven were further described in the Framework (Central Delta Corridor, Yolo Bypass, Cache Slough, Suisun Marsh, and the North, South and West Delta); details on opportunities in the East Delta are less developed.

Within these sub-regions of the Delta, public lands, existing conservation lands, and existing planning partnerships already offer many opportunities for conservation. In many areas, willing private landowners are also contributing to the conservation efforts with the help of nongovernmental organizations like The Nature Conservancy or California Waterfowl Association, partnerships such as the Central Valley Joint Venture or the Migratory Bird Partnership,[14] and agricultural practitioners working with these and other entities.

The information presented in the Framework on each conservation opportunity region includes planning history, activities, conservation projects and challenges.

All of this information is intended to provide a springboard for building regional conservation partnerships and strategies.



Source: CDFW, 2018

Individual Project Approach to Conservation

The *Delta Conservation Framework* also encourages implementation of individual projects in areas without an established regional partnership or regional conservation strategy. The Framework recommends that individual conservation projects should be implemented on publicly owned lands first, or through collaborations between willing landowners and local, state, or federal agencies. Individual projects in areas where no regional partnership exists should adhere to good neighbor practices, such as making contact with neighbors, encouraging regular communication, and discussing important issues like access needs, on-site management practices, agricultural infrastructure, how to avoid increased flood or fire danger, and potential impacts of species movement onto neighboring land.[15] This will help avoid or minimize short- and long-term impacts on neighboring land uses. Proponents of individual projects should also understand how they align with the overarching goals of the *Delta Conservation Framework* and consider using some of the suggested strategies to help achieve each goal during the process of planning, implementing, and managing conservation over the long term.



Windmills in the Montezuma Hills. Photo: Francis Parchaso, USGS

Long-term Sustainability through Delta Conservation

In the context of ecology, the term sustainability describes the ability of ecological systems (ecosystems) to persist indefinitely by remaining diverse and productive. As described throughout this document, conservation is needed to reestablish degraded ecological functions within many Delta ecosystems. Making the connection between the people of the Delta and those entities committed to implementing conservation is vital. Effective education and outreach regarding the benefits of lasting and sustainable Delta ecosystems–their ecosystem services for all Californians–is a key goal with important political, economic, social, and environmental ramifications. Heightening public awareness of the direct connection between a sustainable and healthy environment and the socioeconomic well-being of all Californians is critical to sustaining the motivation to support and implement ecosystem conservation over the long term.[16]

Ecological systems function on many interrelated scales. Untangling this functional complexity to identify key actions that will improve ecosystem function is a daunting task, especially when the drivers of ecosystem function are intermingled with human land uses in the Delta. Great strides have been made in developing a strong, science based understanding of how the Delta functions, and what its species and people need to enjoy a sustained future. However, there will always be numerous uncertainties surrounding our understanding of how each driver of Delta ecosystem function interacts with others, and how climate change will affect our future options and livelihoods, that must be recognized to effectively plan conservation for long-term outcomes.

As described above and in the following Guide, there are a number of effective tools to help planners untangle this complexity and make the best possible decisions concerning conservation goals, actions, strategies, and priority projects. Tools can also help conservation partnerships to manage adaptively once strategies are implemented. Regional conservation partnerships should consider using these tools, along with available Delta science, to ensure full consideration of the influence of conservation actions on ecosystem function. Instead of basing decisions on short-term thinking, conservation planners and stakeholders should be able to rely upon an evolving knowledge of what makes our Delta healthier and more sustainable.



The bridge over Three Mile Slough, one of many intersections of waterways, roads, levees, and landscapes that evoke challenges to long term sustainability, as sea levels rise, in the Delta. Photo: Christina Sloop

The Way Forward

Following the initiation of California WaterFix[17] and EcoRestore,[18] the California Department of Fish and Wildlife committed to leading a high-level planning effort to advance the conservation of the Delta, the Yolo Bypass, and Suisun Marsh. The resulting document — the *Delta Conservation Framework* — is intended to serve as a guide for Delta stakeholders interested in planning for and implementing conservation actions. The Framework includes an array of tools, and summarizes a selection of well-thought out plans and programs, that should enable stakeholder integration, conservation, and adaptive management of Delta ecosystems to benefit both human and natural communities.



Soaring white tailed kite. Photo: Rick Lewis

Building on prior Delta planning efforts, the *Delta Conservation Framework* also provides a shared vision and long-term, landscape-scale goals in the context of the rapidly changing planning parameters associated with climate change. Some of the goals and strategies, for example Goal E, highlight pre-existing and ongoing efforts to successfully implement conservation in the Delta that should be used as resources moving forward. In contrast other goals, such as Goals F and G, highlight the need to consider and motivate new approaches to implementing conservation.

As described throughout Sections II-V, there are many current efforts that align with the Framework and collectively move the Delta closer to the vision for 2050 (for a reminder in brief see right).

Long-term conservation of Delta ecosystems can and will benefit both people and the environment. The *Delta Conservation Framework* embraces this premise with seven broad goals supporting stakeholder communication and outreach, decision making based in science, and thinking ahead collectively to improve permitting and funding. The Framework's goals offer collaborative approaches to conservation challenges, potential regulatory conflicts, and other impediments to conservation initiatives. The Framework also embraces regional-scale conservation goals based on multi-interest partnerships, and supports the strong scientific foundation reflected in the substantive, forward-thinking map for future ecosystem function described in *A Delta Renewed* (see Section IV). Going forward, the *Delta Conservation Framework* will serve as one of several resources informing the amendment of ecosystem elements of the *Delta Plan* and state funding priorities. It should also inform the myriad different plans, programs, projects, and initiatives all in some state of progress as of December 2018, the Framework's publication date. So much is going on all around the Delta that the Framework can only provide a strong vision for integration as of this moment.

Current Major Initiatives Aligned with the Delta Conservation Framework

- **Agricultural Lands Stewardship Framework and Toolkit:** A working group launched by the Department of Water Resources in 2014 to develop a list of strategies to provide project proponents and those affected by proposed conservation projects with an integrated and collaborative approach to address protecting and changing uses of agricultural land.
- **California Department of Fish and Wildlife Grant Solicitation Guidelines:** Draft 2018 Proposition 1 solicitation guidelines make it a priority to fund the development of regional planning partnerships and to facilitate the collaborative development of regional conservation strategies or plans in the Delta.
- **Central Delta Corridor Partnership:** A partnership launched in 2017 to coordinate planning and restoration on a network of roughly 50,000 acres of publically-owned or funded lands in the central Delta.
- **Delta Plan Interagency Implementation Committee:** A committee established in 2013 to facilitate *Delta Plan* implementation through increased coordination and integration among local, state and federal agency participants. The committee has encouraged the development of programmatic permitting tools for conservation projects.
- **Delta Science Program Social Science Task Force:** The Delta Science Program is coordinating a Social Science Task Force tasked with developing a strategic plan to strengthen and integrate social sciences into the science, management, and policy landscape of the Delta. Composed of individuals with a diverse set of expertise in the social sciences, the task force's key goal will be to develop a set of recommendations that can be acted upon by the Delta science community.
- **Franks Tract Feasibility Study:** A study led by the California Department of Fish and Wildlife aimed at restoring portions of Frank's Tract to tidal marsh. This effort solicited feedback from local residents, boaters, and anglers and includes a locally proposed design.
- **Yolo Bypass Cache Slough Partnership:** A partnership of representatives from local, state, federal agencies who signed an memorandum of understanding to oversee collaborative implementation of conservation in this region, all before initiation of the Framework in 2016.



Communities like Discovery Bay will be at the frontlines of Delta adaptation to future conditions. Increasing the acreage of absorbent wetlands, riparian zones, and multi-benefit floodplains (farm fields that can flood occasionally) will vastly improve the safety of Delta communities in the future. But planning and action must occur now, in the small window of time before the Delta faces a marked acceleration in the frequency of extreme flood events and the rate of sea level rise. Efficiencies and cost effectiveness are always lost with crisis management. A Delta in Common, planned now, can benefit both people and the ecosystem. Photo: Christina Sloop

Delta in Common

The path toward more ecologically functional Delta ecosystems within a thriving Delta community remains controversial. Despite mitigation requirements for infrastructure projects and the state and federal water projects, and a long history of public investment in Delta ecosystems through bond funds, few projects have been initiated and managed over the long term. Implementing conservation in the Delta will continue to stall unless Delta stakeholders are willing to work collaboratively, knowing they may have to be open to considering and accepting tradeoffs. If no solutions can be found, Delta ecosystem conservation will remain on hold, or occur in a piecemeal fashion. In the meantime, Delta ecosystems and their important services to humans and wildlife will continue to decline.

Multi-benefit projects that float all boats may seem like an impossible dream. But in reality, what local landowners, hunters, farmers, fishers, and boaters want may not be that far off from what species need to survive and what public infrastructure projects need to provide the greatest good for the lowest price. Every interest – both human and wild – faces the common uncertainty of drought, fire, earthquakes, and political change. There is an equally common reverence, however, for the Delta landscape and a desire to renew the riches of the past in the future.

The *Delta Conservation Framework* reminds the public, farmers, legislators, and water managers about how essential it is to recognize that Delta ecosystems provide services to both people and wildlife. It is an invitation to all interested stakeholders to come to the table. It is a call to continue the work of improving ecosystem health, supporting and recovering Delta wildlife, and growing the science capacity to learn from conservation actions. It is a warning of the urgency of facing the challenges of climate change, drought, and flooding head on.

Progress on key Delta conservation decisions has been stalled for far too long. Collaborative conservation must be in everyone's future.

Find your place, your region, your partners, review the goals and tools provided in the *Delta Conservation Framework*, and set out to make positive progress.

It's up to each and every one of us to build the conservation commons of the future within the unique landscape, and among the unique people, that comprise the Delta.



CONSERVATION OPPORTUNITY REGION

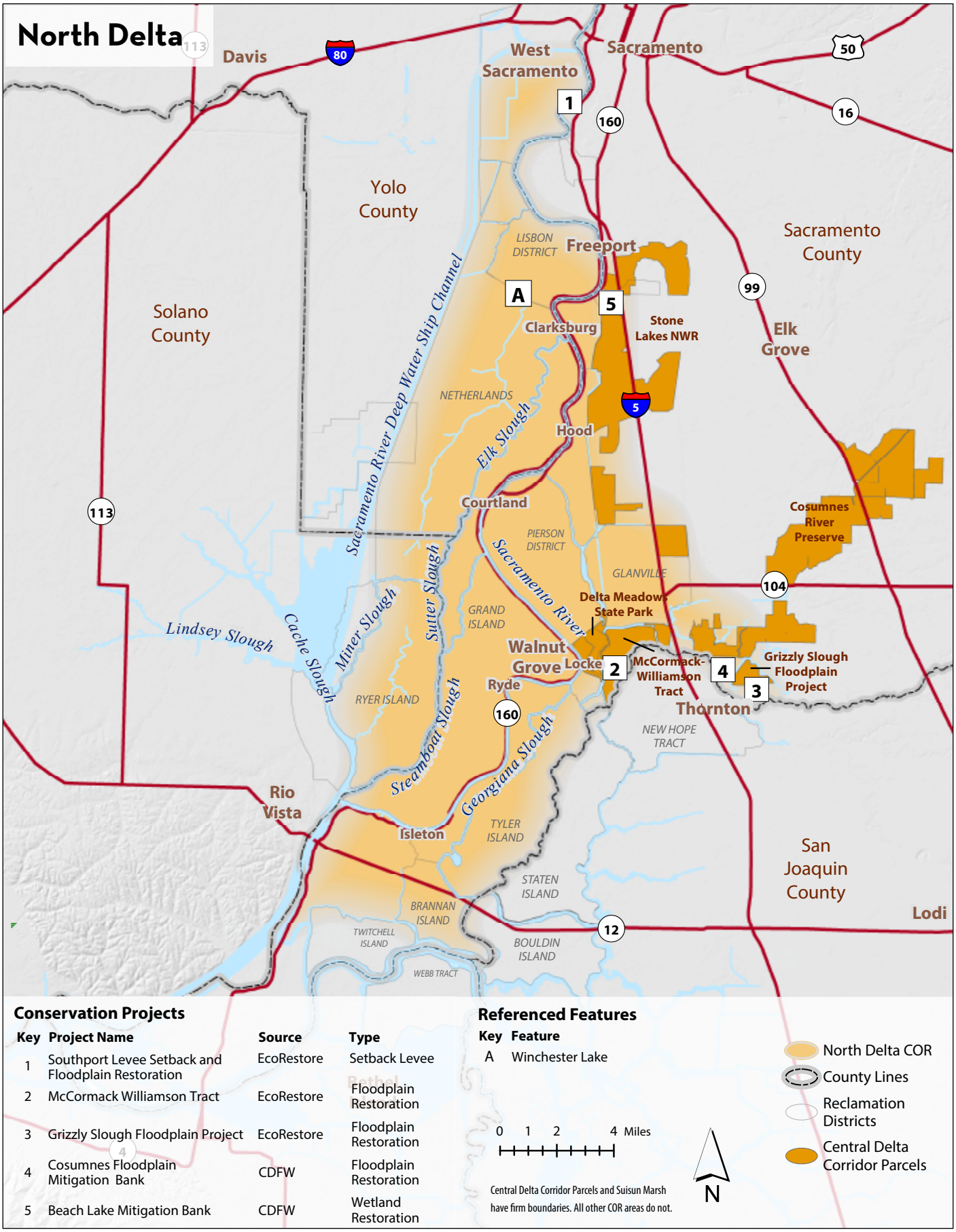
North and South Delta — The Way Forward

Photo: Amber Manfree

Many of the most obvious and ongoing conservation opportunities in the Delta lie around the edges and on public lands in and around the Yolo Bypass, Cache Slough, Suisun Marsh and in the West Delta (see pp. 90, 121 & 149). However, the heart of the Delta, east of the Yolo Bypass and west of the San Joaquin River, encompasses two productive and important agricultural zones. In the North Delta region, high value orchards and vineyards and numerous historic small towns dominate the landscape. In the South Delta region along the San Joaquin, Middle and Old Rivers, agricultural lands predominate with farmers growing tomatoes, corn, and peas, or grazing cattle. In both these regions, where there is little publicly owned land, conservation opportunities lie more with wildlife-friendly farming, improvements around the margins of channels, and optimization of new investments in levees, floodways and bypasses to protect towns and farms.

While supporting the Delta way of life in these regions remains central to the conservation of both people and place, it is important to also recognize from an ecosystem perspective that fish, wildlife, migratory birds, and water still move through these heartland regions. In these regions, no regional partnerships or vast areas of public land exist as opportunity areas for ecosystem improvement, as they do in other areas of the Delta. However it is still worthwhile to consider providing healthy corridors along farm edges and riverfronts, and to build on existing flood management projects, as part of the holistic, landscape scale approach to conservation recommended by the *Delta Conservation Framework*.

CONSERVATION OPPORTUNITY REGION



Conservation Projects

Key	Project Name	Source	Type
1	Southport Levee Setback and Floodplain Restoration	EcoRestore	Setback Levee
2	McCormack Williamson Tract	EcoRestore	Floodplain Restoration
3	Grizzly Slough Floodplain Project	EcoRestore	Floodplain Restoration
4	Cosumnes Floodplain Mitigation Bank	CDFW	Floodplain Restoration
5	Beach Lake Mitigation Bank	CDFW	Wetland Restoration

Referenced Features

Key	Feature
A	Winchester Lake

North Delta COR
County Lines
Reclamation Districts
Central Delta Corridor Parcels

0 1 2 4 Miles

Central Delta Corridor Parcels and Suisun Marsh have firm boundaries. All other COR areas do not.

N

Map: CDFW, 2018

Regional Setting

Seen from the air, the two conservation opportunity regions on the north and south sides of the Delta are a patchwork of orchards, vineyards, crops, waterways, islands and rural communities. Most are closely tied to a diverse agricultural way of life. These two regions also host a number of high-value ecosystems supporting people and wildlife.

The North Delta conservation opportunity region loosely straddles Highway 160, and crosses several counties as it extends from West Sacramento down to Highway 12. The South Delta region begins slightly south of Highway 12, and occupies an area in San Joaquin County that flanks Highway 4 to the west of I-5. Some of the legacy towns within these conservation areas include Freeport, Clarksburg, Hood, Courtland, Isleton, Walnut Grove, Ryde, and Locke in the North Delta, and Lathrop in the South Delta. No major urban developments encroach into these areas, though they are bounded by Sacramento to the north and Stockton to the southeast (see maps).

Compared to other conservation opportunity regions described in the *Delta Conservation Framework*, the North and South Delta regions include little public land (1-10 percent). Most of the public land is in the North Delta region within the 17,640-acre Stone Lakes National Wildlife Refuge,[1] a refuge partially owned and managed by the U.S. Fish and Wildlife Service. Entirely within the Sacramento River's 100-year floodplain, Stone Lakes' strategic location prevents urban encroachment into the Delta and provides a habitat link with the neighboring Cosumnes River Preserve.[2] In addition, Elk Slough, near Clarksburg, remains as one of the most intact riparian ecosystems of its kind in the Delta. Due to the proximity of the Sacramento River and its tributaries, including the American River, flood risk remains an important consideration for the North Delta region's lands, citizens, infrastructure, and environment.

In the South Delta conservation opportunity region, one of the most important planning features is the Paradise Cut. This slough protects the River Islands development from flooding and directs floodwaters away

North & South Delta Regions At A Glance

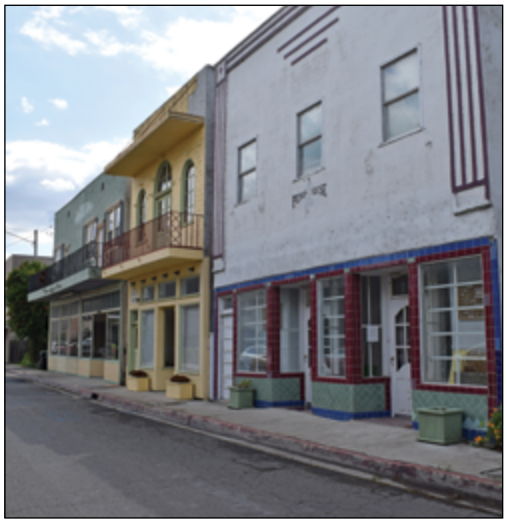
- **Size**
  NORTH: 140,000-150,000 acres
  SOUTH: 220,000 – 250,000 acres
- **Location**
  NORTH: from approximately west sacramento to just south of State Route 12
  SOUTH: west of the San Joaquin River and generally east of Contra Costa County
- **Elevation Range**
  NORTH: -23 feet below to 45 feet above sea level
  SOUTH: -23 feet below to 331 feet above sea level
- **Land Use**
  NORTH: 75-80 percent agriculture; 5-10 percent public lands
  SOUTH: 65-70 percent agriculture; 1-5 percent public lands
  OTHER PRIMARY LAND USES: flood protection, wildlife habitat, residential, water supply and storage, recreation, legacy towns, tourism
- **Natural Communities**
  NORTH: managed wetland, tidal wetland, freshwater emergent wetland, floodplain, grasslands, riparian, vernal pools, channel margin, perennial aquatic, alkali seasonal wetland
  SOUTH: managed wetland, freshwater emergent wetland, floodplain, grasslands, valley foothill riparian, channel margin, perennial aquatic, vernal pool complex
- **Urban/Town Population**
  NORTH: 20,000 – 30,000
  SOUTH: 100,000 – 110,000
- **Rural Population**
  NORTH: 5,500 – 6,000
  SOUTH: 7,000 – 8,000
- **Recreational Opportunities**
  NORTH: wildlife observation, picnic areas, hiking trails, boating, water skiing and water excursions, fishing, hunting, photography, interpretative services, camping, water sports (e.g., windsurfing, swimming), heritage sites, scenic highways.
  SOUTH: boating,water skiing, water excursions, fishing, hiking and cycling trails. (proposed: picnic areas, interpretive water trails, and camping)
- **Sampling of Listed Species**
  NORTH: greater sandhill crane, Delta smelt, longfin smelt, Chinook salmon, Central Valley steelhead, green sturgeon, giant garter snake, Swainson's hawk, tricolored blackbird, vernal pool fairy shrimp, vernal pool tadpole shrimp, California black rail, western yellow-billed cuckoo
  SOUTH: Fish, shrimp, snake and several bird species listed above plus riparian brush rabbit, riparian woodrat, San Joaquin kit fox, California red-legged frog, California tiger salamander, Delta button celery

from the urbanized floodplains in Lathrop and Stockton.[3] Historically, the Paradise Cut was one of the chief distributary branches of the San Joaquin River and, given high enough flows, connects the San Joaquin with Old River downstream. Twice during the 19th century, the main floodwaters of the San Joaquin River flowed through Paradise Cut and will likely do so again.

Planning History

The North Delta's planning history is shaped by the 2016 Community Action Plans for the three largest north Delta communities: Clarksburg, Walnut Grove, and Courtland.[4,5,6] These plans were developed in response to the 2009 Delta Reform Act and the *Delta Plan* (Chapter 5),[7] and recognize the "Delta as Evolving Place" concept (see Section II, p. 43). These plans — whose main themes include transportation, communications, and community ameneties — lay out goals, actions, and implementation steps based on community input. Though the plans don't have any specific focus on conservation, community members generally voiced an appreciation for the Delta's open space, fresh air, scenic views, and recreational opportunities, as well as a desire to expand access to the Sacramento River and other natural areas. Community members also valued the economic benefits of tourism (sandhill crane festivals etc.). Their major concerns included flood insurance,the state's plans for twin tunnels that might have a diversion point along the Sacramento River within the North Delta region (California WaterFix), and aquatic invasive species.

In the South Delta, most planning activities have focused on protecting the Stockton area from flooding and improving the Paradise Cut, a flood bypass in the region. Improvements to the cut, as well as expansion of the lower San Joaquin River's flood capacity and levees, have been the subject of more than 15 years of studies on the part of the US Army Corps of Engineers and the state's Central Valley Flood Protection Board, along with many local partners. Various feasibility studies and overlapping projects, including those referring to a project called the Lower San Joaquin River Bypass, and more recent recommendations developed by the board in the 2017 *Central Valley Flood Protection Plan*, and also endorsed in the 2013 *Delta Plan*, feature some related conservation elements. These include multiple setback levee projects to restore connectivity between the river and portions of the floodplain, and the enhancement of native vegetation.



Legacy town of Walnut Grove in the North Delta. Photo: Amber Manfree

At the 2016 *Delta Conservation Framework* workshops, stakeholders praised the Central Valley Flood Protection Plan's Conservation Strategy. In terms of the larger conservation opportunities in the South Delta, they envisioned a corridor of functional riverine and riparian ecosystems between Highway 5 and the San Joaquin River National Wildlife Refuge near Vernalis, providing a connection to the floodplains in Paradise Cut and restored channel margin habitat in the legal Delta.

North and South Delta Planned or Existing Restoration Projects

NORTH

- Habitat enhancement for Swainson's hawk at Elliot Ranch (approximately 215 acres)
- McCormack Williamson tract floodplain restoration (approximately 1,498 acres)
- Grizzly Slough floodplain restoration project (approximately 400 acres)
- Southport setback levee project (four miles of levee setback creating up to 152 acres of mixed floodplain and riparian habitat)

SOUTH

- Fish barriers
- Paradise cut and Lower San Joaquin Bypass floodplain, levee, and riparian habitat, projects (including 19 miles along the San Joaquin and Old Rivers)
- River Islands mitigation



Riparian brush rabbit in San Joaquin Valley National Wildlife Refuge. Photo: H. Grimes

Opportunities for Conservation

Conservation opportunities in the North Delta include wildlife-friendly agriculture and improvement or expansion of floodplain, tidal marsh, nontidal marsh, riparian, and channel margin habitat for Delta wildlife, including special status species such as the greater sandhill crane, Delta smelt, and tricolored blackbird. Juvenile salmon may benefit from improved channel margins along the Sacramento River and Steamboat and Sutter sloughs, which could provide an alternative route for passage through the Delta to the Sacramento River. Stone Lakes National Wildlife Refuge provides opportunities for wetland and riparian conservation. Washington Lake could also offer terrestrial oak woodland habitat conservation opportunities for wildlife in the North Delta. Other conservation opportunities include continued support for the state's aquatic invasive species management programs[8,9] and efforts to better understand how to avoid blooms of cyanobacteria, such as *Microcystis*, in the Delta.[10]

In the South Delta, the planned expansion of Paradise Cut offers numerous conservation opportunities, with a strip seven miles long and at least 1,000 feet wide permitting seasonal inundation.[11,12] This could offer the potential for riparian forests to reestablish, as well as for large areas of restored freshwater marsh downstream from Paradise Cut, into which floodwaters could feed. The South Delta region also supports a remnant population of the endangered riparian brush rabbit and these actions could support recovery of the species, as well benefitting sensitive fish and plants.[13,14]

Potential Solutions to Recognized Challenges

Consideration for the safety, well-being and sustainability of local communities may be one overriding challenge in the North and South Delta. In the North, small legacy towns represent a historic and current agricultural way of life important to the Delta as an evolving place. In the South, areas of the cities of Manteca, Lodi, and Stockton that lie around the edges of the conservation opportunity region have disadvantaged community status. With very little public land available in either of these Delta regions the challenges of undertaking conservation become even more complex and multi-faceted.

WILDLIFE-FRIENDLY AGRICULTURE

In the North and South Delta, local farming communities remain concerned that the push for more conservation will displace agriculture and its supporting industries. As described in Section II of the *Delta Conservation Framework*, however, there is growing recognition that conservation in areas with little public land should focus more on integrated, dynamic land use management that continues wildlife-friendly agriculture,[15] and on existing flood and channel management projects, than on land purchases from unwilling sellers.The Framework also recognizes that agricultural commodities and their related industries change over time.

In the North Delta, one focus of conservation could be Elk Slough, where a remnant mature riparian zone provides aquatic, transition, and terrestrial habitat for Delta wildlife. Planning for conservation could address existing flood protection needs while potentially restoring an alternative migratory corridor for salmon by expanding its width, where possible, and encouraging maintenance

of adjacent wildlife-friendly farming operations with field crops rather than permanent row crops. Such steps could provide high-quality habitat and connectivity for riparian zone wildlife to the larger Delta landscape.

In the South Delta, conservation in collaboration with agriculture could continue to maintain wildlife-friendly grazing, seasonal crops, and alfalfa adjacent to enhanced riparian vegetation projects along the San Joaquin River and other south Delta channels. This would help expand wildlife movement corridors beyond the riparian zone. The Middle River, which is silting up and mires irrigation intakes, could be a focal point of future multi-benefit conservation initiatives focused on improving channel depths and creating more riparian channel margin habitat.

INTEGRATED FLOOD MANAGEMENT

In the North Delta, areas best suited for shoreline enhancement along the Sacramento River, where floodplain or low riparian bench habitats could be established, were evaluated as part of the *Bay Delta Conservation Plan Channel Margin Opportunities Assessment*.[16] One project broke ground in May 2017 in West Sacramento, a setback levee aimed at improving nearly six miles of vulnerable levee along the west bank.[17] This multi-benefit Southport levee project contributes toward California EcoRestore[18] floodplain and riparian habitat restoration goals, and will provide additional flood protection for the North Delta's legacy communities. To further expand habitat in the area and provide an alternative migratory route for salmon through Elk, Sutter, and Steamboat sloughs, improvements to Elk Slough would need to be considered, including re-establishing a functional connection to the Sacramento River.

In the South Delta, planned projects along the Paradise Cut described above would lower the San Joaquin River flood stage by over two feet where Interstate Highway 5 crosses the river. Modeling suggests they would also

Important Planning Documents

NORTH DELTA

South Sacramento Habitat Conservation Plan

This HCP is currently under development (2010 working draft). Its primary focus is to protect vernal pool and other upland habitats that are being diminished by vineyards and development, but it also protects wetland and riparian habitats and agriculture.[12] The plan covers several special status terrestrial species. The geographic scope includes a small portion of the Delta in Sacramento County, extending from the Stone Lakes National Wildlife Refuge in the north to Tyler Island in the south. Portions of the plan area are included in the *Delta Conservation Framework's* extended planning zone, where habitat could become important for species such as sandhill crane and giant garter snake as sea levels rise and other future conditions render legal Delta habitat less suitable. Reserve areas adjacent to the Delta could also provide stepping-stone connectivity between Delta wildlife populations and populations to the east. (See also p.33)

Yolo Habitat Conservation Plan and Natural Communities Conservation Plan

This countywide HCP/NCCP conservation plan is focused on endangered species and associated mitigation for infrastructure projects (e.g. roads and bridges) and development activities (e.g. agricultural facilities, housing, and commercial buildings). It is coordinated by the Yolo Habitat Conservancy and has a strong link to agricultural preservation, aiming to strike a sensible balance between natural resource conservation and economic growth in the region. Yolo County only overlaps the Delta in the Yolo Bypass and the area between the Sacramento Deep Water Ship Channel and the Sacramento River. However, many special status species are found in this area, including valley elderberry longhorn beetle, giant garter snake, and least Bell's vireo. (See also p 34 and pp.91-101)

Yolo Regional Conservation Investment Strategy

This voluntary, landscape-scale conservation plan serves to identify conservation priorities to guide public and private conservation actions and investment, such as habitat restoration and protection. It will provide a blueprint for additional voluntary, non-regulatory conservation in Yolo County that addresses conservation needs that are not covered in the Yolo habitat conservation plan (HCP/NCCP, see above and also pp. 91-101)

SOUTH DELTA

Bay Delta Conservation Plan Public Draft

The 2013 BDCP plan considered the potential for floodplain restoration and enhanced riparian corridors along the San Joaquin River which traverses the South Delta region.[13] The evaluation of conservation potential in the BDCP focused on a) increased inundation acreage to benefit listed fish species and b) increased frequency of inundation and residence time to improve production of listed fish species food resources.[x] Overall, potential actions for riparian corridor and seasonal floodplain improvements include levee setback installation, creation of flood bypasses, riparian planting, and channel margin enhancement. The BDCP also includes a number of conservation actions in the North Delta region.

Central Valley Flood Protection Plan and Conservation Strategy & San Joaquin Basin Feasibility Study

The 2017 CVFPP serves as a guide to the state's participation in managing flood risk (see Guide p. 31). Various related basin specific plans are pertinent to this conservation opportunity region and suggest options for reducing flood risk, improving wildlife habitat, and adapting to climate change in Paradise Cut, the San Joaquin River Bypass, and the San Joaquin River Basin. (Appendix 10 of the basin feasibility study includes ecosystem restoration concepts).

San Joaquin County Multi-Species Habitat Conservation and Open Space Plan

Approved in 2001, this HCP was developed to provide guidelines for preserving agriculture and protecting species in the context of open space conservation and conversion to other land uses.[14] The geographic scope includes all lands within the legal Delta that overlap with San Joaquin County, as well as secondary zones to the east and southwest of the Delta. (See also p. 34)

substantially reduce flood risk between I-5 and Stockton. Expanding the floodway at Paradise Cut will also improve sensitive species habitat without changing most agricultural production, because farmland in the expanded floodway would only likely be inundated every 12 years. Goals for the Lower San Joaquin River Bypass project, which encompasses Paradise Cut, include maintaining existing agricultural operations; restoring shaded riparian aquatic habitat along decommissioned levees; providing riparian cover for riparian brush rabbit, riparian woodrat, and valley elderberry longhorn beetle; removing revetment to restore geomorphic process along decommissioned levees; and restoring the southern portion of the current in-channel bar for salmon floodplain rearing habitat. In addition, related plans for new, stronger levees setback from the San Joaquin and Old rivers offer similar, multiple, integrated benefits.



Paradise cut. Photo: Patrick Kelly, http://sfoap.com

RECYCLED WATER USE

Underlying many Delta conservation projects is a concern about impacts on water supply and efficiency. In the North Delta, the South County Ag Program[19] (Sacramento County) represents a new water recycling and reuse project designed to provide a sustainable, drought-proof water supply for agriculture, urban, and environmental purposes. The program is supported by a broad group of local and regional stakeholders and aims to: recharge groundwater supplies and increase groundwater levels up to 30 feet; increase flows in the Cosumnes River in the Highway 99 area during critical fish passage and spawning periods; promote ecosystem restoration and viability of unique habitats and special status species; enhance smart irrigation practices through the use of recycled water; and provide groundwater storage opportunities for regional water supply reliability.

INVASIVES SPECIES MANAGEMENT

The South Delta remains ground zero for the greater Delta in terms of the extent of invasions from floating and submerged aquatic invasive plant species. Poor circulation exacerbates this problem. The North Delta also suffers from impacts from invasives. Agricultural welfare and efficiencies in both areas can be impacted by plants clogging irrigation intakes, invading levee banks and waterways, and preventing access and navigation. The *Delta Conservation Framework* recommends that planning for any conservation project, channel margin improvement, floodway expansion, setback levee or riparian habitat development should include an aggressive and adaptive invasive species management component.

CLIMATE CHANGE AND ADAPTATION OPPORTUNITIES FOR LONG-TERM SUSTAINABILITY

In general, the Delta region is expected to experience more intense winter flooding and storm effects due to climate change, causing greater erosion of riparian areas.[20,21,22,23] In the North and South, as in other Delta regions, more intense winter storms with increased winter river flows will likely significantly increase the hydraulic pressure on levees which could lead to flooding.[24] Climate change induced sea level rise could also affect tidal dynamics and exacerbate exisiting salt water intrusion into the Delta.

Additionally ongoing subsidence in these areas releases greenhouse gases and increases potential flood risk. Conservation planning should identify tools to stop or reverse subsidence, through alternative cropping focusing on alfalfa and rice which both build bulky organic matter (adding elevation) and provide benefits to waterfowl, cranes and Swainson's hawks.

Scenario planning[25] is a critical tool that conservation planners can use to help anticipate impacts of climate change on ecosystems, species, infrastructure, agricultural practices, recreation, and inform other land uses and integrate these into the long-term planning picture.[26] A scenario planning approach integrated within a structured decision making process[27] could also incorporate long-term adaptive management and funding planning to anticipate the evolution of near-term conservation actions into the future. See Guide to Planning Tools p.184 for more details.

Looking Ahead

In regions with limited public lands, conservation efforts must continue to focus on multi-benefit land and flood management driven by local support. The *Delta Conservation Framework* supports the expansion of all such efforts. Opportunities to implement conservation in collaboration with private landowners, and areas where conservation is not compatible with local land uses, should be clearly identified as a first step in regional planning.

A partnership process could be a valuable asset in moving integrated planning forward in both the North and South Delta. In the North Delta, any new partnership should be inclusive of very diverse interests, ranging from residents, businesses, and agricultural practitioners to local, state, and federal agencies. Other valuable partners could be non-governmental organizations with a track record of expertise in the North Delta, as well as local reclamation districts, agricultural commissioners, the local farm bureau, and the North Delta Water Agency.

In the South Delta, while there is no current regional partnership focused on conservation, there are a lot of existing partnerships focused on flood management. Efforts could be made to build on the multi-benefit aspects of flood management and riparian habitat improvement here, with important potential partners for continued planning including: the San Joaquin Area Flood Control Agency, the Southern Delta Levee Protection and Channel Maintenance Authority, San Joaquin County, the San Joaquin County Council of Governments, the San Joaquin Farm Bureau, the San Joaquin Valley Resource Conservation District, the River Islands Development, LLC, American Rivers, and the Natural Resources Defense Council. The Resource Conservation District is emerging as a local champion for planning with available funding. The South Delta Water Agency and Reclamation Districts 17 and 2062 are the primary leaders and entities that could engage landowners in the South Delta during planning and implementation of the bypass project. The bypass project would also benefit from an established permitting liaison to resolve permitting issues as they arise, and to potentially develop a Memorandum of Understanding between participating entities.

QUICK LINKS

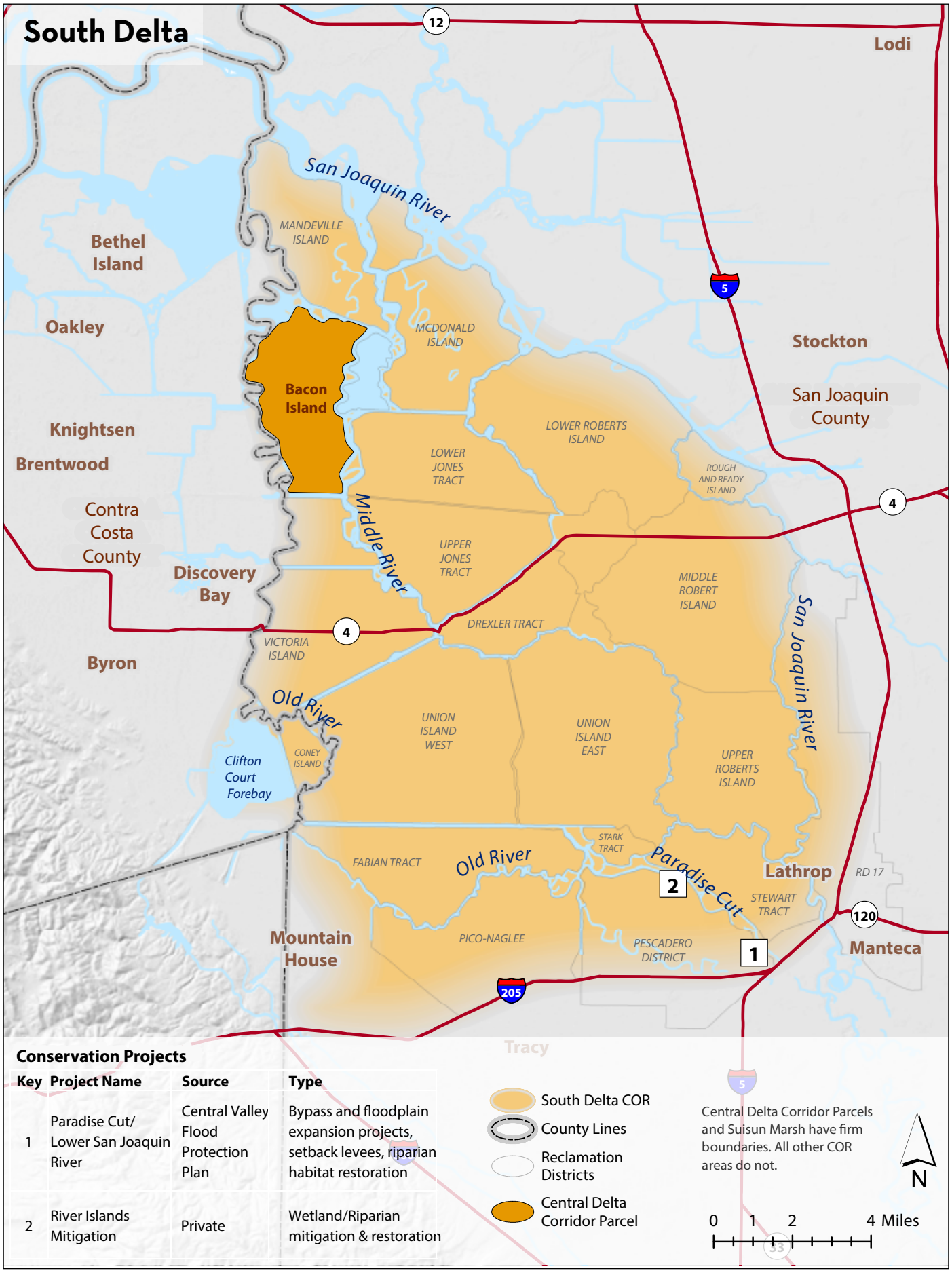
Central Valley Flood Protection Plan
www.water.ca.gov/cvfmp/docs/CVFPP-2017-CVFPP-Update-Draft.pdf.

Southport Setback Levee Project
http://resources.ca.gov/ecorestore/2017/05/southport-setback-levee-project-breaks-ground-in-west-sacramento/

Stone Lakes National Wildlife Refuge
www.fws.gov/refuge/stone_lakes/.

For expanded, more detailed descriptions of these conservation opportunity regions, see Appendix X.

For more detailed descriptions of these conservation opportunity regions, see Appendix 2.



Map: CDFW, 2018

Guide to Planning Tools

Open Standards

The Open Standards for the Practice of Conservation (Open Standards) provide a well-established conceptual framework and tool set for conservation project planning, implementation, and monitoring. The California Department of Fish and Wildlife employed this practice in developing the 2015 *California Wildlife Action Plan*.

The five main Open Standards process steps are: 1) conceptualize the project; 2) develop a formal action plan; 3) implement actions; 4) analyze, use, and adapt; and 5) capture and share learning. These steps align closely with adaptive management frameworks. The Open Standards also offer a software tool called Miradi for use throughout the planning process. The tool allows users to create conceptual models; analyze factors in light of their impact on the conservation targets (e.g., specific ecosystem types, species, human-oriented benefits) and desired outcomes; and create implementation, management, and monitoring plans and project budgets.

The Open Standards' concepts are applicable at any stage in the conservation process, and they allow planning teams to specifically consider the benefits of conservation to human communities and integrate socioeconomic aspects. Additional planning tools include an in-depth, rational analysis of actions to implement individual strategies called Results Chains. Use of Results Chains allows planning partners to evaluate whether actions are linked, focused, feasible, and appropriate for reaching the targeted goal.

The Open Standards also facilitate long-term planning in the context of climate change by encouraging planners to 1) understand and respond to existing and future impacts of climate change, alongside other conventional threats or pressures; and 2) develop and implement actions that do not erode options for responding to future climate change impacts.



Low pressure grade vehicles move dirt to increase elevations and recreate marsh plain on a Delta wetland restoration project benefitting wildlife. Photo courtesy: CDFW

The Open Standards represent the state-of-the-art in the conservation community's knowledge of the process for designing, managing, and monitoring conservation activities. Use of the practice can support the development of regional conservation strategies in the Delta by providing a consistent structure for conservation planning. Open Standards can be used in concert with scenario planning and structured decision-making, and decision support models such as Marxan. The Bay Area Conservation Lands Network successfully uses Marxan for prioritization of Bay Area conservation lands.

The Open Standards help conservation partnerships learn what works, what does not work, and why. Ultimately, this process allows conservation partnerships to adapt, improve their future efforts, and link to other efforts that use the same approach to planning.

See Quick Links p. 188 for access to these tools.

The Open Standards involves five main process steps:

1. Conceptualize Project

The first steps to conceptualize a program or project involve defining the vision and geographic, temporary, and sociopolitical scope; selection of the planning and implementation team and their roles and responsibilities; identification of conservation target (species, habitat, or ecosystem biodiversity) and human wellbeing aims (aims are focus items, such as reestablishing fluvial processes along streams, integrating recreation and other human benefits into conservation outcomes, or incorporating agricultural sustainability into Delta landscape-scale conservation); description of the current status of these aims; identification of direct threats, pressures, or contributing factors with regard to key ecological, biophysical, or human wellbeing attributes; and performing a situation analysis. This involves creating a conceptual model of how all key factors—including threats, enabling conditions, and potential opportunities—affect the aims. A built-in technique for evaluating and ranking factors helps to identify critical threats/pressures for which priority goals and strategies can then be determined.

2. Develop a Formal Action Plan

With a conceptual understanding of the underlying assumptions of how pressures and contributing factors influence the aims, the next process step is to develop goals for each aim and identify key factors and strategies to reach the identified goals. Linking the strategies to the desired goals and ultimate outcomes allows the determination of key intervention points and related actionable objectives that may involve intermediate outcomes on the path to reaching a desired goal. Performing this in-depth, rational analysis of individual strategies allows the evaluation of whether they are linked, focused, feasible, and appropriate for reaching the targeted goal. By following "if, then" logic steps along a "results chain," this evaluation will ultimately result in prioritization of strategies and related actions.

3. Implement Actions and Monitoring

With the set of priority strategies in mind, the next step is to develop short- and long-term work plans and timelines for implementing and monitoring actions. This can then support the solicitation of necessary implementation funds. In addition to, or as part of, the work plan, it is critical to develop a monitoring plan with identified indicators, performance measures and metrics to evaluate the progress toward goals, or the status and trends of aims. Incorporating targeted, goal-oriented assessment in the project budget increases the likelihood of funding support for the adaptive management and monitoring aspect of the program or project.

4. Analyze, Use, Adapt

Once actions and monitoring have been implemented, a system for handling the project data has to be made available to support data analysis. In this respect, shared, easy access data management portals have been shown to be successful tools. Project results and assumptions, and operational and financial data, are then analyzed at set intervals over time, followed by documented discussions and decisions that may or may not lead to the revision of project plans at given points in time.

5. Capture and Share Learning

Key results and lessons are documented throughout program or project implementation to serve as the foundation for sharing insights and knowledge gained throughout. Depending on identified key audiences, communication strategies can be developed and executed. It is important to create a learning environment where regular feedback can be shared formally or informally, regular evaluations that demonstrate a commitment to learning are carried out, and a safe environment for experimentation is provided, allowing sharing of successes and failures with other teams.



Measuring salmon carcasses as they complete their life cycle after habitat restoration work in Putah Creek, one example of checking on conservation outcomes. Photo: Robin Meadows

Guide to Planning Tools - continued

Scenario Planning

Scenario planning is a strategic way to plan. It helps to achieve desired outcomes over the long term by evaluating the consequences of alternative pathways to achieve a defined goal. Also called scenario thinking, or scenario analysis, it is a structured way for agencies, organizations, or partnerships to think about how a variety of strategies and actions will likely affect the future by developing and evaluating a small number of scenarios. Scenarios are essentially stories of how the future might unfold and how this might affect the issues at hand over the short and long term.

To develop and evaluate a suite of representative scenarios to reach a goal, potential prejudgments and preconceived notions influencing the decision-making process need to be brought to light and acknowledged by the partnership. In the first step of scenario planning, participants are asked to recognize and let go of prior misunderstandings to identify known facts (see Figure 6.3 – Step 1 – Rules of the game). This helps uncover what can and cannot be controlled.

In the second step, recognizing what participants cannot control will help them to identify factors that can be influenced by the actions proposed to reach desired outcomes. In addition, identifying the main drivers and related key uncertainties (Figure 6.3 – Step 2) helps to uncover the potential for affecting them. As participants clarify misunderstandings, prejudgments, and key uncertainties, and begin to understand likely difficulties and divergent viewpoints, they will build trust (see Table 6.1 for Delta examples).

The three to five scenarios developed in Step 2 are to be presented as sequential stories. Each scenario then serves to "visualize" the possible steps toward achieving a goal and potential pitfalls to reaching them relative to the existing uncertainties. These

Table 6.1: Examples of prejudices and key uncertainties affecting successful conservation implementation in the Delta.

Misunderstandings – Prejudgments – Key Uncertainties	Controllable?	Potential Approach/Solution
Delta conservation is independent from other land uses	yes	Good neighbor practices
People do not benefit from Delta conservation	yes	Multi-benefit conservation
Conservation area managers are bad neighbors	yes	Good neighbor practices
Delta conservation is incompatible with agriculture	yes	Wildlife-friendly agriculture
People's needs don't matter to conservation decision makers	yes	Multi-benefit conservation
Conservation areas do not offer opportunities for recreation	yes	Multi-benefit conservation
Impacts of conservation (e.g., tidal wetland flooding) will negatively affect other land uses, especially agriculture (e.g., levee seepage affecting prime agricultural soils)	yes	Multi-benefit conservation
Status quo of subsidence is not a problem and does not have to be addressed through change in agricultural practices	yes	Education and outreach on carbon farming to reverse subsidence
Conservation areas invite threatened and endangered species that could spread into neighboring lands.	yes	Employ Safe Harbor Agreements/ Neighboring Landowner agreements.
Climate change effects will change the Delta ecosystems	somewhat	Maintaining or increasing ecosystem and infrastructure resilience through restoring ecosystem function and establishing transition zones
Will Delta stakeholders be able to move Delta conservation forward in collaboration?	yes	Outreach and inclusive planning partnerships



Photo: Rick Lewis

See Quick Links p. 188 for access to these tools.

scenarios can then be individually evaluated and ranked. Evaluation of their strengths, weaknesses, opportunities, and threats—scenario by scenario—allows identification of the most promising options for moving forward (Figure 6.3 – Step 3). Once the most promising options rise to the top, the partnership can develop SMART objectives (specific, measurable, attainable, result-oriented, and time-bound), followed by implementation of related actions (Figure 6.3 – Step 4).

Scenario planning in conservation is a vital tool that enables planners to consider landscape-scale and long-term dynamics. For example, it could be used to help anticipate impacts of short- and long-term changes (e.g., land use or climate change, respectively) on ecosystems, species, infrastructure, water management, agricultural practices, and recreation, and then to evaluate them together as part of the long-term conservation-planning picture.[19] A scenario planning approach could be integrated within structured decision making (see page 188). It could also incorporate long-term adaptive management planning, and consideration of funding needs when anticipating how near-term conservation actions may evolve into the future. Scenario planning can also integrate open standards (see page 184) into the "conceptualize-project" step to evaluate several possible options for reaching the desired outcomes within varied timelines.

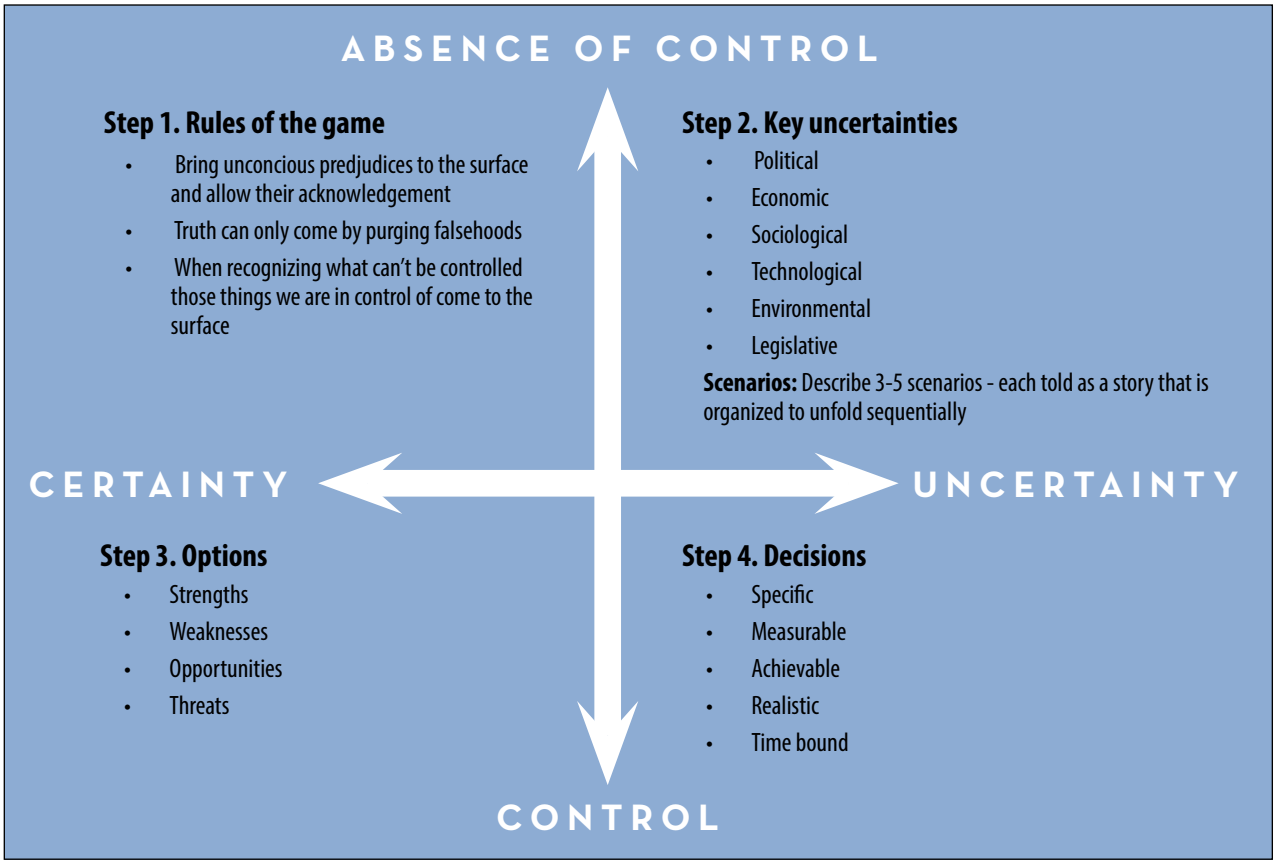


Figure 6.3. *Key considerations in the scenario planning process with levels of certainty and control. Source: Brefi Group Limited, www.brefigroup.co.uk*

Guide to Planning Tools - continued

Structured Decision-Making

Resource management and conservation investment decisions involve complexity and uncertainty. Regional conservation partnerships will therefore have to deliberate on a wide range of factors with complex links between ecosystem function, existing land uses, and local communities. These factors include 1) multiple objectives and stakeholder perspectives; 2) overlapping jurisdictions of local, state, and federal agencies; 3) short- and long-term effects of land use and climate change on regional sustainability and ecosystem function; 4) cumulative effects of all factors combined over time and space; and 5) high levels of uncertainty. All these necessary considerations create an intricate web of potentially competing or confounding factors when planning conservation. As a result, the decisions made by a regional partnership must consider a combination of subjective judgments made by experts about the potential consequences of proposed alternatives, as well as difficult, value-based judgments about priorities, preferences, and risk tolerance. In the case of the Delta, these decisions are associated with high-stakes economic, environmental, social, and political implications; and technical, public, and political interests will closely scrutinize them. Arriving at the best decision is even more difficult because stakeholders participating in a regional conservation partnership are usually working with limited resources. For example, government agencies are increasingly required to do more with less, on short timelines, and with rising expectations for quality, consistency, and transparent decision-making.

Structured decision-making is a process based in decision theory and risk analysis. It offers an organized and transparent approach to identifying and evaluating alternatives that integrates science and policy explicitly; and it focuses on engaging stakeholders, experts, and decision-makers in productive decision-oriented analysis and dialogue. The dialogue established by this approach allows participants to deal proactively with complex problems and judgments by following a decision-focused roadmap for integrating activities related to planning, analysis, and consultation (see Figure 6.4).

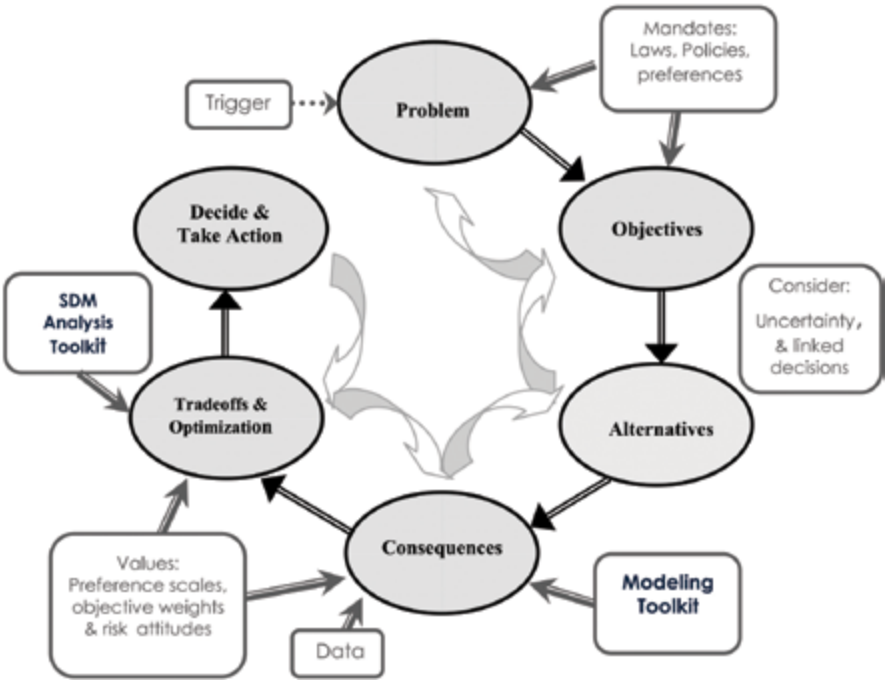


Figure 6.4. *Structured Decision-Making Steps*

Structured decision-making incorporates a simple set of concepts and helpful steps for problem solving focused on achieving fundamental goals/objectives. Within this approach, every decision consists of several primary elements: management goals/objectives, decision options (alternatives), and predictions of decision outcomes (Consequences). As a result, making decisions based on clearly articulated fundamental goals/objectives includes crucial concepts in structured decision making such as dealing explicitly with uncertainty and responding transparently to legal mandates and public preferences or values in decision-making. Structured decision-making is often incorporated in adaptive management.[20]

Scenario planning results directly contribute to the "alternatives" and "consequences" steps of the structured decision-making cycle. Individual planners and land managers, or regional conservation partnerships, can use these and other tools to plan a strategic, coordinated approach to conservation. Prioritizing conservation actions based on the likelihood of long-term effectiveness in achieving objectives highlights the potential for outcomes to evolve over time, and the short- and long-term cost effectiveness of projects. By regularly re-evaluating factors, scenarios, strategies, and decisions over time, conservation partners will better understand how early projections played out and how to adjust management actions of conservation lands over time.

QUICK LINKS

Open Standards Practice for Conservation (Miradi software)
www.miradi.org/open-standards/

Scenario planning
http://sloanreview.mit.edu/article/scenario-planning-a-tool-for-strategic-thinking/

Scenario planning for climate change adaptation
http://scc.ca.gov/climate-change/climate-change-projects/#slr-adaptation

Structured Decision Making
www.fws.gov/science/doc/structured_decision_making_factsheet.pdf

CODA

Delta Conservation Framework Guiding Principles







Developed by Stakeholders in 2016 Workshops

Guiding Principles for the Framework

1. PEOPLE AND PLACE: Recognize the Delta as an evolving place with unique agricultural, cultural, recreational, and natural resource values. Section II outlines related goals and strategies to this guiding principle, and section V offers information on permitting and potential funding.

   a. Seek integrated, collaborative conservation and land management solutions while being sensitive to specific local, cultural, and environmental circumstances.

   b. Consider geographic setting and context in order to select the appropriate conservation strategies within individual regions and their social and biological legacies.

   c. Use available public lands suitable for achieving conservation objectives, as well as available incentives for willing private landowners to preserve land.

   d. Implement good neighbor policies and other stewardship practices (particularly as outlined in ALS Strategies 3, 7, 9, 12, 13, 14, 15, 16, 17, 18, 19, and 23 by the Agricultural Lands Stewardship Workgroup).

   e. Integrate ecological, social, and economic resilience into Delta conservation goals.

   f. Consider conservation values of agricultural and urban lands, where appropriate.

   g. Promote agricultural and socioeconomic research in the Delta to continue to inform conservation planning and implementation.

   h. Coordinate conservation policy, planning, and implementation among agencies and stakeholders.

2. BUILD COMMUNITY AND FOSTER PUBLIC EDUCATION AND OUTREACH: Support outreach, education, and communication across interests, where participants are encouraged to hear all perspectives, interact with respect and humility, and shift focus away from strict traditional roles toward a better understanding of the big picture to promote multi-benefit solutions. Section II outlines related strategies to this guiding principle, and section V offers information on potential funding.

   a. Foster communication and education that focuses on the role each individual can play to improve the Delta.

   b. Conduct regular public outreach and engagement with Delta stakeholders to plan, implement, and evaluate Delta conservation efforts.

   c. Promote early and consistent coordination among resource agencies, practitioners, local residents, land- and business owners, and other stakeholders to develop regional conservation strategies, related funding support, and general regional permitting frameworks.

   d. Expand planning efforts to include multiple sectors and stakeholders and ensure broad consensus.

   e. Seek a better understanding of each other's needs and interests, such as ensuring economic vitality and investing in local interests while finding solutions to benefit wildlife.

   f. Support Delta outreach and education campaigns that teach the importance, status, and value of the Delta at local, state, and national levels, with a strong focus on younger generations.

continued



Pintails in Susiun Marsh. Photo: Cliff Feldheim

Guiding Principles for the Framework - continued

3. MULTIPLE BENEFITS: Integrate conservation with other land use practices, where possible, to provide simultaneous benefits for wildlife and people at a landscape scale over the long term. Section II outlines related goals and strategies to this guiding principle, and section V offers information on permitting and potential funding.

   a. Foster more natural hydrologic processes and use conservation to sequester carbon and reverse subsidence (sinking land) to benefit people and the Delta ecosystem.

   b. Evaluate the current geographic distribution of natural and agricultural ecosystems across the Delta landscapes in developing regional conservation strategies. Consider how the strategy fits into the broader landscape level mosaic of land uses of the Delta (e.g. sandhill crane foraging and roosting sites in close proximity within the natural-agricultural interface).

   c. Reduce the abundance and occurrence of noxious invasive species, where possible, to benefit ecological communities, enhance recreation, and benefit agriculture.

   d. Coordinate flood projects with restoration projects through a landscape-level floodplain restoration planning approach to achieve multiple benefits

4. PROCESS-BASED ECOSYSTEM CONSERVATION: Focus conservation practices on reestablishing natural ecological processes and promoting the functions and adaptive capacity of Delta ecosystems, rather than restoring the Delta to pre-Gold Rush Era conditions. Section III outlines related goals and strategies to this guiding principle, and section V offers information on permitting and potential funding.

   a. Protect, enhance, or restore critical ecosystem processes with a focus on complexity and diversity, to promote resilience and adaptability.

   b. Create functional redundancy by replicating landscape elements across space and by increasing linkages among landscape elements to support wildlife movement.

   c. Provide ecosystem and wildlife connectivity across the landscape and through time.

   d. Design and coordinate conservation projects and regional conservation strategies as part of a larger mosaic at the landscape scale, with consideration of the position, future trajectories, and existing and historical biological conditions of projects.

   e. Where feasible, conserve large areas, with a long time period in mind.

   f. Promote biodiversity in human-dominated landscapes according to the principles of reconciliation ecology and a focus on tying conservation efforts to benefits of wildlife-friendly agricultural lands and urban areas as part of the larger landscape mosaic.

5. PROMOTE ECOSYSTEM SERVICES: Highlight the societal values of the many services healthy ecosystems provide to humans by emphasizing these services as benefits to society. Delta ecosystem services include open space, opportunities for outdoor recreation and tourism, pollination services, flood protection, clean water, clean air, biodiversity, and others. Sections II and III outline related goals and strategies to this guiding principle, and section V offers information on permitting and potential funding

   a. Evaluate and communicate the societal values of ecosystems to humans in the context of conservation.

   b. Educate the public about how healthy ecosystems benefit them through the many services they provide.

continued

Guiding Principles for the Framework - continued

6. DECISIONS GROUNDED IN SCIENCE: In light of continuing ecosystem stressors and accelerating changes from climate shifts and other drivers, as well as changeable socioeconomic conditions, utilize scientific approaches to inform and evaluate conservation practices and projects and conservation-related human needs. Section IV outlines related goals and strategies to this guiding principle.

   a. Conduct research and adaptive management, including modeling, ecological monitoring, and evaluation at project-specific and regional scales to continually improve the scientific basis of planning and management decisions and measuring the achievement of goals over time.

   b. Understand long-term agricultural and other socioeconomic trends and goals, and evaluate those in light of impending changes from sea level rise, conservation goals, and other uses.

   c. Weigh long-term gains against potential short-term impacts, ecologically, socially, and economically.

   d. Recognize a larger landscape-scale, long-term framework, where small pieces are implemented in stages to increase cost-effectiveness, and give opportunities for checks and improvements along the way.

   e. Utilize conservation planning tools and processes based in social sciences, such as the Open Standards for the Practice of Conservation and Structured Decision Making.

7. INCREASED EFFICIENCY: Utilize processes that minimize project costs, and provide consistent and integrated tools to support decision-making, evaluation of success, environmental compliance, and permitting; build on past planning documents and existing efforts. Sections IV and V outline related goals and strategies to this guiding principle.

   a. Use standard approaches for achieving goals and implementing multi-benefit objectives aimed at maintaining, enhancing, or restoring system-wide aquatic, fluvial, transitional, and terrestrial ecosystem functions, while benefiting people.

   b. Utilize opportunities for infrastructure upgrades, such as setback levees or fish screens, to achieve ecological benefits, where possible.

   c. Find mechanisms to improve the efficiency of environmental compliance and permitting requirements by working directly with regulatory agencies.

8. ACKNOWLEDGEMENT OF LONG-TERM FUNDING NEEDS: Recognition that long-term funding is necessary for successful Delta conservation and management through 2050 (see Section V for more details on funding; Section VI for more information on implementation).

   a. Explore opportunities for stable long-term funding sources to develop and implement conservation projects in the Delta.

   b. Utilize endowments for long-term operations and management of conservation lands, when possible.

   c. Through legislation, appropriation, or ballot initiatives, secure state funding for long-term operations and management of publically owned wildlife areas and ecological reserves and federal funding for long-term management of national wildlife refuges and other federally-owned lands.

   d. Promote programs that provide incentives for wildlife-friendly farming practices and landowners who achieve conservation objectives on their lands, such as Habitat Exchanges (see Section II for more information).



Endangered kit foxes. Photo: CDFW

Acknowledgements

The California Department of Fish and Wildlife acknowledges and appreciates the support of the Sacramento-San Joaquin Delta Conservancy beginning with the 2016 public workshops. The Delta Conservancy facilitated communication with Delta stakeholders through the use of it's conference room, the Delta Restoration Network contact list, funding for professional facilitation services, and engagement in each of the public workshops.

The Department of Fish and Wildlife would also like to thank all 2016-18 workshop participants and 2017 reviewers of the Delta Conservation Framework public draft.

Editors Note: The Delta Conservation Framework is a living document, written by several authors, assembled from myriad sources using many different languages (legal, policy, scientific, bureaucratic etc), and gathering input from stakeholder workshops, and public reviews over a long period of time. Stylistically, norms relating to consistency in the use of grammar, capitalization, or acronyms may have been stretched to make it more readable from many starting points.





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VISION



DELTA PROTECTION COMMISSION
STRATEGIC PLAN
2030



Water is

TABLE OF CONTENTS

1 Message From The Commission Chair

2 Introduction
Land Use and Resource Management Plan
Economic Sustainability Plan

6 Vision Statement

7 Mission Statement

8 Challenges, Principles, Themes And Goals

9 Strategic Themes
Water
Agriculture
Levees & Emergency Response
Regional Economy
Delta Heritage
Recreation and Tourism
Education and Outreach

16 Capacity Building
Commission Leadership and Development
Funding

20 Glossary: Definitions Of Common Acronyms

21 Appendices
Roster of Commissioners and Staff
History of the Delta Protection Commission
Sister Agency Diagram

Photography courtesy of California State Lands Commission

the Lifeblood of the Delta

MESSAGE FROM THE COMMISSION CHAIR

On behalf of the Commission, I am honored to present Vision 2030, the Delta Protection Commission's 2015 Strategic Plan. Since 1993, the Commission has served as the voice of the Sacramento-San Joaquin Delta, the largest estuary in the western United States and home to more than 500,000 Californians. Our constituents include generations of farmers, business owners, recreation providers, artists and others from every walk of life, living in an evolving place with a unique historical legacy and a working landscape that is also home to 750 distinct species of plants and animals, some found nowhere else on Earth.

The Commission is committed to the protection and health of the Delta, and Vision 2030 is presented in the midst of many challenges. Statewide fresh water needs threaten the Delta's natural equilibrium and an historic drought strains our habitat and our agricultural, recreational and business assets. This stress can only be expected to increase as the state's population expands over the next fifteen years.

In light of these threats, Vision 2030 offers an opportunity to build relationships and forge policies that will make our vision for a healthy Delta a reality. Vision 2030 defines an approach to embrace "Delta as Place" values and promote California water solutions that ensure water supply reliability to interests both within and outside the Delta, while simultaneously delineating the Commission's regional land use authority, a critical tool for safeguarding the region's richly bucolic setting. The plan also includes initiatives to ensure the Commission's ability to perform at the highest level, now and into the future.

The Commission thanks the Delta Protection Advisory Committee, members of the public and the Commission staff that contributed to every facet of Vision 2030. The commitment of the Delta community to its region is unmatched, and the Commission is grateful for this level of community support. I invite each and every Californian to read Vision 2030 and join us in implementing its objectives. Working together, we can promote and achieve an environment and economy focused on agriculture, recreation and natural resources, while remaining mindful of the importance of the Delta to all Californians.

Mary Nejedly Piepho
Commission Chair

Adopted by the Delta Protection Commission on May 21, 2015

INTRODUCTION

The Sacramento-San Joaquin Delta is the Heart of California on many levels – geographically, historically, and even physically as the central distribution point for California's lifeblood: water. The region enjoys a lovely, moderate climate and a prime location – only a brief drive from every major population center in Northern California, and bounded by highways to world-famous Lake Tahoe and Yosemite. It's an oasis of rural beauty surrounded by high density urban populations, dotted with small towns that tell the stories of the opening of the West – the Gold Rush, immigration, riverboat travel.

The Delta's incredibly productive soil has helped feed Americans for generations, and now the growing Farm-to-Fork movement makes Delta growers the ideal local suppliers for over 9.5 million people in the San Francisco Bay Area, Sacramento and Stockton metropolitan regions, and the growing Interstate highway corridors.



The Delta's thousand-plus miles of levees and waterways and vast islands offer recreation options for multiple outdoor enthusiasts: boaters, hunters, fishermen, pedalers, paddlers, bikers, heritage tourists, wine tasters, ecotourists, music buffs, photographers, historians, birdwatchers and more. It's a natural resource paradise, a physical, livable place, reflective of our heritage and rich beyond compare in beauty and wildlife.

It HAS to be safe. It HAS to be viable. It HAS to be protected, and it needs to be shared.

Yet Paradise is in crisis. Delta water exports and other stressors over the decades have coincided with declines in the Delta ecosystem. These negative effects will only get worse as populations grow, demand for fresh water increases and climate change continues.

With freshwater quality deterioration and fish population decline, the economic sustainability of Delta communities – now overwhelmingly supported by agriculture (dependent on water quality) and recreation in the form of boating and fishing (which require clean water and strong fish populations) - is threatened.

The levee system, even more crucial to protect lives, businesses and infrastructure as sea levels rise and soils subside, is under increasing pressure. Invasive species are clogging waterways, impeding commercial shipping and recreation, and a struggling economy means fewer resources are directed toward solving these urgent problems.

Everything in the Delta is interconnected. The environment sustains the economy which supports the people who run the businesses that attract the people who enjoy the environment, and the circle begins again. As the State's population increases, the demand for water grows, and irreplaceable natural resources and fisheries continue to struggle. The choices made in the Delta over the next fifteen years will dramatically affect California and her people.

AUTHORITY

The Delta Protection Commission was established by the Delta Protection Act of 1992 (Act). In passing the Act the Legislature affirmed "it is the policy of the State to recognize, preserve and protect those resources of the Delta for the use and enjoyment of current and future generations." Later amendments to the Act introduced the concept of the "co-equal goals" of both Delta ecosystem protection and "providing a more reliable water supply for California", but insisted that these co-equal goals "be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource and agricultural values of the Delta as an evolving place."

The Delta Protection Commission serves as an important forum for Delta residents to provide recommendations and take actions to benefit the Delta as an evolving place. This includes promoting, facilitating, and administering efforts to improve flood protection, agriculture, habitat, cultural resources and recreation. It also performs an important land use function by adopting a Land Use and Resource Management Plan (LURMP) and ensuring that local government land use decisions are consistent with that plan. In cases where local land use decisions are inconsistent, they are subject to Commission review and may be overturned by Commission action.

Throughout Vision 2030, reference will be made to the LURMP as well as the Economic Sustainability Plan (ESP), which directs and informs the economic sustainability activities of the Delta Protection Commission and others. These are the tools that have protected and served the Delta in the past, and the Commission will continue to rely on them for significant direction in the future, helping the Commission to preserve and enhance the Delta's precious resources for generations to come.

Land Use and Resource Management Plan (LURMP)

The Delta Protection Act requires the Delta Protection Commission to prepare, adopt, review, and maintain a comprehensive long-term resource management plan for land uses within the Primary Zone. The LURMP describes the needs and goals for the Delta, and presents a statement of the policies, standards, and elements of the plan. All local governments are required to submit proposed amendments to their general plans to the Delta Protection Commission, to ensure that local government general plans are consistent with the Commission's plan. The plan applies to land uses, not to water supply or water quality, and generally addresses local government issues and actions, not those of State or federal agencies. Local government actions may be appealed to the Delta Protection Commission for review of consistency with the LURMP.

The LURMP is one of the few examples in California where a State agency has regional oversight over local land use decisions, and is designed to ensure that proposed land use changes in the Delta are protective of the region's abundant agricultural and natural resource values. Over the years this document has been repeatedly invoked to prevent inappropriate development within the Delta.

Economic Sustainability Plan (ESP)

In 2009, amendments to the Delta Protection Act established the following requirements for an Economic Sustainability Plan that includes, but is not limited to:

1. Public safety recommendations, such as flood protection recommendations.
2. The economic goals, policies, and objectives in local general plans and other economic efforts including recommendations on continued socioeconomic sustainability of agriculture and its infrastructure in the Delta.
3. Comments and recommendations to the Department of Water Resources concerning its periodic update of the flood management plan for the Delta.
4. Identification of ways to encourage appropriate recreational investment along the key river corridors.

It is significant that the Legislature directed the Commission to lead development of these policies and recommendations, many of which were adopted into the final Delta Plan. The ESP, adopted by the Commission in 2012, is an extensive peer-reviewed plan that provides for the maintentance and enhancement of the long-term economic viability and prosperity of the Delta. As such, it is the fundamental building block upon which all plans and projects which govern or impact the Delta should be based. The Commission continues to monitor, update and implement ESP recommendations on an ongoing basis for the benefit of the Delta economy.



HISTORY TIMELINE OF THE

PRIOR TO 1992

1959
Water Code Section 12220 establishes the Legal Delta boundaries.

1972
The Delta Advisory Planning Council (DAPC), a regional planning council, is established through legislation to coordinate the activities of local governments, maintain a comprehensive plan, and strengthen participation in state and federal planning.

DELTA PROTECTION ACT

1992
The Delta Protection Act establishes the Delta Protection Commission (Commission) to develop a comprehensive land management plan for the Primary Zone of the Delta. The Commission replaces the DAPC.

1995
The Commission adopts the Land Use and Resource Management Plan.

1996
The Legislature extends the Commission's original sunset date from January 1, 1997 to January 1, 1999.

1998
The Legislature extends the Commission's sunset until January 1, 2010, in order to provide continued oversight of land use changes in the Primary Zone, due to continued urbanization pressures in the Secondary Zone.

THE EARLY 2000S

2001
The Nature Conservancy acquires 9,200 acre Staten Island to permanently protect wildlife – friendly agriculture. The Commission advocates for the importance of developing a long-term strategy to protect agriculture on Staten Island.

2002
The U.S. Department of Food and Agriculture designates the Legal Delta as a State Conservation Priority Area for the Federal Conservation Reserve Enhancement Program, making funding opportunities available for enhancing habitat and water quality as part of agriculture on private lands.

2002
The Commission participates in the Delta Dredge Reuse Strategy and Technical Advisory Panel to develop a strategy for reused materials, for incorporation into the CALFED program.

2003/04
The Legislative Analysts' Office recommends elimination of the Delta Protection Commission. After a year of public hearings, the Legislature recognizes the Commission's continued role in the region and maintains its jurisdiction and authority unchanged.

2005
In the aftermath of Hurricane Katrina, there is heightened attention to flood protection and water conveyance at the local, State and federal levels for the Delta region.

Assemblywoman Lois Wolk's Assembly Bill 797 passes, affirming the importance of the Commission's role, strengthening its membership, increasing its appeal authority, and adding tools to facilitate long-term agricultural land conservation.

2006

Senator Tom Torlakson's Senate Bill 1556 passes, establishing the Great California Delta Trail.

2006

The Commission initiates an Abandoned Vessel Discussion Group.

2006

The Commission introduces the concept of establishing a National Heritage Area in the Delta.

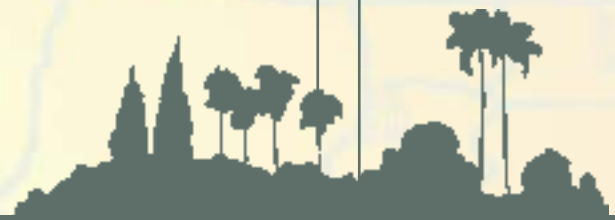
2008

Clarksburg Sugar Mill Development Appeal – Clarksburg land use decision demonstrates the Commission's role in interpreting the Land Use and Resource Management Plan and performing its appellate authority.

2007

The Commission adopts a Strategic Plan and articulates the role of the Delta Protection Commission as the "voice for those who live, work and play in the Delta."

2007



THE 2006-2011 STRATEGIC PLAN

The Legislature passes the Delta Reform Act, which reaffirms and modifies the Commission's role, establishes the Delta Stewardship Council and creates the Sacramento-San Joaquin Delta Conservancy.

2009

Pursuant to the Delta Reform Act, the Commission holds a seat on the seven-member Delta Stewardship Council and as sits as Liaison Advisor on the Board of the Delta Conservancy; initiates the Economic Sustainability Plan; and pursues a proposal to "protect the unique values of the Delta as an evolving place".

2010

DPC adopts the Great California Delta Trail Blueprint Report for Contra Costa and Solano Counties.

2010

The Commission adopts the Economic Sustainability Plan (ESP), which is largely incorporated into the Delta Stewardship Council's Delta Plan.

2012

The National Parks Service and Commission recommend National Heritage Area status to Congress to protect the unique values of the Delta.

2012

DELTA REFORM ACT

The Commission celebrates 20 years of protecting the Delta.

2013

Partnering with the Delta Conservancy, the Commission initiates a Delta Awareness Campaign to educate Californians on the value of the Delta.

2013

The Commission initiates the Eastern Region Delta Trail Blueprint Report for Sacramento, San Joaquin and Yolo Counties.

2013

The Commission completes the Evapotranspiration Study to identify new tools for more efficient reporting of beneficial uses of agricultural water and Delta agricultural water user efficiency requirements.

2013

The Commission declares "Delta Flood Preparedness Week," an awareness campaign providing residents with flood preparedness tools and resources, and hosts a Delta Flood Safety Fair for residents and businesses.

2014

DELTA PROTECTION COMMISSION



VISION STATEMENT

Valuing the needs of the Delta as well as the needs of the State is fundamental to achieving the Delta Protection Commission's vision: the ideal synthesis of cultural, ecological and agricultural values in a sustainable, healthy, and celebrated way of life.

By 2030, the Delta will be recognized and enjoyed as a prime leisure destination, agriculture and its support services will thrive, and unique "Delta as Place" values will be embraced Statewide, nationally and worldwide.

By 2030, the Commission will represent Delta interests in development of a water solution for California that ensures water supply reliability to both Delta and outside-of-Delta interests.

The Commission will continue to work to expand and enrich the Delta economy. Protection and enhancement of commercial agriculture in the Delta is essential to the economic sustainability of the Delta as a globally-important source of food production.

The Commission will advocate for the safety and prosperity of the Delta by supporting necessary maintenance and improvements for Delta levees and roads, effective emergency response planning, and flood preparedness throughout Delta communities.

The Commission will secure funding for the Delta Investment Fund, advance investments in Delta communities, and obtain grants, develop partnerships and gain policy support for Commission objectives.

The Commission, through its strong relationships with Delta stakeholders and other agencies, is in a powerful position to promote, educate and advocate for Delta interests. Commission members will continue to deliver balanced, effective and trusted leadership of Delta interests to supporters and opponents alike, aided by dedicated, professional Commission staff.











MISSION STATEMENT

"Committed to the Protection and Health of the Delta"

We protect, maintain, enhance and enrich the
overall quality of the Delta environment and economy.
We do this with a focus on agriculture, recreation and natural resources,
while remaining mindful of the importance of the Delta to all Californians.

"The Legislature...finds and declares that the basic goals of the state for the Delta are the following:

(a) Achieve the two coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

(b) Protect, maintain, and, where possible, enhance and restore the overall quality of the Delta environment, including, but not limited to, agriculture, wildlife habitat, and recreational activities.

(c) Ensure orderly, balanced conservation and development of Delta land resources.

(d) Improve flood protection by structural and nonstructural means to ensure an increased level of public health and safety."

Delta Protection Act of 1992, updated 2009 (Public Resources Code 29702).



CHALLENGES, PRINCIPLES, THEMES AND GOALS

Throughout the modern history of the Delta, its residents have faced recurring Challenges:

- Managing too much water, or not enough of the right quality water
- Meeting the needs of some without ignoring the needs of others
- Keeping people and property safe
- Sustaining long-term economic and environmental vitality
- Developing and maintaining community infrastructure for essential services
- Competing with Statewide interests on crucial Delta issues

For more than 20 years, the Delta Protection Commission has been the Voice of the Delta and a catalyst for identifying and implementing solutions for these challenges and others. The Commission has adapted to emerging issues with its focus always on protecting the unique values of the Delta.





The Commission's Guiding Principles articulate the values and criteria to be used in developing objectives and actions:

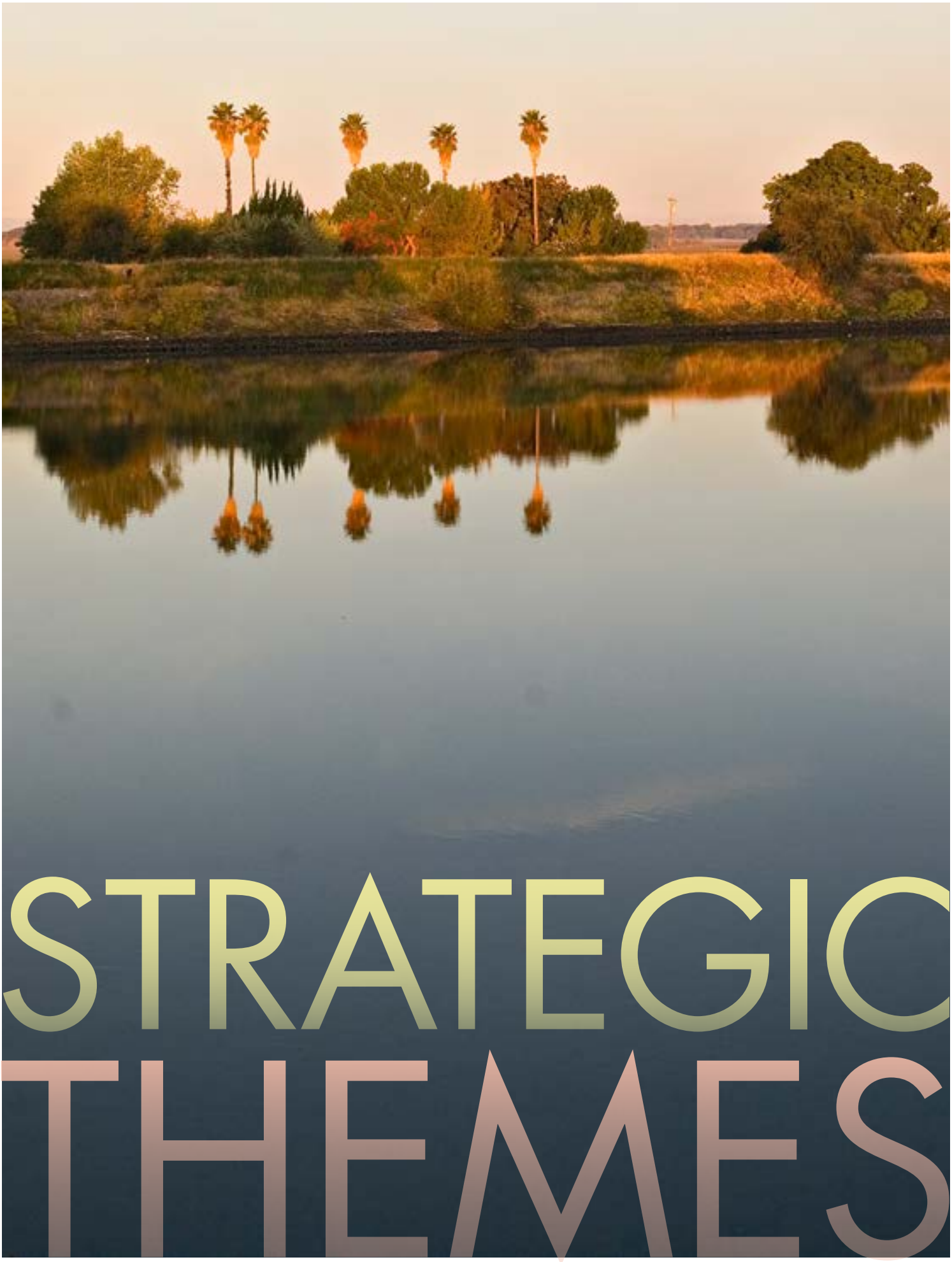
- Protect – The land, its people and its ecosystems
- Restore – Natural resources, economic health and wildlife populations
- Enhance – Economic drivers, historic and cultural treasures, and appreciation
- Provide - A voice for residents in decisions affecting their region
- Facilitate - Partnerships among stakeholders, agencies and beneficiaries

The Strategic Themes for Vision 2030 represent the Commission's portfolio of responsibilities and are supported by legislative mandates of the Delta Protection Act of 1992 and Delta Reform Act of 2009, as well as the recommendations and directives of the Commission's Land Use and Resource Management Plan, Economic Sustainability Plan, and the Delta Stewardship Council's Delta Plan. The Strategic Themes are:

- Water
- Agriculture
- Levees and Emergency Response
- Regional Economy
- Delta Heritage
- Recreation and Tourism
- Education and Outreach

The overarching Goals represent the aim of the Delta Protection Commission to fulfill its Mission by:

- Sustaining and enhancing existing economic drivers
- Fostering new opportunities for economic development
- Protecting and promoting cultural treasures
- Creating cooperative relationships
- Proactively addressing funding



STRATEGIC THEMES



WATER

Water is the lifeblood of the Delta. The Delta Protection Commission seeks a reliable fresh water supply for the Delta while remaining mindful of California's need for water. The Commission insists that a viable California water solution must respect and protect the Delta's unique values.

OBJECTIVES:

W.1 Promote Statewide water solutions that **reduce reliance on Delta fresh water** supplies, **provide through-Delta fresh water conveyance** to protect Delta water quality and water rights, and **protect and enhance** the Delta's natural resources, recreation, agriculture, adjacent urban areas and economies.

- 1.1 Create products (e.g. white papers, videos, brochures, etc.) to **inform and educate** the public, opinion leaders and policymakers on the benefit of through-Delta conveyance on water quality, water rights, and regional ecosystem and economy.
- 1.2 Work with Delta-supportive interests to **identify alternative solutions** for water supply reliability in California.
- 1.3 **Analyze proposals** for addressing water supply reliability for compatibility with Delta values.



W.2 Increase Commission coordination to **advocate for legislation and funding** that protect Delta fresh water resources.

W.3 Work to resolve the problem of **aquatic invasive species** as a fundamental water quality issue in the Delta.



"Water is extremely valuable to all Californians...Northern California is a significant source of the state's water project exports, and this water moves through the Sacramento-San Joaquin Delta. Many programs and plans have been developed over the last 100 years to transport this water to agricultural and urban users in other parts of the state.

All these programs and plans included elements to protect the riparian water rights of upstream rights holders and Delta water rights holders. These water rights are key to the longevity and vitality of Delta agriculture and the Delta region as a whole."

[2012 Economic Sustainability Plan, Chapter 4.5, pg. 55]





AGRICULTURE

The Delta Protection Commission works to conserve agricultural land and economically sustainable agricultural operations in the Delta.

OBJECTIVES:

A.1 **Protect and enhance long-term viability** of commercial agriculture.

- 1.1 Develop and adopt an Agricultural Sustainability Plan
- 1.2 In partnership, develop and implement **Rural-Urban Connection Strategies** (RUCS) for infrastructure improvements necessary to enhance the Delta agricultural economy.
- 1.3 Research and evaluate options to provide adequate **farm labor housing**.
- 1.4 Promote **Farm-to-Fork** and agritourism opportunities for the direct benefit of Delta growers.

A.2 **Protect agricultural lands from inappropriate development.**

- 2.1 Implement the Land Use and Resource Management Plan (LURMP).
- 2.2 Evaluate and **update the LURMP** to address current conversion challenges in the Delta, such as proposed industrial-scale alternative energy developments and large-scale habitat restoration.
- 2.3 Advocate for the use of existing **public lands** and lands owned by conservation entities for habitat restoration to minimize the conversion of productive Delta agricultural land, in part by encouraging identification and mapping of suitable lands.
- 2.4 Advocate for appropriate land usage through the consultation process on **Delta Conservancy restoration projects,** as required by the Water Quality, Supply and Infrastructure Improvement Act of 2014.

A.3 Support **wildlife-friendly farming** and agriculture-friendly habitat restoration.

- 3.1 Promote and disseminate **"good neighbor" policies** to Delta farms and environmental entities.
- 3.2 Collaborate to develop, adopt and publish **"best management practices"** for ag-friendly habitat restoration, using outcomes of the Delta Working Landscapes project and others.



"The delta is an agricultural region of great value to the state and nation and the retention and continued cultivation and production of fertile peat lands and prime soils are of significant value.

The agricultural land of the delta, while adding greatly to the economy of the state, also provides a significant value as open space and habitat for waterfowl using the Pacific Flyway, as well as other wildlife, and the continued dedication and retention of that delta land in agricultural production contributes to the preservation and enhancement of open space and habitat values."

[Public Resources Code 29703(a) and (b)]



LEVEES AND EMERGENCY RESPONSE

The Delta Protection Commission promotes the protection of life and property through the maintenance and improvement of Delta levees, and emergency preparedness and response. This includes long-term planning for ongoing, cumulative levee improvements to address new issues as they arise.

OBJECTIVES:

L.1 Partner with local, State, and federal governments to **improve emergency preparedness and response** to protect Delta communities, property, and infrastructure.

- 1.1 Support development of a **Delta-wide Unified Emergency Plan.**
- 1.2 **Support Levee Maintaining Agencies** in collaborative efforts (e.g. emergency preparedness and response, levee standards, regional funding, public education, communication) and advocate for inclusion of Levee Maintaining Agencies in levee prioritization and other Delta-wide decision-making processes.



L.2 Advocate for **reliable funding** for Delta levee maintenance and improvements.

- 2.1 Seek **pro-Delta implementation** of levee funding in the Water Quality, Supply and Infrastructure Improvement Act of 2014 and other sources.
- 2.2 Advocate with all agencies to prioritize levee funding for **minimum PL 84-99 level of protection for the entire Delta.**
- 2.3 Develop and promote a levee funding strategy that incorporates **financial support from private and public sources,** including contributions from previous non-contributors ("beneficiaries pay").
- 2.4 Pursue **permanent status** and other Delta-supported improvements to the Delta Levee Subvention and Special Projects Programs.
- 2.5 Advocate at the federal, State, and local level to ensure availability of levee **repair and recovery funding** for damages after Delta flood events.

L.3 Work to ensure that Delta residents are **represented in decision-making** processes.

"The Legislature further finds and declares that the leveed islands and tracts of the delta and portions of its uplands are flood-prone areas of critical statewide significance due to the public safety risks and the costs of public emergency responses to floods, and that improvement and ongoing maintenance of the levee system is a matter of continuing urgency to protect farmlands, population centers, the state's water quality, and significant natural resource and habitat areas of the delta."

[Public Resources Code 29704]



REGIONAL ECONOMY

The Delta Protection Commission promotes a robust regional economy that protects agriculture, natural resources and the cultural values of the Delta. The Commission's Economic Sustainability Plan (ESP) is the fundamental document for planning such an economy in the Delta, and is of co-equal significance with this Strategic Plan and should be considered a part thereof.



OBJECTIVES:

E.1 Lead the implementation and required updating of the Economic Sustainability Plan.

E.2 Identify the **regional infrastructure needs and opportunities** to maximize Delta regional benefits.

- 2.1 Assess and monitor infrastructure needs for the Legacy Communities and surrounding areas, including recreation and tourism business needs.
- 2.2 Advocate for necessary infrastructure improvements with State and local government and other partners.

E.3 Facilitate regional economic development projects using the Delta Investment Fund.

- 3.1 Develop and maintain a plan for **Delta Investment Fund** spending and seek support for the Delta Investment Fund through State appropriations and other sources.

E.4 **Identify and address environmental factors** that negatively impact the economic sustainability of the Delta.

- 4.1 Partner with local government and State agencies to control invasive aquatic species which negatively impact recreation, tourism and water supply.
- 4.2 Advocate for improved beautification of Delta roadways.

"The region's rich history boasts of bustling, river-based commerce before the automobile age, and its cultural uniqueness includes the only rural town in America built by early Chinese immigrants. As the largest estuary on the west coast of the Americas, the Delta is also a place of striking natural beauty and ecological significance... Although surrounded by growing cities, the Delta remains a highly-productive agricultural area with rural charms, landscapes, and waterscapes not found elsewhere in California."

[2012 Economic Sustainability Plan, Chapter 1]



DELTA HERITAGE

The Delta Protection Commission promotes and enhances the Delta's unique cultural and natural heritage.

OBJECTIVES:

H.1 Protect the Delta's distinctive character and land uses through implementation of the Land Use and Resource Management Plan (LURMP).

H.2 Protect and promote the cultural and historical resources of the Delta.

- 2.1 Complete and maintain a cultural and historical resources inventory.
- 2.2 Work with Congress and the National Park Service to establish a **National Heritage Area** in the Delta.
- 2.3 Advance recognition of the national significance and **unique stories of the Delta** and support implementation of associated projects, e.g. the Delta Asian and Pacific Islander Heritage Corridor.
- 2.4 Plan and pursue implementation of historic preservation projects, e.g. the Clarksburg Gakuen.

H.3 Support local governments in preparing and implementing plans that emphasize the vitality and preservation of **Legacy Communities**.

H.4 Promote and enhance the Delta's heritage of natural resources, such as wildlife habitat, scenic value, soils and water.

- 4.1 Coordinate with the Delta Conservancy to complete a biological and ecological inventory.
- 4.2 Facilitate habitat restoration and enhancement projects consistent with Delta values.
- 4.3 Advocate for appropriate land usage through the consultation process on **Delta Conservancy restoration projects,** as required by the Water Quality, Supply and Infrastructure Improvement Act of 2014 (Proposition 1).
- 4.4 Partner with local government and State agencies to control invasive aquatic species that negatively impact recreation, navigation, tourism and water supply.

"The first goal is to 'identify the Delta as a region of national significance to educate the public about 'Delta as a Place', and build more support for preserving, protecting, and enhancing the Delta..Utilizing public input, five proposed themes have been developed which explain the Delta's national significance:

1. *At the heart of California lies America's inland Delta.*
2. *Conversion of the Delta from marshland to farmland was one of the largest reclamation projects in the United States.*
3. *Multi-cultural contributions and experiences have shaped the Delta's rural landscape.*
4. *The Delta, California's cornucopia, is amongst the most fertile agricultural regions in the world.*
5. *The Delta lies at the center of California's water resource challenges."*

[2012 National Heritage Area Feasibility Study, Executive Summary, pg. 4]



RECREATION AND TOURISM

The Delta Protection Commission is committed to national recognition of the Delta as a diverse, accessible, modern recreation and tourism destination.

OBJECTIVES:

R.1 Partner with public agencies and private entities to encourage increased recreation and tourism in the Delta.

- 1.1 Maintain current Delta **recreation resource inventory.**
- 1.2 Identify recreation needs and apply available resources to meet those needs, including public-private partnerships and multiple use of appropriate Delta lands.
- 1.3 Extend the **Great California Delta Trail** by continuing planning, support and collaboration efforts.
- 1.4 Partner with Visit California and others to promote the Delta as a **unique destination region** to potential visitors, in-state, nationally and internationally.
- 1.5 Increase Delta agritourism by increasing awareness of **Farm-to-Fork elements** and other rural tourism opportunities.

R.2 Encourage protection of private lands from unauthorized recreational uses by promoting and educating users on recreational opportunities on public lands and private recreation facilities.

R.3 Promote and encourage Delta-wide coordination and collaboration on boating, boating safety, and related programs.

- 3.1 Coordinate partnerships that **reduce abandoned vessels** in Delta waterways by improving title transfer procedures, implementing incentives and penalties to prevent abandonment, and developing abatement funding sources.
- 3.2 Work with US Coast Guard, local agencies and others on a **coordinated marine patrol** strategy that improves Delta boating safety and emergency response.

R.4 Partner with local government and State agencies to control **invasive aquatic species** that negatively impact recreational navigation, tourism and water supply.









EDUCATION AND OUTREACH

The Delta Protection Commission is the voice of those who live, work and play in the Delta. In this role, the Commission is committed to actively supporting communication between stakeholders and policymakers, creating a forum through which Delta residents and businesses can make their interests heard.

OBJECTIVE:

O.1 Ensure consistent, proactive communication between and among Delta interests and decision makers.

- 1.1 Develop, implement and maintain a **proactive** Delta Protection Commission Communication and **Outreach Plan** that covers all Commission program areas with a clear message, coordinated with all partners.
- 1.2 Respond to emerging issues of importance in the Delta in a prompt, effective and transparent manner, with a high degree of flexibility.
- 1.3 Foster **two-way communication** throughout the Delta.
  - 1.3.1 Actively seek input and opinions from the Delta to inform decisions impacting the region.
  - 1.3.2 **Provide a forum** for residents, businesses and Delta interests to participate in decisions affecting the Delta.
  - 1.3.3 Foster communication between Delta interests for improved, coordinated action.
- 1.4 Support an **active and engaged** Delta Protection **Advisory Committee** structure, including utilizing expert work groups, to provide recommendations to the Commission.



- 1.5 Develop an **ambassador program** to effectively elicit input from Delta residents and businesses.
- 1.6 Collaborate with partners on communicating about shared projects, e.g. Delta Awareness Campaign, abandoned vessel abatement, invasive species, etc.

CAPACITY BUILDING







CAPACITY BUILDING

The Delta Protection Commission continually strives to adapt and grow in order to most effectively fulfill its Mission. In addition to the Strategic Themes, it has established a complementary set of initiatives planned to increase capacity to deliver superior service to Delta constituents and to the Delta region as a whole, as follows:

- The Commission promotes a **culture of leadership and excellence** among Commission members and staff, and
- The Commission creatively develops funding to **increase the overall feasibility and sustainability** of all of the Commission's Vision.









COMMISSION LEADERSHIP AND DEVELOPMENT



The Delta Protection Commission demonstrates effective and efficient leadership by developing and supporting Commission members and providing expert Commission staff.

OBJECTIVES:

C.1 Support Commission members, so that each member can operate at their most effective level.

1.1 Develop and implement a Commissioner **Orientation** program.

1.2 Ensure well-informed and prepared Commission members.

1.3 Provide training to Commission members to help them fulfill the **Commission's appellate function** on land use decisions appealed to the Commission.

C.2 Encourage subcommittees as needed to advance Commission Initiatives (e.g. Strategic Plan Subcommittee).

C.3 Recruit, develop and maintain effective Commission staff.

3.1 Develop and regularly update a Vision 2030 **Implementation Plan**, corresponding staff Work Plans, and Individual Development Plans to implement Commission initiatives.

3.2 Annually review staffing needs, expertise and **organizational capacity**. Evaluate long-term needs for positions and levels of expertise and ensure that staff have necessary resources and training to successfully perform their functions.





FUNDING

To accomplish its initiatives to the fullest degree, the Delta Protection Commission seeks to maximize available funding sources to protect and enhance the unique community and cultural values, recreation and tourism, natural resources and agriculture of the Delta.

OBJECTIVES:

F.1 Utilize the **Delta Investment Fund** to support economic sustainability.

- 1.1 Identify federal, State and private sources of potential funding.
- 1.2 Explore feasibility of a **Delta License Plate** to benefit the Delta Investment Fund.
- 1.3 Assist the interested Delta public to create fundraising to benefit Delta Investment Fund.

F.2 Continuously research, identify and develop funding sources to support Commission operations and worthy and compatible activities in the Delta.

- 2.1 Explore entities such as In Our Back Yard (IOBY) and Kickstarter to help **crowd-source funds** for Delta community investments.
- 2.2 Partner with any **Delta region community benefit foundation** or other appropriate private funding sources.
- 2.3 Secure funding for Commission priorities by pursuing grants, partnerships and State appropriations.





COMMON ACRONYMS & ABBREVIATIONS

AWAF Abandoned Watercraft Abatement Fund
BDCP Bay Delta Conservation Plan
BLS Bureau of Labor Statistics
BMP Best Management Practices
CalEMA California Emergency Management Agency
Caltrans California Department of Transportation
CBDA California Bay-Delta Authority
CCWD Contra Costa Water District
CDBG Community Development Block Grant
CDWR California Department of Water Resources
CEQA California Environmental Quality Act
CPI Consumer Price Index
CVFPP Central Valley Flood Protection Plan
CVP Central Valley Project
CWC California Water Code
The Delta The Sacramento–San Joaquin Delta
DAPC The Delta Area Planning Council
Delta Conservancy The Sacramento–San Joaquin Delta Conservancy
DFW Department of Fish and Wildlife
DHCCP Delta Habitat Conservation & Conveyance Plan
DLHAC Delta Levees Habitat Advisory Committee
DMV Department of Motor Vehicles
DPC Delta Protection Commission
DRMS Delta Risk Management Strategy
DSC Delta Stewardship Council
DU Ducks Unlimited
DWR Department of Water Resources
EDI Economic Development Initiative
EIR Environmental Impact Report
EIS Environmental Impact Statement
ESA Federal Endangered Species Act
ESP Economic Sustainability Plan
EPA Environmental Protection Agency
FDPA Flood Disaster Protection Act of 1973
FEMA Federal Emergency Management Agency
FIS Flood Insurance Study
FMMP California Farmland Mapping and Monitoring Program
GIS Geographic Information System
HCP Habitat Conservation Planning
ICS Incident Command System
IEP Inter-Agency Ecological Program
IRP Independent Review Panel
JPA Joint-Powers Authority
MOU Memorandum of Understanding
MWD Metropolitan Water District of Southern California
NAIP National Agriculture Imagery Program
NASS National Agricultural Statistics Service
NBA North Bay Aqueduct
NFIP National Flood Insurance Program
NGO Non-Governmental Organization
NIMS National Incident Management System
NRC National Research Council
NCCP Natural Communities Conservation Plan
PG&E Pacific Gas and Electric Company
PL Public Law
PL 84-99 Public Law 84-99 Federal Levee Standards
POD Pelagic Organism Decline
PPIC Public Policy Institute of California
ROA Restoration Opportunity Area
ROW Right of Way
SA Study Area
SACOG Sacramento Area Council of Governments
SAFCA Sacramento Area Flood Control Agency
SEMS Standardized Emergency Management System
SFHA Special Flood Hazard Area
SHRA Sacramento Housing and Redevelopment Agency
SJAFCA San Joaquin Area Flood Control Agency
SRA State Recreation Area
SWP State Water Project
SWRCB State Water Resources Control Board
TNC The Nature Conservancy
TRPA Tahoe Regional Planning Agency
UC University of California
UOP University of the Pacific
UPL Urban Project Levee
USACE U.S. Army Corps of Engineers
USDA U.S. Department of Agriculture
USFWS U.S. Fish and Wildlife Service
USGS U.S. Geological Survey
WSAFCA West Sacramento Area Flood Control Agency

DELTA PROTECTION COMMISSION

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Contra Costa County Board of Supervisors
Alternate: Karen Mitchoff

Skip Thomson, Vice-Chair
Solano County Board of Supervisors
Alternate: John Vasquez

Brian Bugsch
CA State Lands Commission
Alternate: Eric Gillies

Christopher Cabaldon, Mayor
City of West Sacramento
Alternate: Chris Ledesma

Bob Elliott, Supervisor
San Joaquin County Board of Supervisors
Alternate: Kathy Miller

Robert K. Ferguson
South Delta Reclamation Districts
Alternate: Dean Ruiz, Esq.

Brian Kelly, Secretary
CA State Transportation Agency
Alternates: Kate White & Brian Annis

John Laird, Secretary
CA Natural Resources Agency
Alternates: Todd Ferrara & Janelle Beland

Don Nottoli, Supervisor
Sacramento County Board of Supervisors
Alternate: Patrick Kennedy

Norman Richardson, Mayor
City of Rio Vista
Alternate: David Hampton

Karen Ross, Secretary
CA Department of Food and Agriculture
Alternate: Josh Eddy

Michael Scriven
Central Delta Reclamation Districts
Alternate: Dante Nomellini Sr.

Anthony Silva, Mayor
City of Stockton
Alternate: Alan Nakanishi

Justin van Loben Sels
North Delta Reclamation Districts
Alternate: Tom Slater

Oscar Villegas, Supervisor
Yolo County Board of Supervisors
Alternate: Jim Provenza

Ex-Officio Members

Honorable Jim Frazier
California State Assembly

Honorable Cathleen Galgiani
California State Senate

Commission Staff

Erik Vink
Executive Director

Catherine Caldwell
Assistant Executive Director

Nicole Bert
Communications Specialist

Jann Bullock
Interim Clerk to the Commission

Blake Roberts
Environmental Planner

Jennifer Ruffolo
Project Manager

Jessica Tucker-Mohl, Deputy Attorney General

DELTA PROTECTION COMMISSION HISTORICAL TIMELINE

1959 – Water Code Section 12220 establishes the legal Delta boundaries.

1967 – Inter-County Delta Planning and Recreation Advisory Committee established to study planning matters and recreational developments. Committee had limited staff support to implement planning efforts.

1972 – Delta Advisory Planning Council (DAPC) – a regional planning council established to coordinate the activities of local governments, maintain a comprehensive plan, and strengthen participation in state and federal planning.

Delta Protection Act

1992 – Delta Protection Act establishes DPC to develop a comprehensive land management plan for the Primary Zone of the Delta. The DPC replaces DAPC.

1994 – DPC conducts various studies on land use, agriculture, recreation and levees to inform a comprehensive management plan.

1995 – The DPC adopts the Land Use and Resource Management Plan.

1996 – The Legislature extends the Commission's original sunset date from January 1, 1997 to January 1, 1999.

1997 – DPC updates the Inventory of Delta Recreation Facilities.

1998 – The Legislature extends DPC's sunset until January 1, 2010, in order to provide continued oversight of land use changes in the Primary Zone, due to continued urbanization pressures in the Secondary Zone.

1998 – The Commission advises and monitors the CALFED process and the proposed impacts to land uses in the Delta Primary Zone.

1999 – Delta Protection Act is amended to include the new City of Oakley and requires that any new General Plans in the Primary Zone of the Delta must be consistent with the Commission's adopted Land Use and Resource Management Plan.





The Early 2000s

2000 – Delta agriculture suffers several hard blows, including the bankruptcy of Tri Valley Growers cooperative, the closure of tomato processing facilities and sugar refineries in Woodland, and lower than usual Delta Crop prices.

2000 – CALFED Record of Decision signed.

2001 – The Nature Conservancy acquires 9,200 acre Staten Island to permanently protect wildlife – friendly agriculture. The Commission advocates on the importance of developing a long-term strategy to protect agriculture on Staten Island.

2002 – DPC supports the development of the Delta Resource Conservation and Development Council through the US Secretary for Agriculture, with a mission to ensure the protection and enhancement of agriculture.

2002 – U.S. Department of Food and Agriculture designates the Legal Delta a State Conservation Priority Area for the Federal Conservation Reserve Enhancement Program, making funding opportunities available for enhancing habitat and water quality as part of agriculture on private lands.

2002 – DPC participates in the Delta Dredge Reuse Strategy and Technical Advisory Panel to develop a strategy for reused materials for incorporation into CALFED program. The final report summarizes all dredging data for the last decade and addresses regulatory challenges associated with dredging in the Delta.

2002 – California Bay-Delta Authority created to oversee implementation of the CALFED program, with one representative of the Delta appointed by the Governor.

2003/04 – The LAO recommends elimination of the Commission because its mandated tasks have been completed. After a year of public hearings and discussions, the Legislature recognized DPC's continued role in the region and maintained its jurisdiction and authority unchanged.

-continue on next page

2004 – Jones Tract levee breaks, and consequently DPC prepares a Delta levees conference in co-sponsorship with the California Bay-Delta Authority.
2005 – DPC completes the Delta Recreation Master Strategy focusing on Aquatic Resources with funding from the Department of Boating and Waterways.
2005 – In the aftermath of Hurricane Katrina, there is heightened attention to flood protection and water conveyance at the local, state and federal levels for the Delta region.

The 2006 Strategic Plan

2006 – DPC initiates an Abandoned Vessel Discussion Group.
2006 – Senator Tom Torlakson Bill 1556 passes establishing the Great California Delta Trail.
2006 – Little Hoover Commission reviews CALFED using contributions from DPC regarding land use indicators and trends in the areas of agriculture, habitat, and recreation.
2006 – Senator Lois Wolk Bill AB 797 passes, affirming the importance of DPC's role, strengthening its membership, increasing its appeal authority, and adding tools to facilitate long-term agricultural land conservation.
2006 – DPC and five counties collaborate to install "Welcome to the Delta" signs at strategic entry points and establish the contemporary marketing of "Delta as Place."
2006 – DPC contributes towards development of a Long Term Management Strategy for Dredging and Lower Yolo Bypass Management Plan.
2006 – DPC participates in the Delta Emergency Response Summit.
2007 – DPC adopts a Strategic Plan and articulates the role of Commission as the "voice for those who live, work and play in the Delta."



2007 – DPC participates in the visioning process for the Delta Blue Ribbon Task Force.
2007 – DPC facilitates a five-County Emergency Planning Forum, which influenced the introduction and passage of SB 27 –the Sacramento-San Joaquin Delta Emergency Preparedness Act.
2007 – Clarksburg Sugar Mill Development Appeal – Clarksburg land use decision demonstrates the Commission's role in interpreting the Land Use and Resource Management Plan and performing its appellate authority.
2008 – DPC introduces the concept of establishing a National Heritage Area in the Delta.
2008 – DPC contributes to a proposal for a Delta specific conservancy.

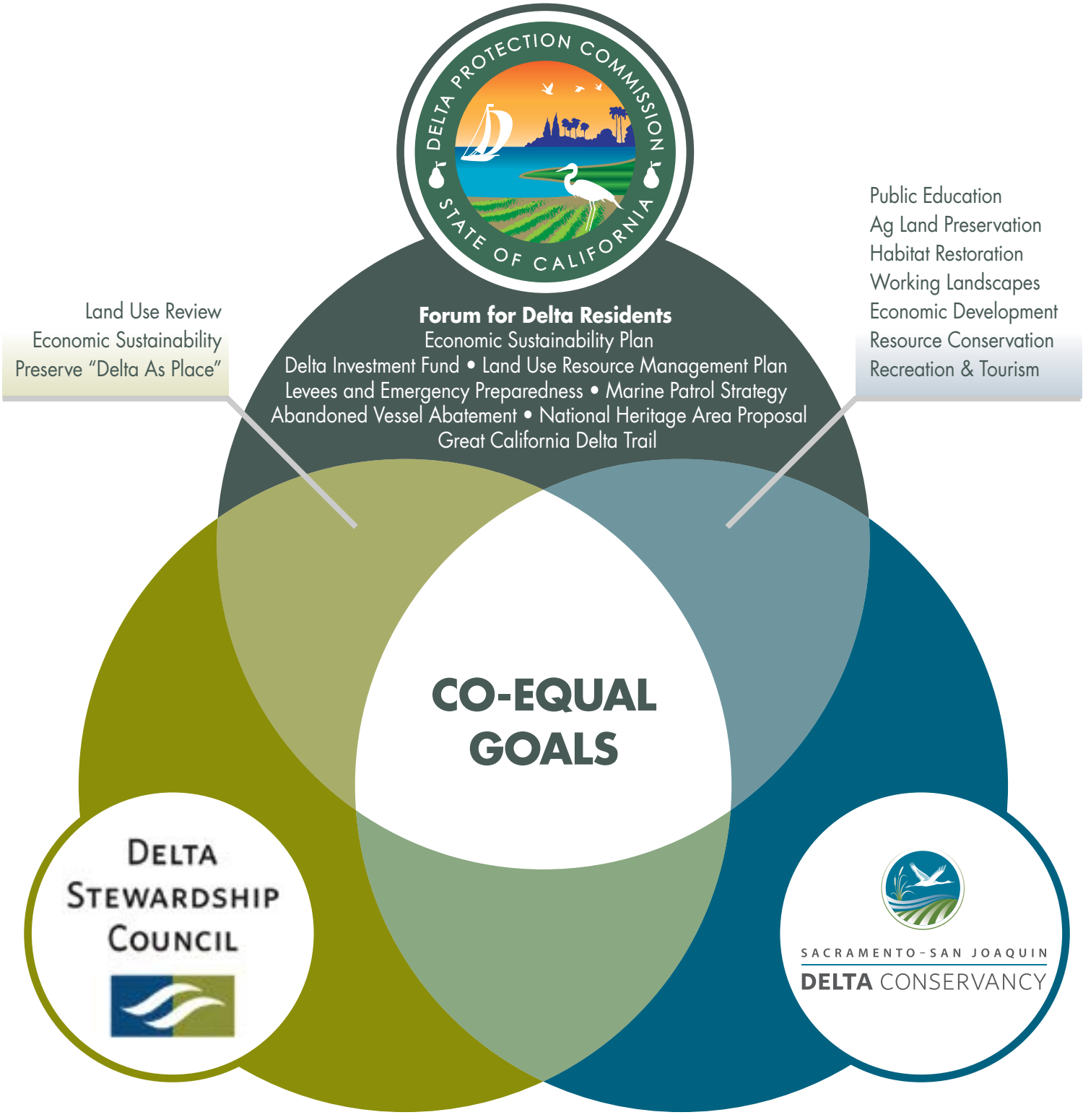


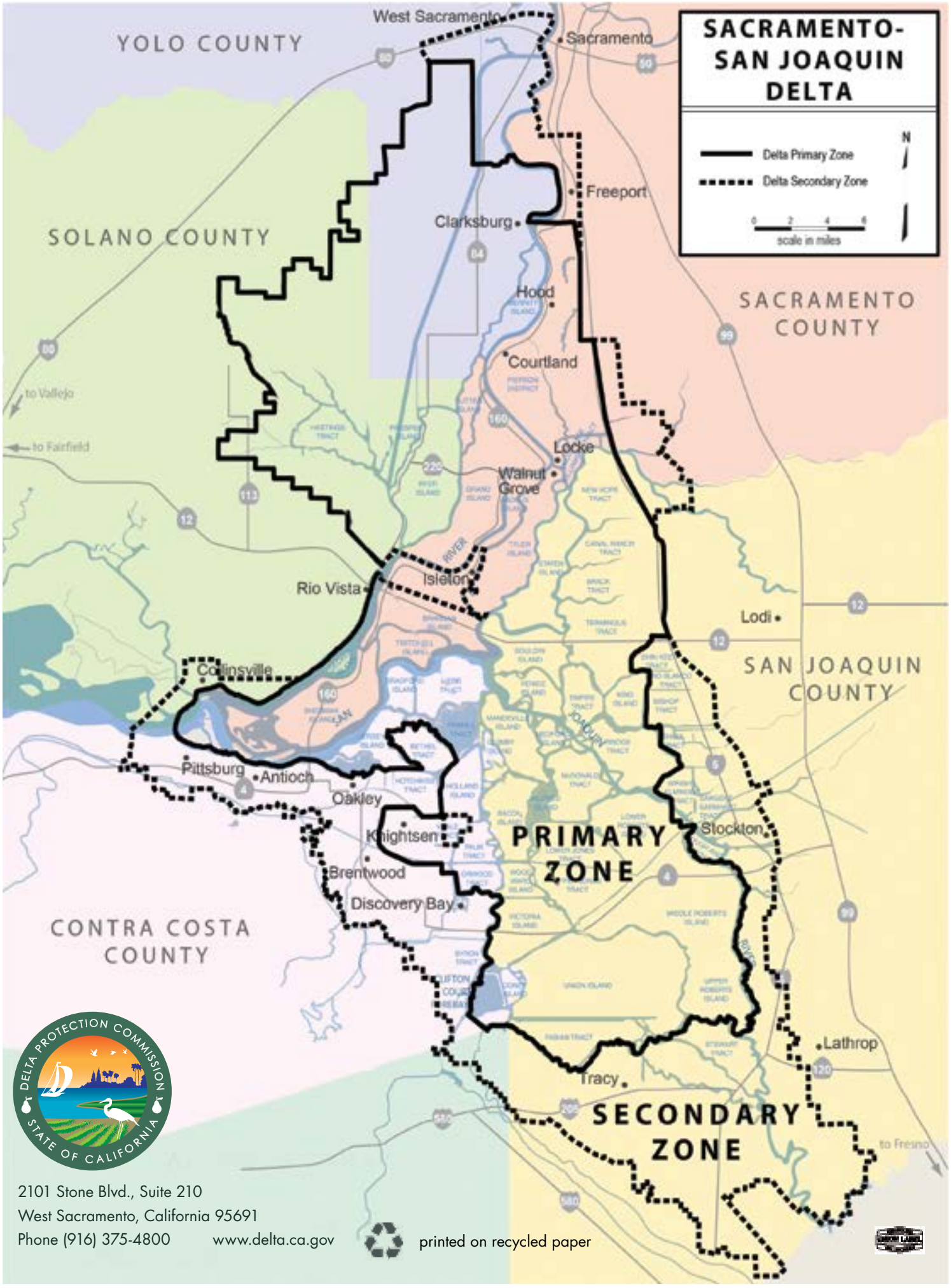
Delta Reform Act

2009 – Legislature passes Delta Reform Act, which reaffirms and modifies DPC's role, and establishes the Delta Stewardship Council and the Sacramento-San Joaquin Delta Conservancy.
2010 – The Commission adopts an updated Land Use and Resource Management Plan.
2010 – Pursuant Delta Reform Act, the DPC participates on the Delta Stewardship Council and as a member of the Delta Conservancy; initiates the Economic Sustainability Plan; and pursues a proposal to protect the unique values of the Delta as an evolving place.
2010 – DPC adopts the Great California Delta Trail Blueprint Report for Contra Costa and Solano Counties.
2010 – DPC leads a collaborative that contributes to the Regional Water Quality Board's draft document on Mercury TMDL, in response to mandates from the US EPA and CA EPA.
2012 – The Commission adopts the Economic Sustainability Plan, which is largely incorporated into the Delta Stewardship Council's Delta Plan.
2012 – DPC recommends to Congress the National Heritage Area Feasibility Study as proposal to protect the unique values of the Delta.
2012 – Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (SB 27) Report released.
2012 – DPC cosponsors the Delta Levee Standards Conference with the Water Education Foundation.
2013 – DPC completes the Evapotranspiration Study (E.T. Study) addressing concerns over beneficial uses of agricultural water and Delta agricultural water user efficiency requirements.
2013 – DPC initiates the Eastern Region Delta Trail Blueprint Report for Sacramento, San Joaquin and Yolo Counties.
2013 – DPC initiates branding partnership with Delta Conservancy.
2013 – DPC celebrates 20 years of protecting the Delta.
2014 – DPC declares "Delta Flood Preparedness Week," an awareness campaign providing residents with flood preparedness tools and resources, and hosts a Safety Fair for Delta residents.

THE DELTA PROTECTION COMMISSION

and Sister Agencies created by 2009 Delta legislation





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CONTRACT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND THE NORTH DELTA WATER AGENCY FOR THE ASSURANCE OF A DEPENDABLE WATER SUPPLY OF SUITABLE QUALITY

THIS CONTRACT, made this 28th day of JAN, 1981, between the STATE OF CALIFORNIA, acting by and through its DEPARTMENT OF WATER RESOURCES (State), and the NORTH DELTA WATER AGENCY (Agency), a political subdivision of the State of California, duly organized and existing pursuant to the laws thereof, with its principal place of business in Sacramento, California.

RECITALS

(a) The purpose of this contract is to assure that the State will maintain within the Agency a dependable water supply of adequate quantity and quality for agricultural uses and, consistent with the water quality standards of Attachment A, for municipal and industrial uses, that the State will recognize the right to the use of water for agricultural, municipal, and industrial uses within the Agency, and that the Agency will pay compensation for any reimbursable benefits allocated to water users within the Agency resulting from the Federal Central Valley Project and the State Water Project, and offset by any detriments caused thereby.

(b) The United States, acting through its Department of the Interior, has under construction and is operating the Federal Central Valley Project (FCVP).

(c) The State has under construction and is operating the State Water Project (SWP).

(d) The construction and operation of the FCVP and SWP at times have changed and will further change the regimen of rivers tributary to the Sacramento-San Joaquin Delta (Delta) and the regimen of the Delta channels from unregulated flow to regulated flow. This regulation at times improves the quality of water in the Delta and at times diminishes the quality from that which would exist in the absence of the FCVP and SWP. The regulation at times also alters the elevation of water in some Delta channels.

(e) Water problems within the Delta are unique within the State of California. As a result of the geographical location of the lands of the Delta and tidal influences, there is no physical shortage of water. Intrusion of saline ocean water and municipal, industrial and agricultural discharges and return flows, tend, however, to deteriorate the quality.

(f) The general welfare, as well as the rights and requirements of the water users in the Delta, require that there be maintained in the Delta an adequate supply of good quality water for agricultural, municipal and industrial uses.

(g) The law of the State of California requires protection of the areas within which water originates and the watersheds in which water is developed. The Delta is such an area and within such a watershed. Part 4.5 of Division 6 of the California Water Code affords a first priority to provision of salinity control and maintenance of an adequate water supply in the Delta for reasonable and beneficial uses of water and relegates to lesser priority all exports of water from the Delta to other areas for any purpose.

(h) The Agency asserts that water users within the Agency have the right to divert, are diverting, and will continue to divert, for reasonable beneficial use, water from the Delta that would have been available therein if the FCVP and SWP were not in existence, together with the right to enjoy or acquire such benefits to which the water users may be entitled as a result of the FCVP and SWP.

(i) Section 4.4 of the North Delta Water Agency Act, Chapter 283, Statutes of 1973, as amended, provides that the Agency has no authority or power to affect, bind, prejudice, impair, restrict, or limit vested water rights within the Agency.

(j) The State asserts that it has the right to divert, is diverting, and will continue to divert water from the Delta in connection with the operation of the SWP.

(k) Operation of SWP to provide the water quality and quantity described in this contract constitutes a reasonable and beneficial use of water.

(l) The Delta has an existing gradient or relationship in quality between the westerly portion most seriously affected by ocean salinity intrusion and the interior portions of the Delta where the effect of ocean salinity intrusion is diminished. The water quality criteria set forth in this contract establishes minimum water qualities at various monitoring locations. Although the water quality criteria at upstream locations is shown as equal in some periods of some years to the water quality at the downstream locations, a better quality will in fact exist at the upstream locations at almost all times. Similarly, a better water quality than that shown for any given monitoring location will also exist at interior points upstream from that location at almost all times.

(m) It is not the intention of the State to acquire by purchase or by proceeding in eminent domain or by any other manner the water rights of water users within the Agency, including rights acquired under this contract.

(n) The parties desire that the United States become an additional party to this contract.

AGREEMENTS

1. **Definitions.** When used herein, the term:

(a) "Agency" shall mean the North Delta Water Agency and shall include all of the lands within the boundaries at the time the contract is executed as described in Section 9.1 of the North Delta Water Agency Act, Chapter 283, Statutes of 1973, as amended.

(b) "Calendar year" shall mean the period January 1 through December 31.

(c) "Delta" shall mean the Sacramento-San Joaquin Delta as defined in Section 12220 of the California Water Code as of the date of the execution of the contract.

(d) "Electrical Conductivity" (EC) shall mean the electrical conductivity of a water sample measured in millimhos per centimeter per square centimeter corrected to a standard temperature of 25° Celsius determined in accordance with procedures set forth in the publication entitled "Standard Methods of Examination of Water and Waste Water", published jointly by the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation, 13th Edition, 1971, including such revisions thereof as may be made subsequent to the date of this contract which are approved in writing by the State and the Agency.

(e) "Federal Central Valley Project" (FCVP) shall mean the Central Valley Project of the United States.

(f) "Four-River Basin Index" shall mean the most current forecast of Sacramento Valley unimpaired runoff as presently published in the California Department of Water Resources Bulletin 120 for the sum of the flows of the following: Sacramento River above Bend Bridge near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River at Smartville; American River, total inflow to Folsom Reservoir. The May 1 forecast shall continue in effect until the February 1 forecast of the next succeeding year.

(g) "State Water Project" (SWP) shall mean the State Water Resources Development System as defined in Section 12931 of the Water Code of the State of California.

(h) "SWRCB" shall mean the State Water Resources Control Board.

(i) "Water year" shall mean the period October 1 of any year

through September 30 of the following year.

2. **Water Quality.**

(a) (i) The State will operate the SWP to provide water qualities at least equal to the better of: (1) the standards adopted by the SWRCB as they may be established from time to time; or (2) the criteria established in this contract as identified on the graphs included as Attachment A.

(ii) The 14-day running average of the mean daily EC at the identified location shall not exceed the values determined from the Attachment A graphs using the Four-River Basin Index except for the period February through March of each year at the location in the Sacramento River at Emmaton for which the lower value of the 80 percent probability range shall be used.

(iii) The quality criteria described herein shall be met at all times except for a transition period beginning one week before and extending one week after the date of change in periods as shown on the graphs of Attachment A. During this transition period, the SWP will be operated to provide as uniform a transition as possible over the two-week period from one set of criteria to the next so as to arrive at the new criteria one week after the date of change in period as shown on the graphs of Attachment A.

(b) While not committed affirmatively to achieving a better water quality at interior points upstream from Emmaton than those set forth on Attachment A, the State agrees not to alter the Delta hydraulics in such manner as to cause a measurable adverse change in the ocean salinity gradient or relationship among the various monitoring locations shown on Attachment B and interior points upstream from those locations, with any particular flow past Emmaton.

(c) Whenever the recorded 14-day running average of mean daily EC of water in the Sacramento River at Sacramento exceeds 0.25 mmhos, the quality criteria indicated on the graphs of Attachment A may be adjusted by adding to the value taken therefrom the product of 1.5 times the amount that the recorded EC of the Sacramento River at Sacramento exceeds 0.25 mmhos.

3. **Monitoring.** The quality of water shall be measured by the State as needed to monitor performance pursuant to Article 2 hereof with equipment installed, operated, and maintained by the State, at locations indicated on "Attachment B". Records of such measurements shall at regular intervals be furnished to the Agency. All monitoring costs at North Fork Mokelumne River near Walnut Grove, Sacramento River at Walnut Grove, and Steamboat Slough at Sutter Slough incurred by the State solely for this contract shall be shared equally by the Agency and the State. All monitoring costs to be borne by the Agency for monitoring at the above locations are included in the payment under Article 10.

4. **Emergency Provisions.**

(a) If a structural emergency occurs such as a levee failure or a failure of an SWP facility, which results in the State's failure to meet the water quality criteria, the State shall not be in breach of this contract if it makes all reasonable efforts to operate SWP facilities so that the water quality criteria will be met again as soon as possible. For any period in which SWP failure results in failure of the State to meet the water quality criteria, the State shall waive payment under Article 10, prorated for that period, and the amount shall be deducted from the next payment due.

(b) (i) A drought emergency shall exist when all of the following occur:

(1) The Four-River Basin Index is less than an average of 9,000,000 acre feet in two consecutive years (which occurred in 1933-4 and 1976-7); and

(2) An SWRCB emergency regulation is in effect providing for the operation of the SWP to maintain water quality different from that provided in this contract; and

(3) The water supplied to meet annual entitlements of SWP agricultural contractors in the San Joaquin Valley is being reduced by at least 50 percent of these agricultural entitlements (it being the objective of the SWP to avoid agricultural deficiencies in excess of 25 percent) or the total of water supplied to meet annual entitlements of all SWP contractors is being reduced by at least 15 percent of all entitlements, whichever results in the greater reduction in acre feet delivered.

(ii) A drought emergency shall terminate if any of the conditions in (b) (i) of this Article ceases to exist or if the flow past Sacramento after October 1 exceeds 20,000 cubic feet per second each day for a period of 30 days.

(iii) Notwithstanding the provisions of Article 2 (a), when a drought emergency exists, the emergency water quality criteria of the SWRCB shall supersede the water quality requirements of this contract to the extent of any inconsistency; provided, however, that the State shall use all reasonable efforts to preserve Delta water quality, taking into consideration both the limited water supply available for that purpose and recognizing the priority established for Delta protection referred to in Recital (g).

(iv) When a drought emergency exists, and an overland supply is not available to an individual water user comparable in quality and quantity to the water which would have been available to the user under Attachment A, the State shall compensate the user for loss of net income for each acre either (A) planted to a more salt-tolerant crop in the current year, (B) not planted to any crop in the current year provided such determination not to plant was reasonable based on the drought emergency, or (C) which had a reduced yield due to the drought emergency, calculated on the basis of the user's average net income for any three of the prior five years for each such acre. A special contract claims procedure shall be estalished by the State to expedite and facilitate the payment of such compensation.

5. **Overland Water Supply Facilities.**

(a) Within the general objectives of protecting the western Delta areas against the destruction of agricultural productivity as a result of the increased salinity of waters in the Delta channels resulting in part from SWP operation, the State may provide diversion and overland facilities to supply and distribute water to Sherman Island as described in the report entitled "Overland Agricultural Water Facilities Sherman Island" dated January 1980. Final design and operating specifications shall be subject to approval of the Agency and Reclamation District No. 341. The Agency or its transferee will assume full ownership, operation, and maintenance responsibility for such facilities after successful operation as specified. After the facilities are constructed and operating, the water qualitry criteria for the Sacramento River at Emmaton shall apply at the intake of the facilities in Three Mile Slough.

(b) The State and the Agency may agree to the construction and operation of additional overland water supply facilities within the Agency, so long as each landowner served by the overland facilities receives a quality of water not less than that specified in Attachment A for the upstream location nearest to his original point of diversion. The design and operation of such facilities and the cost sharing thereof are subject to approval of any reclamation district which includes within its boundaries the area to be served. The ownership, operation, and maintenance of diversion works and overland facilities shall be the subject of a separate agreement between the Agency or its transferees and the State.

6. **Flow Impact.** The State shall not convey SWP water so as to cause a decrease or increase in the natural flow, or reversal of the natural flow direction, or to cause the water surface elevation in Delta channels to be altered, to the detriment of Delta channels or water users within the Agency. If lands, levees, embankments, or revetments adjacent to Delta channels within the Agency incur seepage or erosion damage or if diversion facilities must be modi-

fied as a result of altered water surface elevations as a result of the conveyance of water from the SWP to lands outside the Agency after the date of this contract, the State shall repair or alleviate the damage, shall improve the channels as necessary, and shall be responsible for all diversion facility modifications required.

7. **Place of Use of Water.**

(a) Any subcontract entered into pursuant to Article 18 shall provide that water diverted under this contract for use within the Agency shall not be used or otherwise disposed of outside the boundaries of the Agency by the subcontractor.

(b) Any subcontract shall provide that all return flow water from water diverted within the Agency under this contract shall be returned to the Delta channels. Subject to the provisions of this contract concerning the quality and quantity of water to be made available to water users within the Agency, and to any reuse or recapture by water users within the Agency, the subcontractor relinquishes any right to such return flow, and as to any portion thereof which may be attributable to the SWP, the subcontractor recognizes that the State has not abandoned such water.

(c) If water is attempted to be used or otherwise disposed of outside the boundaries of the Agency so that the State's rights to return flow are interfered with, the State may seek appropriate administrative or judicial action against such use or disposal.

(d) This article shall not relieve any water user of the responsibility to meet discharge regulations legally imposed.

8. **Scope of Contract.**

(a) During the term of this contract:

(i) This contract shall constitute the full and sole agreement between the State and the Agency as to (1) the quality of water which shall be in the Delta channels, and (2) the payment for the assurance given that water of such quality shall be in the Delta channels for reasonable and beneficial uses on lands within the Agency, and said diversions and uses shall not be disturbed or challenged by the State so long as this contract is in full force and effect.

(ii) The State recognizes the right of the water users of the Agency to divert from the Delta channels for reasonable and beneficial uses for agricultural, municipal and industrial purposes on lands within the Agency, and said diversions and uses shall not be disturbed or challenged by the State so long as this contract is in full force and effect, and the State shall furnish such water as may be required within the Agency to the extent not otherwise available under the water rights of water users.

(iii) The Agency shall not claim any right against the State in conflict with the provisions hereof so long as this contract remains in full force and effect.

(b) Nothing herein contained is intended to or does limit rights of the Agency against others than the State, or the State against any person other than the Agency and water users within the Agency.

(c) This contract shall not affect, bind, prejudice, impair, restrict, or limit vested water rights within the Agency.

(d) The Agency agrees to defend affirmatively as reasonable and beneficial the water qualities established in this contract. The State agrees to defend affirmatively as reasonable and beneficial the use of water required to provide and sustain the qualities established in this contract. The State agrees that such use should be examined only after determination by a court of competent jurisdiction that all uses of water exported from the Delta by the State and by the United States, for agricultural, municipal, and industrial purposes are reasonable and beneficial, and that irrigation practices, conservation efforts, and groundwater management within areas served by such exported water should be examined in particular.

(e) The Agency consents to the State's export of water from the Delta so long as this contract remains in full force and effect and the State is in compliance herewith.

9. **Term of Contract.**

(a) This contract shall continue in full force and effect until such time as it may be terminated by the written consent and agreement of the parties hereto, provided that 40 years after execution of this contract and every 40 years thereafter, there shall be a six-month period of adjustment during which any party to this contract can negotiate with the other parties to revise the contract as to the provisions set out in Article 10. If, during this period, agreement as to a requested revision cannot be achieved, the parties shall petition a court of competent jurisdiction to resolve the issue as to the appropriate payment to be made under Article 10. In revising Article 10, the court shall review water quality and supply conditions within the Agency under operation of the FCVP and SWP, and identify any reimbursable benefits allocated to water users within the Agency resulting from operation of the FCVP and SWP, offset by any detriments caused thereby. Until such time as any revision is final, including appeal from any ruling of the court, the contract shall remain in effect as without such revision.

(b) In the event this contract terminates, the parties' water rights to quality and quantity shall exist as if this contract had not been entered into.

10. **Amount and Method of Payment for Water.**

(a) The Agency shall pay each year as consideration for the assurance that an adequate water supply and the specific water quality set forth in this contract will be maintained and monitored, the sum of one hundred seventy thousand dollars ($170,000.00). The annual payments shall be made to the State one-half on or before January 1 and one-half on or before July 1 of each year commencing with January 1, 1982.

(b) The payment established in (a) above shall be subject to adjustment as of January 1, 1987, and every fifth year thereafter. The adjusted payment shall bear the same relation to the payment specified in (a) above that the mean of the State's latest projected Delta Water Rate for the five years beginning with the year of adjustment bears to $10.00 per acre foot; provided that, no adjusted payment shall exceed the previous payment by more than 25 percent.

(c) The payments provided for in this article shall be deposited by the State in trust in the California Water Resources Development System Revenue Account in the California Water Resources Development Bond Fund. The trust shall continue for five years (or such longer period as the State may determine) but shall be terminated when the United States executes a contract as provided in Article 11 with the State and the Agency at which time the proportion of the trust fund that reflects the degree to which the operation of the FCVP has contributed to meeting the water quality standard under this contract as determined solely by the State shall be paid to the United States (with a pro rata share of interest). In the event that the United States has not entered into such a contract before the termination of the trust, the trust fund shall become the sole property of the State.

11. **Participation of the United States.** The Agency will exercice its best efforts to secure United States joinder and concurrence with the terms of this contract and the State will diligently attempt to obtain the joinder and concurrence of the United States with the terms of this contract and its participation as a party hereto. Such concurrence and participation by the United States in this contract shall include a recognition ratified by the Congress that the excess land provisions of Federal reclamation law shall not apply to this contract.

12. **Remedies.**

(a) The Agency shall be entitled to obtain specific perfor-

mance of the provisions of this contract by a decree of the Superior Court in Sacramento County requiring the State to meet the standards set forth in this contract. If the water quality in Delta channels falls below that provided in this contract, then, at the request of the Agency, the State shall cease all diversions to storage in SWP reservoirs or release stored water from SWP reservoirs or cease all export by the SWP from Delta channels, or any combination of these, to the extent that such action will further State compliance with the water quality standards set forth in this contract, except that the State may continue to export from Delta channels to the extent required to meet water quality requirements in contracts with the Delta agencies specified in Section 11456 of the California Water code.

(b) To the extent permitted by law, the State agrees to forego the use of eminent domain proceedings to acquire water rights of water users within the Agency or any rights acquired under this contract for water or water quality maintenance for the purpose of exporting such water from the Delta. This provision shall not be construed to prohibit the utilization of eminent domain proceedings for the purpose of acquiring land or any other rights necessary for the construction of water facilities.

(c) Except as provided in the water quality assurances in Article 2 and the provisions of Article 6 and Article 8, neither the State nor its officers, agents, or employees shall be liable for or on account of:

(i) The control, carriage, handling, use, disposal, or distribution of any water outside the facilities constructed, operated and maintained by the State.

(ii) Claims of damage of any nature whatsoever, including but not limited to property loss or damage, personal injury or death arising out of or connected with the control, carriage, handling, use, disposal or distribution of any water outside of the facilities constructed, operated and maintained by the State.

(d) The use by the Agency or the State of any remedy specified herein for the enforcement of this contract is not exclusive and shall not deprive either from using any other remedy provided by law.

13. **Comparable Treatment.** In the event that the State gives on the whole substantially more favorable treatment to any other Delta entity under similar circumstances than that accorded under this contract to the Agency, the State agrees to renegotiate this contract to provide comparable treatment to the Agency under this contract.

GENERAL PROVISIONS

14. **Amendments.** This contract may be amended or terminated at any time by mutual agreement of the State and the Agency.

15. **Reservation With Respect to State Laws.** Nothing herein contained shall be construed as estopping or otherwise preventing the Agency, or any person, firm, association, corporation, or public body claiming by, through, or under the Agency, from contesting by litigation or other lawful means, the validity, constitutionality, construction or application of any law of the State of California.

16. **Opinions and Determinations.** Where the terms of this contract provide for action to be based upon the opinion, judgment, approval, review, or determination of either party hereto, such terms are not intended to be and shall never be construed as permitting such opinion, judgment, approval, review, or determination to be arbitrary, capricious, or unreasonable.

17. **Successors and Assigns Obligated.** This contract and all of provisions shall apply to and bind the successors and assigns of the parties hereto.

18. **Assignment and Subcontract.** The Agency may enter into subcontracts with water users within the Agency boundaries in which the assurances and obligations provided in this contract as to such water user or [illegible]s are assigned to the area covered by the subcontract. The Agency shall remain primarily liable and shall make all payments required under this contract. No assignment or transfer of this contract, or any part hereof, rights hereunder, or interest herein by the Agency, other than a subcontract containing the same terms and conditions, shall be valid unless and until it is approved by the State and made subject to such reasonable terms and conditions as the State may impose. No assignment or transfer of this contract or any part hereof, rights hereunder, or interest herein by the State shall be valid except as such assignment or transfer is made pursuant to and in conformity with applicable law.

19. **Books, Records, Reports, and Inspections Thereof.** Subject to applicable State laws and regulations, the Agency shall have full and free access at all reasonable times to the SWP account books and official records of the State insofar as the same pertain to the matters and things provided for in this contract, with the right at any time during office hours to make copies thereof, and the proper representatives of the State shall have similar rights with respect to the account books and records of the Agency.

20. **Waiver of Rights.** Any waiver at any time by either party hereto of its rights with respect to a default, or any other matter arising in connection with this contract, shall not be deemed to be a waiver with respect to any other default or matter.

21. **Assurance Relating to Validity of Contract.** This contract shall be effective after its execution by the Agency and the State. Promptly after the execution and delivery of this contract, the Agency shall file and prosecute to a final decree, including any appeal therefrom to the highest court of the State of California, in a court of competent jurisdiction a special proceeding for the judicial examination, approval, and confirmation of the proceedings of the Agency's Board of Directors and of the Agency leading up to and including the making of this contract and the validity of the provisions thereof as a binding and enforceable obligation upon the State and the Agency. If, in this proceeding or other proceeding before a court of competent jurisdiction, any portion of this contract should be determined to be constitutionally invalid, then the remaining portions of this contract shall remain in full force and effect unless modified by mutual consent of the parties.

22. **Notices.** All notices that are required either expressly or by implication to be given by one party to the other shall be deemed to have been given if delivered personally or if enclosed in a properly addressed, postage prepaid, envelope and deposited in a United States Post Office. Unless or until formally notified otherwise, the Agency shall address all notices to the State as follows:

Director, Department of Water Resources
P.O. Box 388
Sacramento, California 95802

and the State shall address all notices to the Agency as follows:

North Delta Water Agency
333 Forum Building, 1107 - 9th Street
Sacramento, California 95814

IN WITNESS WHEREOF, the parties hereto have executed this contract on the date first above written.

Approved as to legal form and sufficiency:

By _____
Chief Counsel
Dept. of Water Resources

STATE OF CALIFORNIA

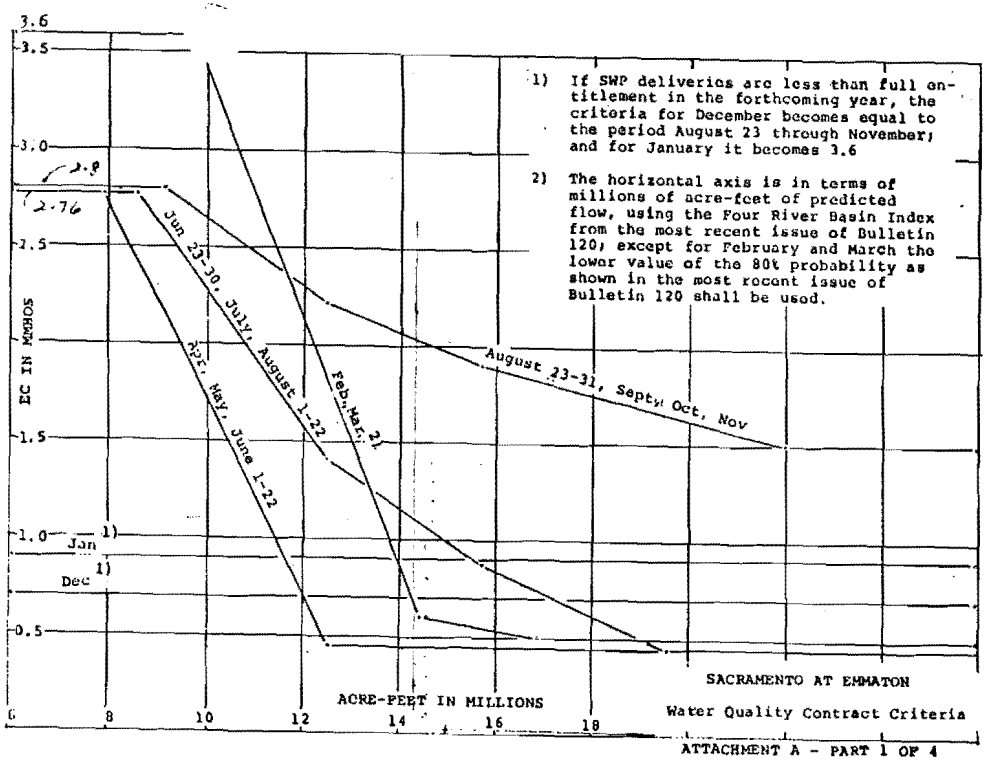
By _____
Dept. of Water Resources

Approved as to legal form and sufficiency:

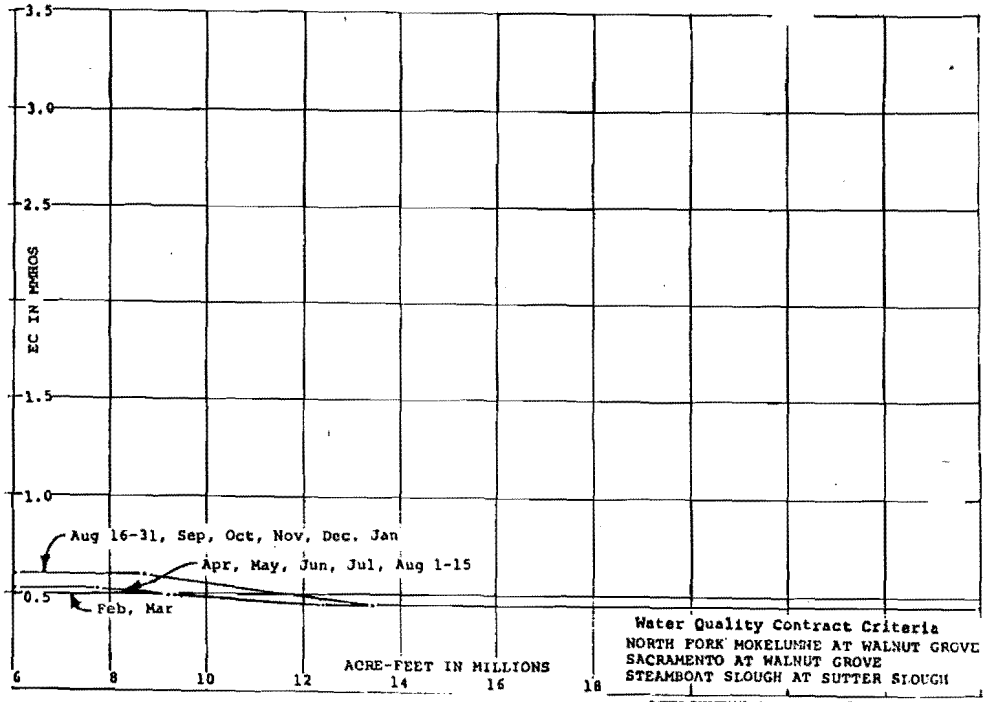
By _____
General Counsel
North Delta Water Agency

NORTH DELTA WATER AGENCY

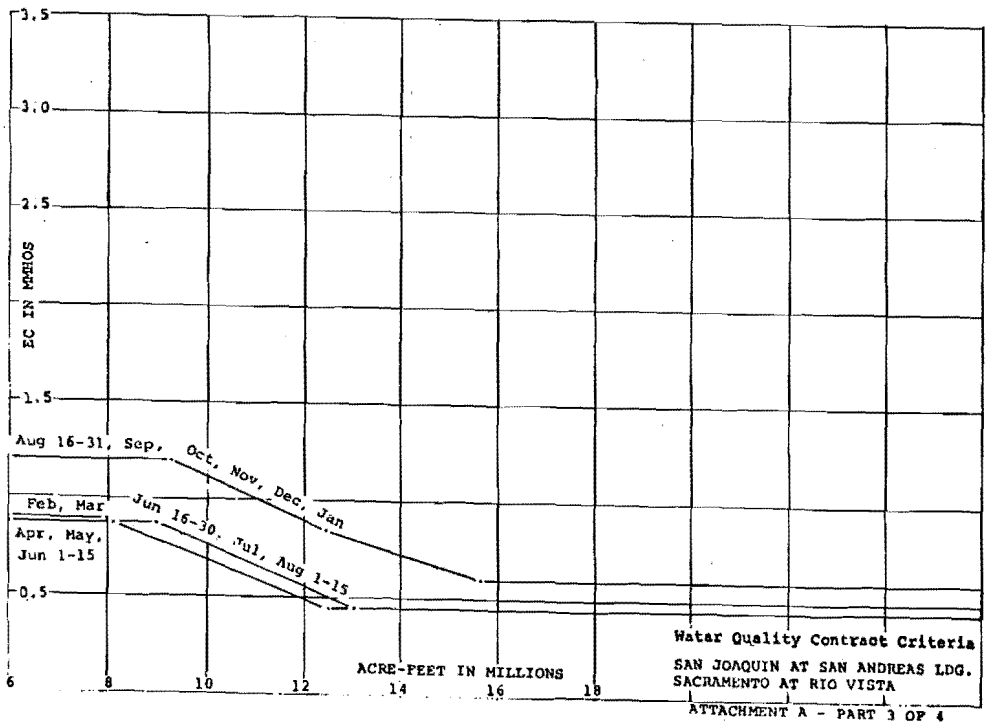
By _____
Chairman
Board of Directors



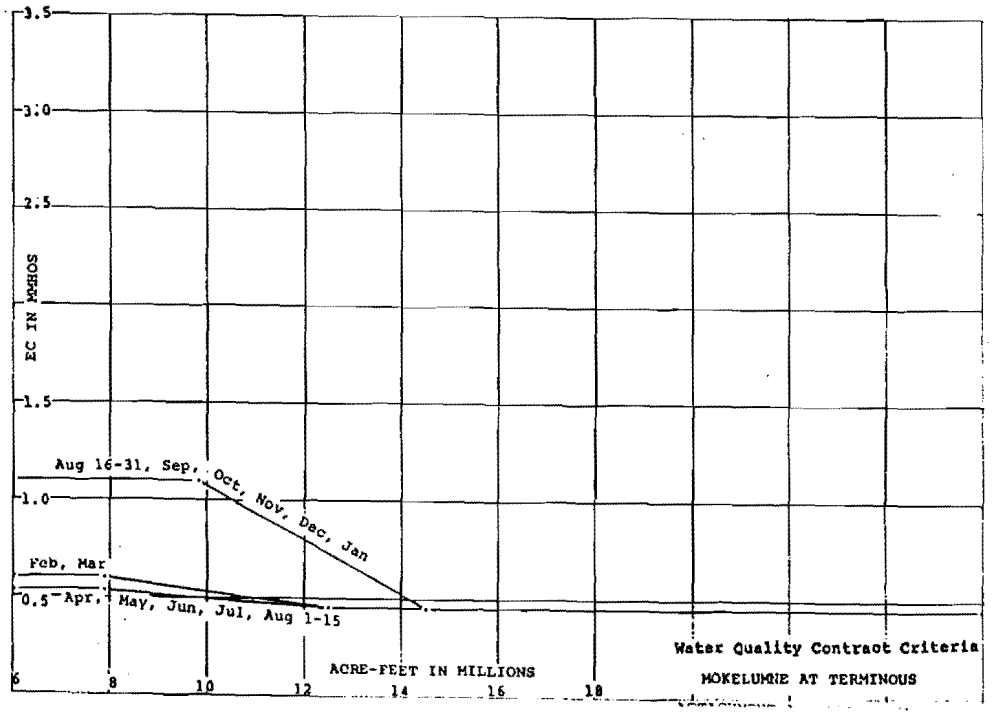
ATTACHMENT A - PART 1 OF 4

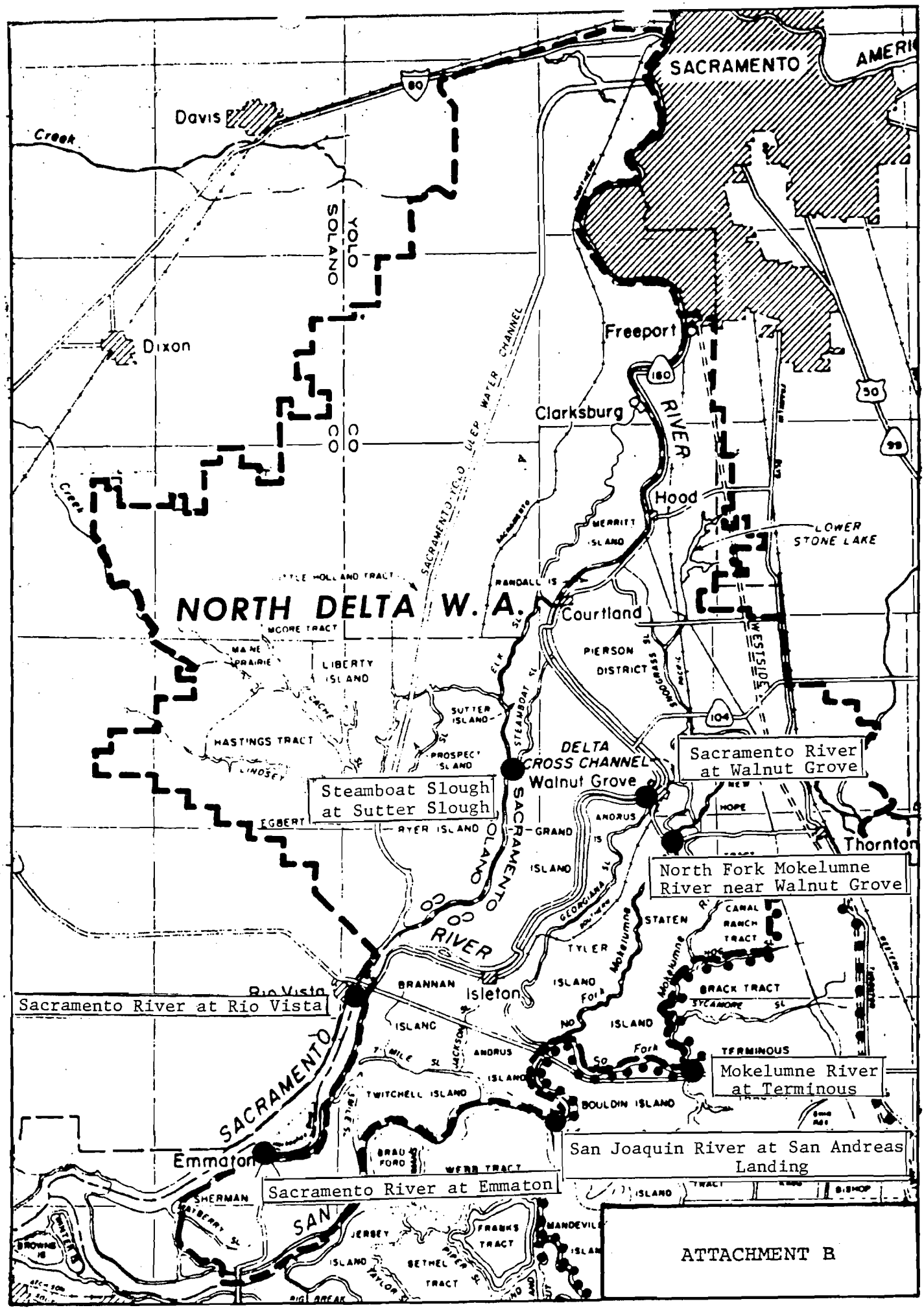


ATTACHMENT A - PART 2 OF 4



ATTACHMENT A - PART 3 OF 4




SACRAMENTO
Davis
Creek
YOLO
SOLANO
CO
Dixon
Freeport
Clarksburg
RIVER
Hood
LOWER STONE LAKE
SACRAMENTO-YOLO DEEP WATER CHANNEL
NORTH DELTA W. A.
Courtland
MERRITT ISLAND
RANDALL IS
MOORE TRACT
MAINE PRAIRIE
LIBERTY ISLAND
PIERSON DISTRICT
SUTTER ISLAND
HASTINGS TRACT
PROSPECT ISLAND
STEAMBOAT SL
DELTA CROSS CHANNEL
Walnut Grove
Sacramento River at Walnut Grove
Steamboat Slough at Sutter Slough
EGBERT
RYER ISLAND
GRAND ISLAND
ANDRUS
NEW HOPE
Thornton
North Fork Mokelumne River near Walnut Grove
STATEN
CANAL RANCH TRACT
TYLER ISLAND
BRACK TRACT
SYCAMORE SL
Rio Vista
Sacramento River at Rio Vista
BRANNAN ISLAND
Isleton
TERMINOUS
Mokelumne River at Terminous
TWITCHELL ISLAND
BOULDIN ISLAND
San Joaquin River at San Andreas Landing
Emmaton
Sacramento River at Emmaton
BRAU FORD
WEBB TRACT
SHERMAN
SAN
JERSEY ISLAND
FRANKS TRACT
BETHEL TRACT
MANDEVILLE ISLAND
BISHOP TRACT
ATTACHMENT B

NoD

STATE OF CALIFORNIA—THE RESOURCES AGENCY GEORGE DEUKMEJIAN, *Governor*

DEPARTMENT OF WATER RESOURCES
P.O. BOX 388
SACRAMENTO, CA 95802

JUL 19 1984

Mr. Michael A. Catino, Manager
North Delta Water Agency
921 - 11th Street, Room 703
Sacramento, CA 95814

Dear Mr. Catino:

Re: Channel Work in the North Delta

This letter is a response to issues raised at recent meetings attended by Department staff and North Delta interests.

The Department recognizes that there have been continuing impacts upon the channels of the Mokulumne River caused by the federal cross channel through which water of the federal Central Valley Project and some water of the State Water Project now flows. The Department of Water Resources (DWR) will attempt to address this issue in consultation with the Agency, Reclamation Districts and landowners and seek the cooperation of the United States Bureau of Reclamation in the analysis and solution of existing problems.

The Department of Water Resources is also aware of Delta landowner concerns that in proceeding with a State project we would attempt to limit our responsibility for erosion control to only those areas of actual construction as has been the history of the federal cross channel. This is not the case. We intend to analyze and examine conditions in the Delta to be sure we do not cause flow changes that could be reasonably considered to cause measurable adverse impacts without mitigating such impacts.

It is recognized that existing preliminary design information may be insufficient to accurately project velocities and stages of channel flows. However, as detailed design and construction proceeds, the Department will prevent or correct erosion or seepage problems attributable to the project. Should operational experience of completed works reveal unforeseen impacts attributable to DWR actions, they will be corrected.

The contract between the State and the North Delta Water Agency dated January 28, 1981, provides in Article 6 for the repair or alleviation of any erosion or water level impacts caused by the State Water Project upon users within the Agency. I concur that a supplemental agreement with the Agency should be agreed upon prior to construction of channel work in the North Delta envisioned in SB 1369 to implement this contract provision, existing Water Code sections 12627.3, 12627.4 and section 12627.5 proposed for SB 1369.

JUL 19 1984

The supplemental agreement between the State and the Agency, and the State's commitment to Reclamation Districts and landowners abutting effecting channels, will cover at least the following points:

(a) Designation of an employee by DWR to be responsible for liaison with the Agency, Reclamation Districts and landowners.

(b) Appointment by the Agency of an advisory committee to the Department on such matters as the selection of project design criteria, construction specifications, alignment and right-of-way requirements. This would include recreational features.

(c) Provision to the Agency by DWR of all applicable records and files relevant to and indicative of flows and seepage from the channels in the North Delta. This information will be made available prior to the agreement if requested by Agency.

(d) Provision for detailing maintenance standards and appropriate sharing of financial responsibility for maintenance among the Department and Reclamation Districts.

If you need further information, please contact me at (916) 445-6582.

Sincerely,

David N. Kennedy
Director

DEPARTMENT OF WATER RESOURCES SPECIAL CONTRACT CLAIMS PROCEDURE

FOR THE 1981

CONTRACT BETWEEN THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND THE NORTH DELTA WATER AGENCY FOR THE ASSURANCE OF A DEPENDABLE WATER SUPPLY OF SUITABLE QUALITY

DURING THE 2015 DROUGHT EMERGENCY

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1. Purpose: The California Department of Water Resources (DWR) establishes this Special Contract Claims Procedure in accordance with the procedure called for in the 1981 Contract Between the State of California Department of Water Resources and the North Delta Water Agency for the Assurance of a Dependable Water Supply of Suitable Quality and a subsequent amendment in 1997 (1981 Contract), Provision 4(b)(iv), which states in relevant part, "When a drought emergency exists… a special contract claims procedure shall be established by the State to expedite and facilitate the payment of such compensation." **The Special Contract Claims Procedure defined herein shall not modify the 1981 Contract or otherwise abridge the rights or responsibilities of the parties to that contract.**

2. Initiation of Drought Emergency: As defined in the 1981 Contract, Provision 4(b)(i), a drought emergency began on **April 6, 2015** (2015 Drought Emergency) when all of the following occurred:

   (1) the Four-River Basin Index is less than an average of 9,000,000 acre feet in two consecutive years; and

   (2) a State Water Resources Control Board emergency regulation is in effect providing for the operation of the State Water Project to maintain water quality different from that provided in the 1981 Contract; and

   (3) the water supplied to meet annual entitlements of State Water Project agricultural contractors in the San Joaquin Valley is reduced by at least 50 percent of these agricultural

entitlements or the total of water supplied to meet annual entitlements of all State Water Project contractors is being reduced by at least 15 percent of all entitlements, whichever results in the greater reduction in acre feet delivered.

[Four-River Basin Index trigger met on April 1, 2015; emergency regulation trigger met on April 6, 2015; SWP delivery trigger met on December 1, 2014.]

3. Termination of Drought Emergency: As defined in the 1981 Contract, Provision 4(b)(ii), the 2015 Drought Emergency shall terminate if any of the conditions in the 1981 Contract, Provision 4(b)(i) cease to exist or if the flow past Sacramento after October 1 exceeds 20,000 cubic feet per second each day for a period of 30 days. The 2015 Drought Emergency terminated on **August 15, 2015** upon the expiration of the State Water Resources Control Board emergency regulation providing for water quality different from that provided in the 1981 Contract by modifying the Emmaton/Three-Mile Slough water quality criteria.

4. Claims Eligible for Reimbursement under this Procedure: For purposes of the Special Contract Claims Procedure described herein, an eligible claim for evaluation under this Special Contract Claims Procedure occurs within the timeframe of the 2015 Drought Emergency as determined by 1981 Contract Provisions 4(b)(i) and (ii). **Claims shall be submitted as described in this Special Contract Claims Procedure no later than six (6) months after harvest in the last growing season that occurs during a time when the 2015 Drought Emergency was in effect.** A growing season is the period of time within a single year needed to grow, harvest, produce and sell a crop.

5. Extra-contractual Extension of 2015 Drought Emergency: Should DWR and NDWA mutually agree to extend the term of the 2015 Drought Emergency, such an agreement shall, for the purposes of establishing eligible claims, amend paragraph 4 above.

6. Persons or Entities Eligible to act as Claimant: For purposes of the Special Contract Claims Procedure described herein, an eligible claimant is a legal user of water and landowner or lessee with a claim arising upon land within the boundaries of the North Delta Water Agency (NDWA) as defined in the 1981 Contract Provision (1)(a) as amended, and shall be referred to hereinafter as Claimant.

7. Calculating the Basis of an Eligible Claim: Calculating the basis of an eligible claim shall comply with the 1981 Contract Provision 4(b)(iv). During the 2015 Drought Emergency, and when an overland supply is not available to Claimant

comparable in quality and quantity to the water which would have been available to Claimant under Attachment A, the State shall compensate Claimant for loss of net income for each acre either (A) planted to a more salt-tolerant crop in the current year, (B) not planted to any crop in the current year provided such determination not to plant was reasonable based on the drought emergency, or (C) which had a reduced yield due to the drought emergency, calculated on the basis of Claimant's average net income for any three of the prior five years for each such acre. Any recovery under crop insurance, or any other source of income recovery, by the Claimant shall be included in the calculation of net income for the purposes of calculating claims under Provision 4(b)(iv).

8. Initiation of a Claim: In order to file a claim under this Special Contract Claims Procedure, a Claimant shall submit a Claim Request, Attachment 1 of this Special Contract Claims Procedure, any supplemental information required at the discretion of DWR, and any information the Claimant considers relevant to evaluation of the claim. Attachment 1 requires the North Delta Water Agency to confirm the Claimant's status as a legal user of water and member of the agency in order to establish the applicability of the 1981 Contractual protections.

9. Initial Claim Review: DWR will evaluate the completeness of the claim within 30 days of receipt of initial claim information or subsequent additional information and issue a written response informing the Claimant of the completeness of the submitted claim. DWR, at its sole discretion, may request additional information from the Claimant during this period.

   Claimant shall make a good faith effort to provide DWR with the requested information that shall not exceed 90 days per request by DWR. Should the Claimant fail to make a good faith effort or exceed the 90 day threshold, DWR may, at its sole discretion, deny the claim.

   Upon notice to the Claimant of DWR receiving a complete claim, DWR shall evaluate the claim and provide Claimant of its decision within 60 days. Failure to provide a decision within 60 days is deemed a denial of the claim. Upon mutual agreement by DWR and the Claimant, this 60 day period may be extended.

   If the response by DWR regarding the claim is unacceptable to the Claimant, the Claimant may either (1) pursue the dispute resolution procedure described herein at paragraph 10, or (2) pursue other remedy in accordance with 1981 Contract and applicable state law.

10. Disputes over Initial Claim Review Outcome: If a Claimant disputes the outcome of the initial claim review process, described herein at paragraph 9, the Claimant may choose to pursue this Dispute Resolution Procedure.

    A. Claimant shall submit to DWR a completed and signed Dispute Resolution Initiation form, Attachment 2.
    B. Any controversy or claim pursued through this Dispute Resolution Procedure shall be settled by arbitration and judgment upon the award rendered by the arbitration may be entered in any court having jurisdiction thereof.
    C. Rules of Arbitration:
        i. Claims shall be heard by a panel of three arbitrators. One arbitrator shall be selected by the Department of Water Resources. One arbitrator shall be selected by the North Delta Water Agency. One arbitrator shall be selected by DWR and shall be agricultural practices and crop yield expert.
        ii. The place of arbitration shall be Sacramento, CA.
        iii. The arbitration shall be governed by the laws of the State of California.
        iv. There shall be no discovery allowed. The arbitration will be based on the production of documents during the initial claims review by Claimant and DWR, and there shall be no in-person or oral hearing.
        v. Time is of the essence for any arbitration under this agreement and arbitration shall take place within 90 days of filing and awards rendered within 120 days. Arbitrator(s) shall agree to these time limits prior to accepting appointment.
        vi. The arbitrators will have no authority to award punitive or other damages not measured by the prevailing party's actual damages as determined by the 1981 Contract Provision 4(b)(iv), except as may be required by statute.
        vii. Each party shall bear its own costs and expenses and an equal share of arbitration fees and any administrative fees of arbitration. A cost quote for arbitration shall be prepared by the neutral arbitrator and payment of arbitration fees and any administrative fees of arbitration shall be paid prior to initiation of arbitration, including initial review of documents.
        viii. Except as may be required by law, neither a party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of the DWR and NDWA.

11. Timeframe for Payment of Claims: Claims that are approved for payment and not contested by the Claimant shall be paid within 45 days from the date upon which DWR receives a complete and signed copy of the Liability Release, Attachment 3, from the Claimant.

12. Department of Water Resources Contact: All claims and written communications shall be submitted to:

    Chief, State Water Project Analysis Office
    Department of Water Resources
    P.O. Box 942836
    Sacramento, CA 95814

13. Department of Water Resources Internal Processes: State Water Project Analysis Office shall, within a reasonable time after receipt of a claim, forward two copies to:

    DWR Accounting Office
    Contracts Payable Unit

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DEPARTMENT OF WATER RESOURCES SPECIAL CONTRACT CLAIMS PROCEDURE

ATTACHMENT 1

CLAIM REQUEST

FORM FOR CROP DAMAGE OR LOSS OF INCOME

Claim Number:

Submit to:

Chief, State Water Project Analysis Office
Department of Water Resources
P.O. Box 942836
Sacramento, CA 95814

PLEASE PROVIDE THE FOLLOWING INFORMATION AS APPLICABLE. Attach additional sheets as necessary:

1. Name of Claimant:

2. Property (APN or other description):

3. Description of the circumstances surrounding the claimed damage or loss of net income:

4. Provide the following information for permanent and annual crops:

2015 Permanent Crops (as applicable)

A. Yield quantity(ies):

B. Yield value(s):

2015 Annual Crops (as applicable)

A. Planting decision date(s):
If Planted:

If Fallowed:

B. Planting decision details:
1. Sow date(s):

2. Harvest date(s):

3. Receipts/invoices:

4. Yield quantity(ies):

5. Yield value(s):

5. Timing of irrigation and pre-irrigation:

6. Crop history on the property for the past five years:

7. Knowledge of water quality and flexibility regarding irrigation (i.e. could you

have pre-irrigated when water quality standards were met?):

8. Verification of crop sales (please attach):

9. Information regarding crop insurance:

10. Method of calculating yield reduction per acre:

11. Estimate of losses of net income due to SWP operation in connection with NDWA contract, calculated on the basis of the user's average net income for any three of the prior five years. Briefly describe how calculated.

I hereby certify that the losses on which this claim is based have not been paid

and are not payable from any other party. I declare under penalty of perjury that the information given above is true and correct.

Dated, this day of , 20__.

_____ as represented by _____
(Printed Claimant Name) (self or Claimant legal representative)

_____
(Signature)

The North Delta Water Agency hereby certifies that the Claimant was at the time of the claimed loss, and is now, a legal water user and a leasee or landowner within the boundaries of the North Delta Water Agency as specified in the North Delta Water Agency Act (California Water Code App. Ch. 115 et seq.), and covered by the protections of the 1981 Contract Between the State of California Department of Water Resources and the North Delta Water Agency for the Assurance of a Dependable Water Supply of Suitable Quality as amended.

Dated, this day of , 20__.

_____, legal representative of North Delta Water Agency
(Printed Name)

_____
(Signature)

DEPARTMENT OF WATER RESOURCES SPECIAL CONTRACT CLAIMS PROCEDURE

ATTACHMENT 2

DISPUTE RESOLUTION INITIATION

Claim Number:

Submit to:

Chief, State Water Project Analysis Office
Department of Water Resources
P.O. Box 942836
Sacramento, CA 95814

PLEASE PROVIDE THE FOLLOWING INFORMATION AS APPLICABLE. Attach additional sheets as necessary:

1. Name of Claimant:

2. Property (APN or other description):

3. Consent to Enter into Binding Resolution:
   Participation in expedited dispute resolution of 2015 Drought Emergency Claims Pursuant to the Department of Water Resources Special Contract Claims Procedure established by virtue of the 1981 Contract Between the Department of Water Resources and the North Delta Water Agency for the Assurance of a Dependable Water Supply of Suitable Quality is voluntary. Should it be utilized by a Claimant it requires the agreement of the Claimant to be bound by the decision rendered.

   I, _____ on behalf of Claimant, freely and voluntarily agree to be bound, and have authority to bind Claimant, to any determination regarding my claim against the Department of Water Resources brought under this Special Contract Claims Procedure, and shall not pursue any further recourse, legal or otherwise, as it relates to this claim.

4. Dispute Resolution Procedure: If a Claimant disputes the outcome of the initial claim review process the Claimant may choose to pursue this Dispute Resolution Procedure.

    A. Claimant shall submit to DWR a completed and signed Dispute Resolution Initiation form, which is this form.
    B. Any controversy or claim pursued through this Dispute Resolution Procedure shall be settled by arbitration and judgment upon the award rendered by the arbitration may be entered in any court having jurisdiction thereof.
    C. Rules of Arbitration:
        i. Claims shall be heard by a panel of three arbitrators. One arbitrator shall be selected by the Department of Water Resources. One arbitrator shall be selected by the North Delta Water Agency. One arbitrator shall be selected by DWR and shall be agricultural practices and crop yield expert.
        ii. The place of arbitration shall be Sacramento, CA.
        iii. The arbitration shall be governed by the laws of the State of California.
        iv. There shall be no discovery allowed. The arbitration will be based on the production of documents during the initial claims review by Claimant and DWR, and there shall be no in-person or oral hearing.
        v. Time is of the essence for any arbitration under this agreement and arbitration shall take place within 90 days of filing and awards rendered within 120 days. Arbitrator(s) shall agree to these time limits prior to accepting appointment.
        vi. The arbitrators will have no authority to award punitive or other damages not measured by the prevailing party's actual damages as determined by the 1981 Contract Provision 4(b)(iv), except as may be required by statute.
        vii. Each party shall bear its own costs and expenses and an equal share of arbitration fees and any administrative fees of arbitration. A cost quote for arbitration shall be prepared by the neutral arbitrator and payment of arbitration fees and any administrative fees of arbitration shall be paid prior to initiation of arbitration, including initial review of documents.
        viii. Except as may be required by law, neither a party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of the DWR and NDWA.

5. Payment of Approved Claims:
   Payment shall only occur after the Claimant submits to DWR a complete and signed release of liability acceptable to DWR. A copy of this release is included as Attachment 3.

I hereby certify that the losses on which this claim is based have not been paid and are not payable from any other party. I declare under penalty of perjury that the information given above is true and correct. I agree to enter into this binding dispute resolution process as defined in the documents collectively known as the Department of Water Resources Special Contract Claims Procedure for the 1981 Contract Between the State of California Department of Water Resources and the North Delta Water Agency for the Assurance of a Dependable Water Supply of Suitable Quality during.

Dated, this day of , 20__.

_____ as represented by _____
(Printed Claimant Name) (self or Claimant legal representative)

_____
(Signature)

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DEPARTMENT OF WATER RESOURCES SPECIAL CONTRACT CLAIMS PROCEDURE

ATTACHMENT 3

LIABILITY RELEASE

Claim Number:

RELEASE

Upon receipt of payment in the amount of _____, ($_____), Claimant _____, as legally represented by _____, hereby agrees to release and discharge the State of California, its officers, agents and employees from any and all liability arising from and under the matters recited in Claim Number _____ filed with the Department of Water Resources and from any and all claims or demands which Claimant now or hereafter may have against the State of California, or the officers, agents and employees thereof for damages of any kind or nature arising out of the matters alleged in the above claim.

Claimant in signing this Release also agrees that this Release shall constitute a full and final accord and satisfaction and release of each and every matter stated in the above claim.

Claimant hereby waives and relinquishes any and all rights or benefits that Claimant may have under the provisions of Section 1542 of the California Civil Code which reads as follows:

> A general release does not extend to claims which the creditor does not know or suspect to exist in his favor at the time of executing the release, which if known by him must have materially affected his settlement with the debtor.

This release is freely and voluntarily entered into by the undersigned.

Dated, this day of , 20__.

_____ as represented by _____
(Printed Claimant Name) (self or Claimant legal representative)

_____
(Signature)

A-13-276

PROTEST DISMISSAL AND SETTLEMENT AGREEMENT BETWEEN DELTA WETLANDS PROPERTIES, SAN JOAQUIN COUNTY AND SAN JOAQUIN COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

This Protest Dismissal and Settlement Agreement ("Agreement") is entered into and effective this 13th day of AUGUST, 2013 ("Execution Date"), by and between San Joaquin County ("County"), a political subdivision of the State of California, San Joaquin County Flood Control and Water Conservation District ("District"), a political subdivision of the State of California, and Delta Wetlands Properties, an Illinois General Partnership ("Delta Wetlands"). San Joaquin County and San Joaquin County Flood Control and Water Conservation District are collectively referred to as "County". Hereinafter, the term "Delta Wetlands" shall include Delta Wetlands Properties, its successors and assigns.

RECITALS

A. WHEREAS, Delta Wetlands is proposing to develop the Delta Wetlands Project ("Project") on Bacon Island, Bouldin Island, Webb Tract and Holland Tract;

B. WHEREAS, the Project involves water storage reservoirs for diversion and storage of water on and discharge of water from Bacon Island and Webb Tract (the "Reservoir Islands") and seasonal diversion and use of water on Bouldin Island and Holland Tract (the "Habitat Islands") for farming and wildlife habitat;

C. WHEREAS, Delta Wetlands and the Semitropic Water Storage District ("Semitropic") state that they are presently jointly responsible for the permitting, development, construction and operation of the Project;

D. WHEREAS, the Project is described in the 1995 Draft Environmental Impact Report/Statement for the Delta Wetlands Project, the 2000 Revised Draft Environmental Impact Report/Environmental Impact Statement, the 2001 Final Environmental Impact Report, the 2001 Final Environmental Impact Statement, the 2010 Delta Wetlands Project Place of Use Draft Environmental Impact Report and the Delta Wetlands Project Place of Use Final Environmental Impact Report ("2011 FEIR");

E. WHEREAS, Semitropic served as the lead agency for purposes of compliance with the California Environmental Quality Act and certification of the 2011 FEIR for the Project;

F. WHEREAS, the Project is located within the Sacramento – San Joaquin River Delta ("Delta");

G. WHEREAS, Bacon Island and Bouldin Island are located in San Joaquin County and Holland Tract and Webb Tract are located in Contra Costa County;

H. WHEREAS, Bacon Island consists of approximately 5,263 acres of Important Farmland, which includes approximately 5,151 acres designated as Prime Farmland; however,

only 4,807 acres are presently in active agricultural production (USDA, FSA-578 Report of Acreage for 2012), and the remainder of the land is not currently farmable due to roads, levees, drains, and wet soil conditions;

I. WHEREAS, agricultural production on Bacon Island will cease during the life of the Project, eliminating the agricultural production capabilities on the island and resulting in a 4,807-acre reduction in agricultural production during that time;

J. WHEREAS, Bacon Island will be seasonally inundated but the agricultural soils will not be permanently lost or converted to non-agricultural use, and the island will be restored to commercially farmable condition following its use as a water storage reservoir;

K. WHEREAS, Delta Wetlands will conduct wildlife-friendly farming on Bouldin Island as part of the Project's Habitat Management Plan ("HMP"), which also calls for the creation of wetlands and other wildlife habitat under a California Fish and Wildlife Easement;

L. WHEREAS, County, Central Delta Water Agency ("CDWA"), Reclamation District No. 2038, Reclamation District No. 2072, and RC Farms, Inc., jointly filed a lawsuit challenging Semitropic's certification of the 2011 FEIR and approval of the Project in the case, *Central Delta Water Agency, et al. v. Semitropic Water Storage District, et al.*, San Francisco County Superior Court Case No. CPF-11-511753 (hereinafter referred to as "Lawsuit");

M. WHEREAS, the San Francisco County Superior Court denied the County's and other parties' claims in the Lawsuit and entered Judgment in favor of Semitropic and Delta Wetlands on October 29, 2012;

N. WHEREAS, Semitropic and Delta Wetlands filed a memorandum of costs in the Lawsuit on November 2, 2012;

O. WHEREAS, County and other parties have jointly filed an appeal of the San Francisco County Superior Court decision and Judgment in the Lawsuit, which is pending before the First District Court of Appeal as Case No. A137300;

P. WHEREAS, Delta Wetlands has applied for appropriative water right permits from the State Water Resources Control Board for the Project and the active Applications and Petitions to Change Applications (hereinafter collectively the "Applications") for the Project have been assigned the following numbers by the State Water Resources Control Board: Nos. 29062 and 30268 (Webb Tract), and Nos. 29066 and 30270 (Bacon Island);

Q. WHEREAS, County has filed protests against some or all of the Applications (hereinafter collectively referred to as "Protests");

R. WHEREAS, County is concerned about possible seepage and levee stability issues in connection with Project activities on Bacon Island and Bouldin Island, and also on Webb Tract and Holland Tract, which while located in Contra Costa County, are close enough to the County that they could cause seepage and levee stability problems for landowners and Reclamation Districts within San Joaquin County;

S. WHEREAS, County does not wish to duplicate the Protest Dismissal and Settlement agreement that Delta Wetlands and CDWA have entered into, but remains concerned with the seepage and levee stability issues;

T. WHEREAS, the County has enacted San Joaquin County Code Section 9-115.582 and Table 9-605.2, a zoning ordinance that requires a conditional use permit ("CUP") to construct water storage facilities of 500 acre-feet or greater;

U. WHEREAS, the County has enacted San Joaquin County Code Section 9-1080 *et seq.*, an agricultural land conversion ordinance that requires conservation of other agricultural land at a 1:1 ratio or payment of an in lieu fee for projects involving a zoning change that results in conversion of agricultural land to non-agricultural purposes;

V. WHEREAS, Delta Wetlands and County dispute whether a CUP and additional agricultural land mitigation will be required for the Project;

W. WHEREAS, although the Parties are in disagreement as to appropriate agricultural land conservation measures, the Parties desire to settle the litigation and disputes between them, thus avoiding continued expense and attention, and the Parties have therefore agreed that Delta Wetlands will acquire easements on 5,500 acres of Prime Farmland in accordance with the terms of this Agreement;

X. WHEREAS, the Parties intend and agree that easements satisfying mitigation land obligations of the Agreement be held by the Central Valley Farmland Trust ("CVFT") or another third party mutually agreed upon by the County and Delta Wetlands; and

Y. WHEREAS, the Parties desire to address the County's concerns regarding the construction and operation of the Project, its impacts to agricultural production, and its other impacts by entering into this settlement of all existing legal claims and disputes between the County, Delta Wetlands and Semitropic regarding the 2011 FEIR and the Project's construction, operation, approvals, and water rights.

AGREEMENT

NOW, THEREFORE, the Parties hereby agree as follows:

1. **Purpose of Agreement.**

The purpose of this Agreement is to provide a mechanism for the terms herein and to settle litigation and permitting disputes between the Parties.

2. **Definitions**.

2.1.1. **"CDWA Settlement Agreement"**. The Protest Dismissal and Settlement Agreement between Delta Wetlands, CDWA, and other parties, dated _____, 2013, as

may be amended, restated or supplemented from time to time. The _____, 2013 Protest Dismissal and Settlement Agreement is attached hereto as Exhibit A.

2.1.2. **"Commercial Agricultural Production"**. The production of crops for sale including, but not limited to, livestock production and grazing, on land and includes the capability to alter, from time to time, practices and crops produced to attain the most economically advantageous production given the climate and soil of the land. Nothing in this definition is intended to exclude agricultural lands used for seasonal wildlife hunting and recreation, such as the common practice of intentional flooding of Delta agricultural lands in the fall and winter.

2.1.3. **"County"**. County shall refer to the County of San Joaquin, the Board of Supervisors of the County of San Joaquin, San Joaquin County Flood Control & Water Conservation District, and all departments and agencies of the County of San Joaquin.

2.1.4. **"Easement(s)"**. Agricultural conservation easements acquired pursuant to Section 3 of this Agreement.

2.1.5. **"Easement Agreement"**. The legal document encumbering a specific property with an easement that substantially conforms to the Easement Form and that is tailored to the specific features of the property by Easement Holder.

2.1.6. **"Easement Form"**. The form of easement attached hereto as Exhibit B. Each Easement Agreement entered into between Easement Grantor and Easement Holder shall substantially conform to the Easement Form.

2.1.7. **"Easement Grantor"**. The owner of land granting an Easement.

2.1.8. **"Easement Holder"**. The organization selected by the Parties in accordance with Section 3.3 to administer the Easements acquired pursuant to the this Agreement.

2.1.9. **"Easement Holder-Delta Wetlands Agreement"**. The agreement entered into between Easement Holder and Delta Wetlands to carry out easement provisions of this Agreement.

2.1.10. **"Project" or "Delta Wetlands Project"**. The Delta Wetlands Project, including all governmental and non-governmental regulatory, real property and other permits, clearances and approvals necessary for the construction and operation of the Project, as defined in the 2011 Delta Wetlands Project Place of Use Environmental Impact Report.

3. Agricultural Conservation Easements

Delta Wetlands, its agent, or one or more Easement Holders shall acquire perpetual agricultural easements from willing sellers on 5,500 acres in accordance with the following terms.

3.1. **Land Eligible for Easements**. The land eligible for easements shall meet the following terms:

3.1.1. Land must be Prime Farmland that has been used for Commercial Agricultural Production within three of the last five years and is free of restrictions limiting agricultural use subject to Section 3.1.4. "Prime Farmland" means land designated as such by the California Department of Conservation at the time the easement is acquired.

3.1.2. Land shall be located anywhere within San Joaquin County; however, Delta Wetlands may request County approval, in accordance with Section 3.2.3, for land located outside of San Joaquin County but within the area defined as the "Sacramento-San Joaquin Delta" (hereinafter, "legal Delta") in Water Code section 12200 if Delta Wetlands is not able to acquire all 5,500 acres of easements within San Joaquin County at a reasonable cost.

3.1.3. Land must have a permanent water supply that is adequate to support customary local commercial agricultural production on the land. This term shall be fulfilled by providing either a statement of the easement grantor that the property has an adequate water supply or other documentary evidence of a water right or other entitlement to use water on the property subject to review and approval by County, which approval shall not be unreasonably denied. This term does not require submission of further proof or evidence to establish the validity of water rights unless reasonably requested by County in the case of a particular Easement.

3.1.4. Land may have existing or future Williamson Act, flood, flowage or other easements that do not impair agricultural productive capacity of the property, provided that such other easements are not conservation easements that already restrict use of the property to agricultural uses or which restrict the use of the property for wildlife habitat conservation purposes. Any other existing easement, restriction or encumbrance on land shall be subject to review and approval by County, which approval shall not be unreasonably denied.

3.2. **Verification that Easements Lands Meet Section 3.1 Criteria.**

3.2.1. Easement Holder Verification. Easement Holder shall exercise due diligence to verify that the easement lands meet the criteria in Section 3.1. Easement Holder shall provide a written statement to County Counsel that the easement meets the Section 3.1 criteria.

3.2.2. County Review and Approval of Verification. County Counsel shall have thirty days to review and approve or deny the proposed easement and verification submitted by Easement Holder for compliance with this Agreement. If County Counsel does not approve or deny the proposed easement within thirty days it shall be deemed approved. If County Counsel denies the proposed easement it shall provide Easement Holder and Delta Wetlands with specific reasons in writing why the proposed easement does not comply with this Agreement.

3.2.3. Procedure for Approval of Lands outside San Joaquin County. In the event that Delta Wetlands proposes easements outside of the County in accordance with Section 3.1.2, the following procedures shall govern.

3.2.3.1. Delta Wetlands shall submit to the County a request to satisfy easement obligations with easements located on lands outside San Joaquin County but within the legal Delta, as provided in 3.1.2. The request shall be supported with Delta Wetlands'

explanation of its efforts to acquire easements within San Joaquin County, and an explanation of the impediments and obstacles to obtaining easements at reasonable cost on land comparable to those impacted on Bacon Island (e.g., Delta lowlands properties) within San Joaquin County. The request shall also include the quantity of acres Delta Wetlands expects to acquire outside San Joaquin County, and a legal and physical description of the land within the legal Delta that Delta Wetlands proposes for easements. The County Board of Supervisors shall respond to Delta Wetlands' request within 45 days. County Board of Supervisors shall respond in writing by approving or disapproving Delta Wetlands' request, or the County may seek additional information supporting the request. Where County Board of Supervisors seeks additional information regarding the request, then upon a response from Delta Wetlands, County Board of Supervisors shall respond to Delta Wetlands' request within 45 days. County Board of Supervisors shall not unreasonably deny Delta Wetlands' request. .

3.3. **Easement Holder**. The parties shall mutually agree to the organization that shall hold and administer the easement(s). The easement holder shall be an organization whose purposes include agricultural land preservation and be a "qualified organization" under Section 170(h) of the United States Internal Revenue Code and meet the requirements of Section 815.3(a) of the California Civil Code.

3.3.1. The parties propose that CVFT shall be the holder of the easement(s). County agrees that CVFT shall serve as easement holder if CVFT and Delta Wetlands execute an Easement Holder-Delta Wetlands Agreement whereby CVFT agrees to administer the easements in accordance with this Agreement and Delta Wetlands agrees to provide the Easement administration and enforcement costs. The Parties agree that CVFT meets the requirements of Section 3.3 of this Agreement.

3.3.2. The parties may mutually select a different easement holder to hold and administer all or a portion of the Easements.

3.4. **Required Elements for Easement Holder-Delta Wetlands Agreement**. The Easement Holder-Delta Wetlands Agreement shall provide the following:

3.4.1. Verification of Easements Lands. Easement Holder shall exercise due diligence to verify that the Easement lands meet the Section 3.1 criteria in accordance with the Section 3.2.1 procedure.

3.4.2. Verification of Easement Agreements. Easement Holder shall verify that the Easement Agreements conform to the Easement Form and other applicable obligations set forth in the Agreement.

3.4.3. Monitoring. Easement Holder shall monitor the property(ies) encumbered by the Easements for compliance with the terms of the each specific property's Easement Agreement.

3.4.4. Enforcement. Easement Holder shall establish procedures for enforcement where Easement Grantor or subsequent landowner does not comply with the terms of the Easement Agreement. The Easement Holder-Delta Wetlands Agreement shall state that both Easement Holder and County have the authority to enforce the terms of the Easement

Agreements and to take any enforcement action authorized by the Easement Holder-Delta Wetlands Agreement.

3.4.5. Annual Report. The Easement Holder shall provide to County's Board of Supervisors by March 1 an annual report that summarizes the monitoring and enforcement activities as to each Easement for the prior year.

3.4.6. Delta Wetlands Payments. The Easement Holder-Delta Wetlands Agreement shall provide that Delta Wetlands shall make the payments described in Section 3.6.

3.5. **Easement Agreements.**

3.5.1. The Easement Agreements entered into between Easement Grantors and Easement Holder shall substantially conform to the Easement Form attached hereto as Exhibit B.

3.5.2. The terms of the Easement Agreements shall provide that the grantor of any easement shall not substantially impair or diminish the agricultural productive capacity of the encumbered property.

3.5.3. The easement(s) shall not limit or prevent any activities of a reclamation district or any measures to construct, operate and maintain flood control, drainage, reclamation, seepage control, or irrigation facilities. The foregoing list does not allow for inundation for a reservoir or water storage facility or other facilities or uses of any kind that impair the commercial agricultural production capacity of the encumbered property.

3.5.4. Closing of each Easement Agreement shall be by a national title insurance company with an office in San Joaquin County and at closing, County and Easement Holder shall be issued a policy of title insurance insuring that the Easement is not subordinate to any lender interest, encumbrance or restriction capable of foreclosing the property and extinguishing the easement. All title costs and the cost of the required policy of title insurance shall be borne by Delta Wetlands.

3.6. **Delta Wetlands Easement Administration Payments.** Delta Wetlands shall be responsible for the following payments to Easement Holder. The amounts of the payments shall be negotiated between Easement Holder and Delta Wetlands and included in the Easement Holder-Delta Wetlands Agreement.

3.6.1. An initial payment to Easement Holder for the costs of the establishment, administration, and initial stewardship of the Easement(s).

3.6.2. Annual payments to Easement Holder for stewardship of the easement(s), including, but not limited to, ongoing monitoring, yearly reporting, and enforcement of the easement(s). The annual payment shall be secured by an encumbrance on Delta Wetland's Bacon Island and Bouldin Island. It is understood by County that the encumbrance will be subordinate to a prior and superior Fish and Wildlife Habitat easement. In the alternative to annual payments, Delta Wetlands may place in trust funds which will yield annually the amount required for the purposes specified in this subparagraph, as determined by CVFT or a one-time payment agreed upon by Easement Holder and Delta Wetlands may be made.

3.7. **Timing for and Conditions Precedent to Acquisition of Easements.** Delta Wetlands' obligation to acquire Easements pursuant to this Agreement shall not be effective until Delta Wetlands has received all necessary governmental and nongovernmental regulatory, real property and other permits, clearances and approvals to locate, construct and operate the Project, including but not limited to any all approvals required by County. If Delta Wetlands' obligation to acquire Easements takes effect, Easements shall be acquired prior to Delta Wetlands' commencement of construction of facilities for diversion of water to storage on Bacon Island in accordance with any water right permits issued for applications 29066 and 30270.

4. Delta Wetlands Protest Dismissal and Settlement Agreement with CDWA

4.1. **County as Third Party Beneficiary.** The CDWA Settlement Agreement shall provide that County shall be authorized and shall have the power to enforce the terms of that agreement as they relate to seepage (Section 2), levee integrity (Section 3), road integrity (Section 3) and future reclamation for agricultural use of Bacon Island (Section 4) with respect to the portion of the Project within the San Joaquin County or any effects from the Project to lands within San Joaquin County, in accordance with the same terms and conditions applicable to CDWA under the CDWA Settlement Agreement; provided, however, County expressly agrees to be bound by the CDWA Agreement as if it were a party signatory thereto including to be bound to the enforcement and arbitrations provisions (Sections 5 and 6) and any other procedural or substantive requirements and remedies of the CDWA Settlement Agreement that pertain to seepage (Section 2), levee integrity (Section 3), road integrity (Section 3) and future reclamation for agricultural use of Bacon Island (Section 4). County acknowledges that the CDWA Settlement Agreement provides the exclusive remedies regarding construction and operation of the Project, including those relating to Project seepage, levee integrity, road integrity and reclamation available to the County. The CDWA Settlement Agreement shall include the following language as a subsection in Section 6:

> This Agreement confers rights and remedies upon the County of San Joaquin as a third-party beneficiary of this Agreement. The County of San Joaquin may enforce the provisions of this Agreement pertaining to seepage (Section 2), levee integrity (Section 3), road integrity (Section 3) and future reclamation for agricultural use of Bacon Island (Section 4) as to the portion of the Project within the San Joaquin County or any effects from the Project to lands within San Joaquin County in the same manner and subject to the same limitations as provided for herein applicable to the CDWA. The Parties expressly intend to confer these rights and remedies upon the County of San Joaquin and may not materially amend this Section 6.24 or Section 9.1 of this Agreement or terminate this Agreement without the prior written consent of the County of San Joaquin, which consent shall not be unreasonably withheld.

4.2. **County Rights of Entry.** Section 9.1 of the CDWA Settlement Agreement shall confer to the County a right of entry to Bacon Island and Bouldin Island in accordance with and subject to the same terms, conditions and limitations applicable to CDWA defined in Section 9, including the obligation to indemnify Delta Wetlands in accordance with Section 9.4.

4.3. **Satisfactory Form of Agreement.** County acknowledges that it has received the CDWA Settlement Agreement dated _____, 2013 (Exhibit A). County acknowledges that the language of Sections 6.24 and 9.1 of the attached CDWA Settlement Agreement satisfy the terms of Sections 4.1 and 4.2 above.

4.4. **Waiver.** To the extent that the foregoing provisions of this Section 4 are releases by County to which Section 1542 of the California Civil Code or similar provisions of other applicable law applies, it is the intention of the parties that the foregoing releases shall be effective as a bar to any and all actions, fees, damages, losses, claims, liabilities and demands of whatsoever character, nature and kind, known or unknown, suspected or unsuspected specified herein of County as to Delta Wetlands. In furtherance of this intention, County expressly waives any and all rights and benefits conferred upon them by the provisions of Section 1542 of the California Civil Code, or similar provisions of applicable law, which states:

> **"A general release does not extend to claims which the creditor does not know or suspect to exist in his or her favor at the time of executing the release, which if known by him or her must have materially affected his or her settlement with the debtor."**

The Parties acknowledge that the foregoing waiver of the provisions of Section 1542 of the California Civil Code was bargained for separately. Notwithstanding the provisions of Section 1542, and for the purpose of implementing a full and complete settlement, County expressly acknowledges that this waiver is intended to include in its effect without limitation all of the claims, causes of action and liabilities which County do not know or suspect to exist in its favor at the time of execution of this Agreement, and this Agreement, contemplates extinguishment of all such claims, causes of action and liabilities as provided herein.

5. Bacon Island Restoration

Delta Wetlands agrees to prepare and implement a reclamation plan to restore Bacon Island to a commercially farmable condition at the conclusion of water storage operations. This paragraph is satisfied by Delta Wetlands compliance with the CDWA Settlement Agreement's provisions for a Reclamation Plan (Section 4), including provisions in that the CDWA Settlement Agreement provide for funding for the Reclamation Plan (Section 8).

6. County Permits and Approvals

6.1. **County Permits and Approvals Required for Project.** The Parties agree that the County permit and approval provisions of this Section shall apply to the construction and operation of the Project.

6.2. **Project Construction and Operations.** The County plans, permits and approvals identified herein shall be the exclusive means by which the County shall apply its regulatory authority to permit, condition or otherwise control Project construction and operation associated with the conversion of Bacon Island into a water storage reservoir, including construction of new water diversion and discharge facilities, major land grading and other construction that will be undertaken to convert Bacon Island into a water storage reservoir, and Project construction and operation associated with development of the HMP on Bouldin Island.

The requirements of this Section are not intended to apply to activities not associated with the Project, including any ongoing agricultural activities and levee maintenance and repair, and maintenance, repair and construction of electrical, natural gas, and other utilities not owned and operated by Delta Wetlands.

6.3. **Ministerial County Permits and Approvals.** Notwithstanding any claim that such permits and approvals may be preempted under Government Code section 53091, Delta Wetlands shall do the following prior to or during (if applicable) construction of Project:

6.3.1. Prepare a traffic control plan for the Project's construction and operation;

6.3.2. Obtain any encroachment or other County permits necessary for traffic associated with Project construction activities;

6.3.3. Comply with San Joaquin County Code agricultural excavation noise standards (San Joaquin County Code, Development Title 9, Section 9-1410.3) during Project's construction activities;

6.3.4. For new recreation facilities on Bouldin Island, obtain San Joaquin County building permits and permits required for septic systems and disposal of solid waste;

6.3.5. Prepare an integrated pest management plan prior to construction and coordinate plan implementation with the San Joaquin County Mosquito Vector and Control District; and

6.3.6. Obtain well permits for all monitoring wells or other wells of any kind that it installs as part of the Project in San Joaquin County.

6.4. **Conditional Use Permit**

6.4.1. Government Code Section 53091. The parties are in agreement that pursuant to Government Code section 53091, subdivision (e), zoning ordinances of the County shall not apply to the location or construction of facilities for the production, generation, storage, treatment, or transmission of water by a Local Agency as defined in Government Code 53090.

6.4.2. No Local Agency Ownership of Bacon Island. The parties do not agree on the application of County building ordinances and zoning ordinances to the location, construction and operation of a water storage facility on Bacon Island if a local agency does not own Bacon Island but such local agency has an interest in construction or operation of the Project. To attempt to resolve such a dispute and any dispute as to the meaning of Local Agency, the parties agree that Delta Wetlands will apply for and pursue, in good faith, County approval of a conditional use permit for the Project pursuant to San Joaquin County Code Section 9-115.582 and Table 9-605.2, as may be amended or renumbered ("CUP") in accordance with the following terms:

6.4.2.1. A water storage facility shall not be constructed on Bacon Island unless one of four events has occurred: County has issued a CUP authorizing such construction and Delta Wetlands elects to proceed under the terms of the CUP; Delta Wetlands

after final decision on a CUP asserts it is not bound by the requirement of a CUP as provided by Section 6.4.2.2, below; the CUP is preempted by State or Federal law; or one or more Local Agencies have acquired Bacon Island for value such that a CUP is not required.

6.4.2.2. Delta Wetlands reserves the right to proceed without compliance with the County's zoning ordinances (a) after application and good faith participation in the process for a CUP if dissatisfied with the outcome of the CUP process necessary to obtain a CUP after a final decision by the Planning Commission or the final decision by the Board of Supervisors if appealed (final decision), or (b) if the CUP is preempted by State or Federal law. Asserting that a CUP is not required as a matter of law and proceeding with the Project without compliance with the terms of a CUP shall not be deemed a breach of this Agreement by Delta Wetlands or its successor and County, in such event, may pursue litigation or undertake other proceedings to enforce the requirement of a CUP.

6.4.3. Local Agency Ownership of Bacon Island. The parties agree that if one or more Local Agencies acquire Bacon Island for value and construct a water storage facility on Bacon Island, County zoning ordinances including but not limited to San Joaquin County Code Section 9-115.582 and Table 9-605.2, shall not apply to the location, construction and operation of Bacon Island as a water storage facility and no conditional use permit or other County zoning approval shall be required for such a facility.

6.4.4. Regardless of whether Delta Wetlands has submitted an application for a CUP, or has obtained a CUP, neither the CUP application nor any CUP shall be binding on a public agency that is exempt from compliance with the requirement for a CUP.

6.5. **No Additional Agricultural Land Mitigation.** In no event, including in connection with the CUP application or any other permit or approval sought under the Agreement, shall the County insist or require that Delta Wetlands provide any agricultural land mitigation in excess of the amount or form of agricultural conservation easements specified in the Agreement, or insist or require that the standards for agricultural easements differ from those provided in this Agreement.

6.6. **County Approvals.** County shall not unreasonably withhold any permits or approvals associated with the items listed in this Section.

6.7. **Terms Continue.** Whether a CUP is required or is pursued by Delta Wetlands or is not pursued due to a Local Agency being exempt from the CUP requirement, all of the other terms of this Agreement shall remain binding on the parties and on any successor to Delta Wetlands whether a Local Agency or other entity.

7. County Road Restoration

Delta Wetlands shall repair or replace to their pre-construction condition Bacon Island Road and any other roads within the County that are damaged due to impacts associated with construction or operation of the Project, including, but not limited to damage caused by hauling or other work in San Joaquin County for the portions of the Project in Contra Costa County.

8. **County Dismissal of Lawsuits, Withdrawal of Protests and Agreement Not to Oppose the Project**

8.1. **Withdrawal of Protests.** County shall withdraw any Protests filed on behalf of itself against the Project and the Applications. To effect the withdrawal, within five (5) working days of execution of this Agreement by both Parties, County shall file with the State Water Resources Control Board, Division of Water Rights, a letter or other instrument withdrawing and requesting dismissal, with prejudice, of the Protests filed on behalf of itself, landowners and water right holders against the Project and the Applications. County shall diligently and in good faith pursue having the State Water Board enter the withdrawal of Protests, dismiss the Protests, or otherwise acknowledge the withdrawal of Protests, as expeditiously as possible. None of Delta Wetlands' obligations under this Agreement shall take effect unless and until the State Water Resources Control Board has entered the withdrawal or dismissal of all Protests on behalf of County with regard to the Project.

8.2. **Dismissal of Appeal of Judgment.**

8.2.1. County shall dismiss with prejudice the County's appeal of the Judgment entered in San Francisco County Superior Court Case No. CPF-11-511753. To effect these dismissals, within five (5) working days of execution of this Agreement by both Parties, County shall file with the First District Court of Appeal a request for dismissal, with prejudice, of the County's appeal of the Judgment, First District Court of Appeal Case No. A137300, and any other outstanding claims in the Lawsuit, against all respondents and real parties in interest, including parties not known to County. County shall diligently and in good faith pursue having each dismissal entered as expeditiously as possible. Within five (5) working days of entry of dismissal, County shall serve on all Parties notice of entry of that dismissal. None of Delta Wetlands' obligations under this Agreement shall take effect unless and until the First District Court of Appeal has entered dismissal of Case No. A137300 by County as to all respondents and real parties in interest in the Lawsuit.

8.2.2. If other parties to the Lawsuit, including CDWA, Reclamation District No. 2038, Reclamation District No. 2072, RC Farms, Inc., and any party who may intervene in the Lawsuit including the Attorney General's Office of the State of California, pursue claims, causes of action and requests for relief, County shall not indemnify, fund, or otherwise assist such parties to the Lawsuit.

8.3. **Agreement to Not Oppose Project.** So long as Delta Wetlands is in compliance with the terms of this Agreement and the conditions of all permits pertaining to the Project, and there has not been material change in the Project, County shall not protest or otherwise object to the permitting, location, construction or operation of the Delta Wetlands Project in any forum or encourage others to do the same, including, but not limited to, the following:

8.3.1. County shall seek no further relief, including appeals, with regard to the Protests and the Lawsuit, including any award of costs or attorneys' fees incurred in connection with the Protests, Lawsuit or previous administrative proceedings.

8.3.2. County shall not file, take, support in any way (financially or otherwise),

any administrative or legal action, protest or objection of any kind, in any forum, that opposes, challenges or seeks to delay, hinder or modify any or all existing or future approvals or actions by any private entity or federal, state or local public agency implementing the Project or implementing any future non-material modification to the Project, including but not limited to any permits, clearances, approvals or actions by Semitropic, the State Water Resources Control Board, the United States Army Corps of Engineers, the National Oceanic and Atmospheric Administration, the United States Fish and Wildlife Service, the California Department of Fish and Wildlife, the California Department of Water Resources, the Delta Protection Commission, the Delta Stewardship Council, the State Lands Commission, the Central Valley Flood Protection Board, Reclamation District Nos. 756, 2025, 2026 and 2028, California Department of Transportation, State Historic Preservation Office, Semitropic Water Storage District, Metropolitan Water District of Southern California, San Bernardino Valley Municipal Water District, Western Municipal Water District of Riverside of County, Kern County Water Agency, the United States Bureau of Reclamation, the United States Environmental Protection Agency, the applicable Regional Water Quality Control Board, the applicable Air Quality Control Board, San Joaquin County, Contra Costa County, and any other third party governmental or nongovernmental entity. County also shall not oppose or submit any written or oral comments on any National Environmental Policy Act or California Environmental Quality Act document prepared for the Project, including approvals by responsible and cooperating agencies, or prepared for any non-material modification to the Project. It is understood that County has taken, and expects in the future to take and pursue, positions in opposition to alterations in Delta channels and flows, the reconfiguration of the movement of water from the Sacramento River to the Tracy area pumps, increases in the quantity and flow rate of Delta exports, and related positions. County shall not be precluded from taking the foregoing positions or other positions on Delta issues by this Section 8.3.2 or this Agreement. If in the future the Project should become an integral component of a larger Delta project that alters Delta channels and flows, or reconfigures the movement of water from the Sacramento River to the Tracy area pumps, or increases the quantity and flow rate of Delta exports, County shall not be precluded from opposing the larger Delta project but County shall not oppose the Project.

8.3.3. For purposes of this Agreement, the following non-exhaustive list of Project modifications shall be deemed non-material: (a) a change in Project footprint or operations that decreases the average water storage quantity or residence time or reduces the maximum permitted water storage capacity of the Reservoir Island(s); (b) a change in Project operations or infrastructure that decreases the maximum permitted daily, monthly, and combined rates of diversion; (c) a change in Project operations or infrastructure that reduces maximum permitted discharges from the Reservoir Islands to the central Delta; (d) a change in the authorized place of use of the Project's water rights; or (e) a change in ownership of the Project.

8.3.4. Notwithstanding the foregoing obligations and restrictions in this Section 8, County may elect to seek judicial enforcement of its CUP requirements in the event that Delta Wetlands withdraws its CUP application pursuant to Section 6.5.2, a local agency does not own Bacon Island, and Delta Wetlands proceeds with construction of water storage facilities on Bacon Island. The filing and/or processing of a CUP application by Delta Wetlands shall not constitute an admission by Delta Wetlands that a CUP is required.

8.3.5. If there is a material change in the Project, County shall not be bound by this section 8.3 with respect to the material change, unless County has approved the material change in writing.

9. Each Party to Bear its Own Costs and Attorney's Fees; Delta Wetlands Withdrawal of Claim for Costs of Suit

9.1. **Costs and Fees.** Each party shall bear its own attorney's fees and costs in the Lawsuit. Neither party shall be entitled to recover any attorney's fees or costs from another party associated with the Lawsuit under any theory.

9.2. **Withdrawal of Claim for Costs of Suit.** Within five (5) working days of notice of entry of dismissal by County, Delta Wetlands shall withdraw or dismiss with prejudice its memorandum of costs filed under the Lawsuit with the San Francisco County Superior Court.

10. Arbitration of Disputes Regarding Section 3

All questions and disputes with respect to rights and obligations of the parties arising under Section 3 of this Agreement shall be resolved exclusively by arbitration.

10.1. **Demand for Arbitration.** Either party has 60 days from the date of notice of a claim to demand arbitration.

10.2. **Appointment of Arbitrators.** The parties may agree on one arbitrator. If they cannot agree on one arbitrator, there shall be three: one named in writing by each of the parties within five days after demand for arbitration is given, and a third chosen by the two appointed. Should either party refuse or neglect to join in the appointment of the arbitrator(s) or to furnish the arbitrator(s) with any papers or information demanded, the arbitrator(s) may proceed ex parte.

10.3. **Hearing.** The arbitration hearing shall be set by the arbitrator(s) to begin within 120 days from the date of a demand for arbitration, and the decision of the arbitrator(s) shall be issued within 180 days from the date of a demand for arbitration. The hearing on the matter to be arbitrated shall take place before the arbitrator(s) in Stockton, California, the time and place to be selected by the arbitrator(s). At the hearing, any relevant evidence may be presented by either party, and the formal rules of evidence applicable to judicial proceedings shall not govern. Evidence may be admitted or excluded in the sole discretion of the arbitrator(s). The arbitrator(s) shall hear and determine the matter and shall execute and acknowledge the award in writing and cause a copy of the writing to be delivered to each of the parties.

10.4. **Award.** If there is only one arbitrator, his or her decision shall be binding and conclusive on the parties, and if there are three arbitrators, the decision of any two shall be binding and conclusive. Except as otherwise expressly stated in this Section 10, the Commercial Arbitration Rules of the American Arbitration Association shall apply to the arbitration, and judgment on the award rendered by the arbitrator(s) may be entered in any court having jurisdiction.

10.5. **New Arbitrators.** If three arbitrators are selected, but no two of the three are able to reach a consensus regarding the determination of the dispute, then the matter shall be decided by three new arbitrators who shall be appointed and shall proceed in the same manner, and the process shall be repeated until a decision is agreed on by two of the three arbitrators selected.

10.6. **Cost of Arbitration.** Each party shall bear their own respective costs of arbitration and the cost of the arbitrator or arbitrators shall be shared equally.

11. Partners, Successors and Assigns

11.1. **Partners and Successors.** This Agreement shall inure to the benefit of and shall be binding upon the assigns, partners, successors in interest, personal representatives, estates, heirs, and legatees of each of the Parties hereto. Any successor or assignee of Delta Wetlands shall be bound to the terms of this Agreement in the same manner and to the extent as Delta Wetlands.

12. Miscellaneous Provisions

12.1. **Other Documents.** The Parties hereto agree to execute any and all additional documents reasonably necessary to carry out the purpose and intent of this Agreement.

12.2. **Entire Agreement.** Except for the documents incorporated by reference herein, this Agreement contains the entire understanding among the Parties and supersedes any prior written or oral agreements between them respecting the subject matter contained herein. There are no representations, agreements, arrangements, or understandings, oral or written, between and among the Parties relating to the subject matter of this Agreement that are not fully expressed herein.

12.3. **Amendments.** The provisions of this Agreement may be amended only by written agreement executed by the Parties hereto and recorded as required herein for this Agreement.

12.4. **Attorneys' Fees.** If any action at law or in equity, including an action for declaratory or injunctive relief, is brought to enforce or interpret the provisions of this Agreement, the prevailing party shall be entitled to reasonable attorneys' fees.

12.5. **Governing Law.** All questions with respect to the construction of this Agreement and the rights and liabilities of the Parties hereto shall be governed by the laws of the State of California.

12.6. **Severability.** If any non-material provision of this Agreement is declared by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions shall continue in full force and effect.

12.7. **Counterparts.** This Agreement may be executed in several counterparts and all counterparts so executed shall constitute one agreement which shall be binding on all of the

Parties hereto, notwithstanding that all of the Parties are not signatory to the original or the same counterpart.

12.8. **Headings**. The headings preceding the paragraphs of this Agreement are for convenience of reference only, are not a part of this Agreement, and shall be disregarded in the interpretation of any portion of this Agreement.

12.9. **Agents**. All rights and obligations agreed to herein by any Party may be exercised and fulfilled by the Party's authorized agent.

12.10. **Notices**. Any notice, demand, request or communication that the Parties desire or are required to give in writing pursuant to this Agreement shall be deemed to have been duly given if delivered by hand or mailed, postage prepaid, certified or registered mail, return receipt requested and addressed to the appropriate Party as set forth below with copies to all of the other Parties to this Agreement. Notice of change of address shall be effective only when given in accordance with this Paragraph. All notices, demands and other communications made in compliance with this paragraph shall be deemed to have been received on the earlier to occur of the date of delivery or on the third business day after mailing.

To DWP:

Delta Wetlands Properties
c/o Rick Stephens
Stephens Real Estate Partners, LLC
1330 Arnold Drive, Suite 142
Martinez, CA 94553-6538
Phone: (925) 932-0251
Fax: (925) 932-0277
stephens@zks.com

With copies to:

George Childs
Zurich Alternative Asset Management
165 Broadway - One Liberty Plaza
New York, NY 10006
Phone: (212) 871-1578
Fax: (866) 457-7296
george.childs@zurich.com

Peter J. Kiel
Ellison, Schneider & Harris L.L.P.
2600 Capitol Avenue, Suite 400
Sacramento, CA 95816
Phone: (916) 447-2166
Fax: (916) 447-3512
pjk@eslawfirm.com

To COUNTY:

County of San Joaquin
Office of the County Counsel
David E. Wooten
44 N. San Joaquin Street
Sixth Floor, Suite 679
Stockton, CA 95202
Phone: (209) 468-2980
Fax: (209) 468-0315

With copies to:

Neumiller & Beardslee
c/o Thomas J. Shephard, Sr.
P.O. Box 20
Stockton, CA 95201-3020
Phone: (209) 948-8200
Fax: (209) 948-4910
tshephard@neumiller.com

12.11. **Effective Date.** Except as otherwise stated in this Agreement, the effective date of this Agreement shall be the date it has been executed by all parties.

12.12. **Termination Date.** This Agreement shall terminate upon the later of the termination or abandonment of all water right permits for Project water diversion and storage on Bacon Island or the restoration of Bacon Island to a farmable condition pursuant to the Reclamation Plan.

12.13. **No Admission of Liability.** Execution of this Agreement and compliance with its terms do not constitute an admission of liability or wrongdoing by any Party.

DELTA WETLANDS PROPERTIES
An Illinois general partnership

By KLMLP 2, LLC
A Delaware limited liability company,
Managing General Partner of Delta
Wetlands Properties

By KLMLP, L.P.
A Delaware limited partnership,
Managing Member of KLMLP 2, LLC

By Zurich American Corporation (fka
Kemper Corporation)
A Delaware corporation,
Managing General Partner of
KLMLP, L.P.

By _____

Date: 7/2/2013

ACKNOWLEDGMENT

State of New York)
) ss
County of New York)

On JULY 2nd, 2013, before me, RONALD RAMDEO, Notary Public, personally appeared ELIZABETH LAND, who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of New York that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____(SEAL)

RONALD RAMDEO
Notary Public, State of New York
No.: 01RA6182165
Qualified in New York County
Commission Expires March 10, 2016

COUNTY OF SAN JOAQUIN,
a political subdivision of the State of California

By _____
KEN VOGEL, Chairman
Board of Supervisors
County of San Joaquin

Date: 8/13/2013

SAN JOAQUIN COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT

By _____
KEN VOGEL, Chairman
Board of Supervisors
San Joaquin County Flood Control
and Water Conservation District

Date: 8/13/2013

ATTEST:
MIMI DUZENSKI
Clerk of the Board of Supervisors, County of San Joaquin, State of California

By _____
MIMI DUZENSKI
Clerk of the Board of Supervisors

Date: 8/13/2013

ATTEST:
Clerk of the Board of Supervisors of the San Joaquin County Flood Control and Water Conservation District

By _____
MIMI DUZENSKI
Clerk of the Board of Supervisors

Date: 8/13/2013

APPROVED AS TO FORM:
DAVID WOOTEN
County Counsel

By _____
J. MARK MYLES
Assistant County Counsel

Date: 7/23/13

Exhibit A

Agreement between Central Delta Water Agency and Delta Wetlands Properties

RECORDING REQUESTED BY AND WHEN RECORDED, RETURN TO:	THIS SPACE RESERVED FOR RECORDER ONLY (Govt. Code § 27361.6)

PROTEST DISMISSAL AND SETTLEMENT AGREEMENT

This Protest Dismissal and Settlement Agreement is entered into by and between Central Delta Water Agency, a public agency ("CDWA"), RC Farms, Inc, a California corporation, Reclamation District No. 2038 (Lower Jones Tract), a public agency, Reclamation District No. 2072 (Woodward Island), a public agency, Reclamation District No. 2030 (McDonald Island) Reclamation District No. 2027 (Mandeville Island), a public agency, Tuscany Research Institute, a Nevada corporation, CCRC Farms, LLC, a California limited liability company, Delta Wetlands Properties, an Illinois general partnership ("Delta Wetlands"), Reclamation District No. 756 (Bouldin Island), a public agency, Reclamation District No. 2025 (Holland Tract), a public agency, Reclamation District No. 2026 (Webb Tract), a public agency, Reclamation District No. 2028 (Bacon Island), a public agency, and Semitropic Water Storage District, a public agency ("Semitropic"). Hereinafter, CDWA, RC Farms, Inc, Reclamation District No. 2038 (Lower Jones Tract), Reclamation District No. 2072 (Woodward Island), Reclamation District No. 2030 (McDonald Island), Reclamation District No. 2027 (Mandeville Island), Tuscany Research Institute, and CCRC Farms, LLC shall collectively be referred to as the "CDWA Parties". Hereinafter the term "Delta Wetlands" shall include Delta Wetlands Properties, its successors and assigns. Hereinafter, Reclamation District No. 756 (Bouldin Island), Reclamation District No. 2025 (Holland Tract), Reclamation District No. 2026 (Webb Tract), and Reclamation District No. 2028 (Bacon Island) shall collectively be referred to as the "Project Island Reclamation Districts." The aforementioned parties may be referred to individually as "Party" and collectively as "Parties."

RECITALS

A. WHEREAS. Delta Wetlands is proposing to develop a project (the "Delta Wetlands Project" or "Project") on Bacon Island, Bouldin Island, Webb Tract and a portion of Holland Tract (individually, "Project Island, and collectively, the "Project Islands") that involves water storage reservoirs for diversion and storage of water on and discharge of water from Bacon Island and Webb Tract (the "Reservoir Islands") and seasonal diversion and use of water on Bouldin Island and Holland Tract (the "Habitat Islands") for farming and wildlife habitat;

B. WHEREAS, Delta Wetlands owns all of Bacon Island, Bouldin Island and Webb Tract and the portion of Holland Tract to be used for the Project;

C. WHEREAS, Delta Wetlands has entered into an agreement with Semitropic whereby Delta Wetlands and Semitropic will be jointly responsible for the permitting, development, construction and operation of the Project;

D. WHEREAS, Reclamation District No 2026 (Webb Tract) and Reclamation District No 2028 (Bacon Island) are reclamation districts encompassing the Reservoir Islands;

E. WHEREAS, Reclamation District No. 756 (Bouldin Island) and Reclamation District No 2025 (Holland Tract) are reclamation districts encompassing the Habitat Islands:

F. WHEREAS, the Project is described in the 1995 Draft Environmental Impact Report/Statement for the Delta Wetlands Project, the 2000 Revised Draft Environmental Impact Report/Environmental Impact Statement, the 2001 Final Environmental Impact Report, the 2001 Final Environmental Impact Statement, the 2010 Delta Wetlands Project Place of Use Draft Environmental Impact Report and the Delta Wetlands Project Place of Use Final Environmental Impact Report ("2011 FEIR");

G. WHEREAS, Semitropic served as the lead agency for purposes of compliance with the California Environmental Quality Act and certification of the 2011 FEIR for the Project;

H. WHEREAS. CDWA, Reclamation District No. 2038. Reclamation District No. 2072, and RC Farms. Inc., San Joaquin County, and San Joaquin County Flood Control and Water Conservation District have jointly filed a lawsuit challenging Semitropic's certification of the 2011 FEIR and approval of the Project in the case, Central Delta Water Agency, et al. v. Semitropic Water Storage District. et al., San Francisco County Superior Court Case No. CPF-11-511753 (Judgment entered October 29, 2012) and First District Court of Appeal Case No. A137300 (Notice of Appeal filed December 10, 2012) (hereinafter referred to as "Lawsuit");

I. WHEREAS, the Project is located within the Sacramento – San Joaquin River Delta ("Delta"). Bacon and Bouldin Islands are located in San Joaquin County and Holland and Webb Tract are located in Contra Costa County:

J. WHEREAS, Delta Wetlands has applied for appropriative water rights permits from the State Water Resources Control Board ("SWRCB") for the Project and the active Applications and Petitions to Change Applications for the Project have been assigned the following numbers by the SWRCB: Nos. 29062 and 30268 (Webb Tract), and Nos. 29066 and 30270 (Bacon Island) (hereinafter collectively the "Applications");

K. WHEREAS, CDWA has filed protests against some or all of the Applications on behalf of itself and landowners and water right holders within CDWA (hereinafter collectively referred to as "Protests");

L. WHEREAS, CDWA is concerned

(1) That increased seepage caused by the proposed Reservoir Islands may adversely affect the levee integrity of neighboring islands and the farmability of the lands thereon;

(2) That erosion of the interior levee slopes of the Reservoir Islands or other actions could result in levee failures or reduction of the Reservoir Island levee widths to the extent that proper installation and maintenance of roadways, seepage and interceptor well fields, seepage cutoff walls and other remedial actions cannot be easily accomplished;

(3) That loss of economically productive farming activities on such Reservoir Islands and Habitat Islands may result in lack of revenue to sustain adequate levee maintenance and drainage:

(4) That the Project could be abandoned due to financial difficulty or other causes and there will be a need to restore the levees, drainage systems and farmland on the Reservoir Islands and Habitat Islands so that farming could be recommenced and sustained to generate income to fund ongoing levee maintenance, operation and maintenance of the drainage systems and carryout other functions necessary to sustain reclamation of the lands for farming purposes; and

(5) That the Habitat Islands (Bouldin Island and Holland Tract) be maintained with productive farming and wildlife friendly agriculture and not be allowed to become permanently flooded or the levees opened to provide tidal wetlands.

M. WHEREAS, when CDWA filed its first Protests, Delta Wetlands' preferred alternative was the four-island water storage alternative with flooding only in the winter and early spring and farming of waterfowl food crops in the spring and fall. Since that time, Delta Wetlands' proposed alternative has been revised to the Project described above which involves two Reservoir Islands and two Habitat Islands, and the Project as revised also includes an improved levee protection system, a maximum water storage elevation of +4 feet mean sea level ("MSL") (NGVD 1929 Datum), and a seepage monitoring and control system that will be installed prior to Project operation;

N. WHEREAS, Delta Wetlands has entered into a Protest Dismissal Agreement with East Bay Municipal Utility District ("EBMUD") dated September 13, 2000 ("EBMUD PDA," attached hereto as Exhibit A) whereby Delta Wetlands has agreed to implement a program to ensure that seepage from Delta Wetlands' water storage operations does not damage neighboring islands;

O. WHEREAS, the EBMUD PDA requires Delta Wetlands to implement a "Seepage Control Plan" (EBMUD PDA, Att. C) that requires extensive groundwater monitoring of the islands in the vicinity of the Reservoir Islands, a seepage control system, identification of groundwater "reference envelopes" for the purpose of assessing Project water storage impacts on groundwater elevations and criteria that require Delta Wetlands to suspend diversions to storage and to lower storage when certain groundwater elevations are reached;

P. WHEREAS, the Seepage Control Plan includes requirements for the vertical filling of the Reservoir Islands in 25% volume increments, holding the water level at each stage while operating interceptor wells and other measures as appropriate to verify that no net seepage impacts are occurring on neighboring islands ("Initial Stage Filling") (EBMUD PDA, Att. C, Art. 1 § E);

Q. WHEREAS, CDWA is concerned that filling be stopped at any time that monitoring reflects that seepage into neighboring levees or lands is being caused by the filling and that reservoir water levels be lowered if such seepage is not promptly eliminated;

R. WHEREAS, the EBMUD PDA requires Delta Wetlands to establish and fund a Design Review Board ("DRB") (EBMUD PDA, Att. B) of engineers to review plans and specifications for the Reservoir Island levees and diversion and discharge facilities including but not limited to: levee factors of safety, wave wash protection for levees, levee slopes widths and heights, seepage control, interceptor well system and monitoring programs;

S. WHEREAS, the EBMUD PDA requires Delta Wetlands to establish and fund a three-member Monitoring & Action Board ("MAB") (EBMUD PDA, Att. B) of engineers to review groundwater monitoring data submitted by Delta Wetlands, to review Project compliance with groundwater performance criteria, to review and recommend changes to the groundwater performance criteria, to serve as a neutral technical engineering advisory panel to hear and investigate complaints associated with Project operations through the EBMUD PDA Dispute Resolution Procedure, and to recommend remedial actions;

T. WHEREAS, the EBMUD PDA provides that the SWRCB shall appoint one member to the MAB, Delta Wetlands shall appoint one member to the MAB, and the two appointed members shall appoint the third member and two alternates (EBMUD PDA, Att. B, § 4);

U. WHEREAS, the EBMUD PDA includes a Dispute Resolution Procedure to identify and remedy levee, seepage and related problems that may be caused by Project Reservoir Island operations (EBMUD PDA, Att. B, §§ 8-17);

V. WHEREAS, the EBMUD PDA requires Delta Wetlands to provide certain "Financial Assurances" including the obligation to initially fund and maintain a "Seepage and Monitoring Fund" (EBMUD PDA, Att. B. § 19), a "Drawdown Fund" (EBMUD PDA, Att. B. § 20), a "Remedial Actions" fund (EBMUD PDA. Att. B. § 21), and "Insurance" (EBMUD PDA, Att. B, § 22);

W. WHEREAS, the purpose of the Seepage Control Plan and Financial Assurances is to prevent or mitigate impacts on or to the lands and levees on neighboring properties, including without limitation, seepage into the lands and levees on adjacent islands, failure of Reservoir Island levees giving rise to increased erosive forces on adjacent islands from wave action, increased velocity of water flows by water diversion and discharge operations, and other impacts to neighboring properties attributable to the Project:

X. WHEREAS, Semitropic has incorporated the EBMUD PDA into the Project Description as a Project environmental commitment in the 2011 FEIR;

Y. WHEREAS, CDWA is concerned that there is no timely mechanism to ensure Delta Wetlands will comply with the EBMUD PDA, that the EBMUD PDA may not prevent the Project from causing increased seepage into neighboring lands and/or levees and there may be no funding source adequate to cover damages from the Project and no adequate funding to recover the Reservoir Islands in the event of levee failure or abandonment;

Z. WHEREAS, Delta Wetlands and Semitropic are confident that increased seepage into neighboring lands and/or levees caused by Reservoir Island operations can be prevented by way of the proposed interceptor well system to be installed on the Reservoir Island levees and other measures confined to the Reservoir Islands;

AA. WHEREAS, Delta Wetlands, Semitropic, and Project Island Reclamation Districts fully understand and agree if increased seepage into neighboring lands and levees caused by the Project is not prevented by such Reservoir Island measures, that reservoir water levels will be limited to such levels as will avoid such increased seepage and if necessary: Reservoir Island operations and other operations causing such seepage will be permanently precluded. Similarly, if changes are made to Habitat Island operations or lands such that seepage into neighboring lands or levees is increased then it is agreed that such seepage must be promptly corrected and that adjustments be made to operations and actions such that there will be no reoccurrence of such increased seepage;

BB. WHEREAS, the Parties wish to resolve CDWA's Protests to the Applications and legal challenges to the Project through this Agreement by providing a legal mechanism for timely enforcement of the terms herein and adequate funding for the remedies provided herein: and

CC. WHEREAS, the Parties wish to establish an effective and expeditious mechanism for resolving future problems and disputes that will be available in addition to the EBMUD PDA.

AGREEMENT

NOW, THEREFORE, the parties hereby agree as follows:

1. **Purpose of Agreement.** The purpose of this Agreement is to provide a mechanism for timely legal enforcement of the terms herein and adequate funding for the remedies provided herein.

2. **Seepage Control and Other Measures**

2.1 As modified by the more restrictive provisions herein the provisions of the EBMUD PDA Seepage Control Plan (Attachment C) are enforceable pursuant to this Agreement by CDWA, the County of San Joaquin and neighboring Reclamation Districts and owners and operators of lands within ten thousand (10,000) feet of any Project island.

2.3 (a) Delta Wetlands will request and use its reasonable best efforts to ensure that the SWRCB includes the Seepage Control Plan (including the groundwater monitoring program) as a term and condition to any permit and license issued pursuant to the Applications.

(b) Delta Wetlands shall implement the Seepage Control Plan (including groundwater monitoring program) and the more restrictive provisions herein whether or not such are included as a term and condition to any permit issued pursuant to the Applications.

2.4 Delta Wetlands will keep all excavations (other than customary farm ditch excavations) at least one thousand (1,000) feet from the landside toe of the Reservoir Island levees, however excavations necessary for Project water diversion and discharge structure facilities may occur within 1,000 feet of the landside of any Reservoir Island levee.

2.5 Delta Wetlands will in accordance with the provisions herein expeditiously implement all measures to stop Reservoir Island operations causing seepage into neighboring lands and levees including without limitation, lowering reservoir water levels sufficiently to stop such seepage.

2.6 Water levels within the Reservoir Islands shall at no time exceed + 4 feet MSL (NGVD 1929 Datum).

2.7 Delta Wetlands agrees that it will not cause damage on or to the lands and levees on neighboring islands including without limitation damage due to: a) seepage into the lands and levees; b) failure of Reservoir Island or Habitat Island levees giving rise to increased erosive forces on neighboring islands from wave action; and c) increased velocity of water flows and increased erosive forces on neighboring islands caused by water diversion and discharge operations. The Parties agree that there may be other damage caused by the Delta Wetlands Project which could result on or to neighboring islands and that the above listing is not intended to be exhaustive.

2.8 On or before one year prior to the start of filling of any reservoir Delta Wetlands shall advance to CDWA the sum of two hundred thousand dollars ($200,000.00) to fund CDWA review of and participation in the initial filling, monitoring and adjustment process. Any funds not used for such purpose shall be repaid to Delta Wetlands within twelve (12) months after completion of the initial filling of the Reservoirs to the maximum water levels and resolution of the initial filling related adjustments to the Operational Criteria Limit as provided herein.

2.9 Delta Wetlands shall not raise water levels or store water on the Reservoir Islands unless all of the following are met: 1) there are at least three operating background groundwater monitoring wells ("piezometers"); 2) there are at least three operating piezometers fronting the Reservoir Islands on each of the segments of neighboring island levees located within two thousand (2,000) feet from the Reservoir Islands; 3) there is continuous groundwater elevation data collected and promptly made available to the CDWA Parties; 4) that the data include a calculation of the daily mean and seven day running averages of the daily mean for each such piezometer for at least the preceding twelve months; and 5) provision is made for collection of such data continuously thereafter. In the event permission for installation of such piezometers on any neighboring island levee segment cannot be obtained then the obligation for installation and monitoring of such piezometers shall be excused and the next three closest piezometers shall be used as substitutes. The actual readings together with the daily mean and seven day running average of daily means for each piezometer shall be posted at least weekly to a website accessible to neighboring island landowners, neighboring island Reclamation Districts and CDWA. The posting shall include the data through the end of the prior week. At least one piezometer on each of such neighboring island levee segments and at least three background piezometers shall be equipped and operated to provide real-time data via telephone or the internet to neighboring landowners, reclamation districts and CDWA. It is recognized that maintenance and service interruptions may on occasion interrupt the production of such data however Delta Wetlands agrees to include more than the minimum number of piezometers and other redundancy to minimize the interruptions in producing such data.

2.10 Delta Wetlands shall operate and maintain piezometers in accordance with the Seepage Control Plan and also install, operate and maintain piezometers in accordance with the terms of this Agreement at all times that the Reservoir Islands are permitted to be used for water storage operations. In the event that the groundwater monitoring wells (piezometers) fail or do not produce the data necessary to make required groundwater and seepage determinations under the Seepage Control Plan and as required herein, Delta Wetlands shall not store water in or raise the water level of any portion of any Reservoir Island until the groundwater monitoring system is restored. In such event the discharge of stored water from the Reservoir Island shall take place as soon as practicable.

2.11 **Operational Criteria Limit.**

(a) If on an island neighboring a Reservoir Island or Habitat Island where the Project is raising water levels or allowing water levels to rise any three (3) piezometers which are contiguous to each other and fronting on the Reservoir Island or Habitat Island ("fronting piezometers") show an average "net increase in head" of .75 feet or more in the average of the

seven day running average of such three fronting piezometers daily mean water levels, it shall be presumed that seepage into the levee and or land of the neighboring island is caused by the Project. The seepage presumed to be caused as a result of a net increase in head of .75 feet shall not be presumed to cause actual, physical or monetary property, levee, or crop damage or entitle any person to recover economic or other damages for said increase in head. The proof of damage caused by such seepage shall be based on a preponderance of the evidence.

The "net increase in head" will be determined as follows:

The average of the seven day running average of the daily mean water levels for the three (3) "fronting piezometers" for any day will be compared to the pre-Delta Wetland Project operation average of the seven day running average of the daily mean water elevations for the same three (3) piezometers for the same calendar day in the baseline year. This initial comparison will be used to establish the "gross change in head." A similar calculation for the same calendar day will be made on the nearest three (3) "background piezometers" that are at least 10,000 feet from any active Project operation. If the "gross change in head" of the "fronting piezometers" is .75 feet or more higher than the "gross change in head" of the "background piezometers" then there is a "net increase in head" of .75 feet or more in the "fronting piezometers" and therefore seepage into the levee and/or land of the neighboring island is presumed to be caused by the Project. The seepage presumed to be caused as a result of a net increase in head of .75 feet shall not be presumed to cause actual, physical or monetary property, levee, or crop damage or entitle any person to recover economic or other damages for said increase in head. The proof of damage caused by such seepage shall be based on a preponderance of the evidence.

The net increase in head of .75 feet is defined to be the "Operational Criteria Limit" or "OCL." The OCL shall be subject to change as experience is gained during the initial water storage filling of the Project Reservoir Islands and thereafter during water storage operations of the Reservoir Islands. The OCL shall be used to control operation of the Project in accordance with this Agreement.

Continuous daily measurements will be used to determine the daily means. The calculations and measurements must be performed under the supervision of and certified by a civil engineer registered with the State of California. Piezometers shall be installed and screened to reflect head conditions in the sand/gravel strata below the neighboring levees which extend beneath the Reservoir Island. Piezometers shall be open standpipe design and the boring logged to verify soil conditions. If a piezometer is destroyed, damaged or otherwise fails to operate properly, a replacement piezometer shall be deemed to be the same piezometer provided it is installed within twenty (20) feet of the original piezometer and screened at the same depth subject to reasonable construction tolerances

(b) If readings from three piezometers closest to the Reservoir Island are not available, then the readings from the nearest piezometers which are available shall be used. If comparative readings are available from only one piezometer, then it shall be used. Any uncertainty relating to insufficient piezometer readings shall be resolved by lowering the

reservoir water level and monitoring the available piezometers (if none are available, then new piezometers shall be installed at Delta Wetlands' expense). No water storage shall be allowed unless at least three piezometers usable for such determinations are installed and operating on each of the neighboring island levee segments fronting on and located within two thousand (2,000) feet of the subject Reservoir Island. If uncertainty in readings arises due to excavation in the adjoining channels or other causes, then the uncertainty shall be resolved by lowering the reservoir water level while monitoring piezometers on the neighboring island to determine the reservoir impact on seepage in accordance with Section 2.12 and 2.14.

2.12 **Initial Stage Filling Seepage Detection and Management Criteria.** Delta Wetlands shall utilize the Initial Stage Filling process of the Seepage Control Plan (Att. C, § E) in conjunction with the CDWA Monitoring Procedure and OCL, subject to the following terms. Delta Wetlands shall fill the Reservoir Islands in no more than 25% volume increments, holding the water level at each stage while operating interceptor wells and other measures as appropriate to verify that no net seepage impacts are occurring on neighboring islands. If seepage into neighboring lands or levees is detected before the 25% increment is reached, then the filling shall stop and if necessary lowered to stop such seepage. Delta Wetlands shall use the criteria and process described in this section to refine the groundwater monitoring program and seepage control measures.

The OCL shall be used as the Project operating criteria until the relationship between Reservoir Island water storage operations and seepage is better understood. The parties shall confer on changes to the OCL and make such changes as per the procedure herein.

(a) If during the initial stage of filling there has been no exceedance of the OCL Delta Wetlands may fill the reservoir to the next 25% volume stage.

(b) If there is an exceedance of the OCL caused by the Project Delta Wetlands shall stop filling the Reservoir and if necessary lower the water level to stop the seepage in accordance with the following:

(i) If Delta Wetlands determines that the exceedance of the OCL is a false positive exceedance not caused by the Project, Delta Wetlands shall within five (5) days of occurrence submit the determination to the MAB for review in accordance with the EBMUD Dispute Resolution Process in Section 5.2(a). Either party may refer the MAB determination to the CDWA Dispute Resolution Process within ten (10) days of the MAB determination. Notwithstanding the above CDWA may submit the Delta Wetlands determination that the OCL exceedance is a false positive exceedance to the CDWA Dispute Resolution Process if the MAB has not rendered its own determination within fifteen (15) days of the exceedance.

(ii) If the seepage control measures are implemented but are ineffective in reducing groundwater levels below the applicable OCL within fifteen (15) days of the exceedance, the exceedance may be referred to the CDWA Dispute Resolution Process in Section 6.

(iii) Delta Wetlands shall release stored water to levels where the Project is no longer causing an exceedance of the OCL if directed by a final MAB determination or CDWA Dispute Resolution arbitrator decision.

(c) If seepage control measures are effective in returning groundwater levels below the OCL, or if the exceedance was not caused by the Project, then Delta Wetlands may fill the reservoir to the next stage.

(d) The Initial Stage Filling process shall be complete for each Reservoir Island once the reservoir has been filled to the maximum permitted elevation with no further exceedance of the OCL at the maximum elevation. After the Initial Stage Filling process is complete, the reservoir shall be subject to the Normal Operations Criteria in Section 2.14.

2.13 The parties shall, during the initial filling and draining of the Reservoir Islands or sooner if conclusive evidence exists, evaluate piezometer data to determine the effectiveness of the OCL in predicting actual seepage caused by the Project. If the data indicate that the OCL does not reflect seepage caused by the Project or gives false indications that seepage is caused by the Project, the parties agree to negotiate in good faith to reach agreement on a modification of the OCL. If the matter is not resolved by agreement, the matter may be submitted to the CDWA Dispute Resolution Process in Section 6 as provided herein. Pending resolution, the criteria shall remain in effect.

2.14 **Normal Operations Seepage Detection and Management Criteria.** After the Initial Stage Filling process has been completed for a reservoir, the following provisions for normal operations shall apply:

(a) The CDWA Monitoring Procedure and OCL, as may be amended, shall be used to control normal Project operations. If there is an exceedance of the OCL, it shall be presumed that seepage into the levee or land of the neighboring island is caused by the Project and Delta Wetlands shall take immediate action to reduce the seepage and, if necessary, stop filling and reduce the level of water within the reservoir to stop the seepage. An exceedance of the OCL shall not be presumed to cause actual, physical or monetary property, levee, or crop damage or entitle any person to recover economic or other damages for said exceedance. The proof of damage caused by such seepage shall be based on a preponderance of the evidence.

(b) If there is a dispute as to an exceedance of the OCL, it shall be addressed first through the EBMUD Dispute Resolution Process in Section 5.2(b). If an exceedance of the OCL is not resolved in the EBMUD Dispute Resolution Process within fifteen (15) days of the exceedance, or if CDWA does not agree to the resolution, then the matter may be submitted to the CDWA Dispute Resolution Procedure in Section 6.

2.15 Project Island Reclamation Districts each agree that they will, upon the approval of a permit issued by the SWRCB for the Delta Wetlands Project, grant the rights of entry as provided in Section 10 herein. Project Island Reclamation Districts hereby further authorize and approve the corrective actions directed by the Arbitrator as provided in Section 6 herein provided

that the district encompassing the subject Delta Wetlands Project area is first given the opportunity to perform the corrective work with funds to be provided from the CDWA Security Fund. All such corrective work performed by any party shall be directed by a California Registered Civil Engineer with at least ten years of experience working on levees in the Lowlands portion of the Delta as such Lowlands are shown on page 4 of the 1993 Sacramento-San Joaquin Delta Atlas prepared by the California Department of Water Resources.

2.16 Any aggrieved party as per paragraph 6.13 and any Party to this Agreement may at its own expense elect to install and monitor additional piezometers. In such event and upon the request of such party, Delta Wetlands agrees to have the same contractors and consultants performing the installation, monitoring and data reporting of the Project piezometers install, monitor and report the data for such additional piezometers. In such case, the party requesting the same shall on a monthly basis advance to Delta Wetlands the funds necessary to pay the costs for such services.

2.17 The parties recognize that raising water levels in the Project Islands may enlarge or open seepage paths into neighboring levees and lands resulting in increased seepage even from sources other than the Project. In such event remedies in addition to reduced maximum water levels on the Project Islands shall be required. The priorities for such additional remedial action shall first be increased operation and/or improvements of the on Reservoir Island interceptor well system, and shall second include the installation and operation of interceptor wells and/or other physical measures on the impacted areas. In all cases compensation for damages shall apply. Disputes regarding the above may be submitted for resolution through the CDWA Dispute Resolution Procedure.

3. **Levee Integrity and Other Measures**

3.1 As modified by the more restrictive terms herein the EBMUD PDA Geotechnical terms and Conditions (Attachment B) are enforceable pursuant to this Agreement.

3.2 **Reservoir Island Levee Standards.** Prior to allowing or causing the water surface elevation at any point within any Reservoir Island to rise four (4) feet above the preexisting land elevation, Delta Wetlands shall complete all levee and other improvements on the Reservoir Islands necessary to meet as a minimum standard either (1) the recommendations contained in the Preliminary Design Report, Reservoir Island Levees, Delta Wetlands Project, Sacramento-San Joaquin River Delta, Project No.101.20, dated March 11,2003, Prepared by Hultgren–Tillis Engineers and for Reservoir Islands and Habitat Islands or (2) the United States Army Corps of Engineers ("USACE") PL 84-99 Agricultural Delta Levee Standards, whichever provides the greatest protection against failure, in accordance with the practice described in Section 3.5. Where County roads are located on the levees the minimum levee crown width shall be sufficient to provide for a twenty-two (22) foot roadway with two (2) foot shoulders on each side and shall provide a subgrade with at least six inches of properly graded and compacted aggregate base with an oil dust cap.

3.3 **Habitat Island Levee Standards.** Delta Wetlands shall not allow or cause the water surface elevation at any point within any Habitat Island to rise four (4) feet above the preexisting land elevation. Delta Wetlands shall maintain all Habitat Island levees and other improvements as necessary to meet as a minimum the USACE PL 84-99 Delta agricultural levee requirements in accordance with the practice described in Section 3.5.

3.4 Until such time as the Project is abandoned or discontinued and the Islands restored to a good and farmable condition Delta Wetlands shall assure that the levees are maintained to the minimum conditions specified in Sections 3.2 and 3.3 adjusted from time to time to account for increases in the 100 year flood elevation due to sea level increase and climate changes.

3.5 The Parties recognize that some levee subsidence and erosion occurs gradually and non-uniformly and unless the subsidence or erosion has reached the point where the levee integrity is jeopardized, the common practice in the Delta is to repair the areas of gradually occurring subsidence and erosion every few years through projects extending over considerable distances. Consistent with the above practice, the levees shall be repaired, rehabilitated and improved to meet all requirements. Conditions presenting an immediate threat shall be addressed immediately.

3.6 **Levee Emergencies.** If a Party reasonably believes that a Delta Wetlands Project levee is at risk of imminent failure the Party may notify Delta Wetlands and the reclamation district where the levee is located. If repairs have not been commenced or a plan for expeditiously completing repairs acceptable to the complaining party have not been prepared within 72 hours of the notification, a Party may invoke Section 6.15 of the CDWA Dispute Resolution Procedure herein.

4. Reclamation Plan

4.1 Within six (6) months from the date of execution of this Agreement Delta Wetlands shall submit to CDWA a Draft Reclamation Plan to restore each Reservoir and Habitat Island to a farmable or shallow marsh habitat condition together with the estimated cost thereof. Such plan shall delineate the areas to be excavated during the life of the project and shall set forth the required actions necessary to restore the various fields to a farmable or shallow marsh habitat condition at the conclusion of the Project. The areas to be excavated shall not exceed fifteen (15) percent of the gross acreage within the Reservoir Islands and Habitat Islands and shall otherwise be planned to reasonably minimize the impact on potential restoration of the land to a farmable condition. No excavation shall take place on any Reservoir Island or Habitat Island except in conformance with such Reclamation Plan. No excavation for levee fill material or water storage shall take place within one thousand (1,000) feet of the landside toe of any Reservoir Island levee; however, excavation necessary for water diversion and discharge structure facilities may occur within 1,000 feet of the landside toe of any Reservoir Island levee. The Reclamation Plan may include planned use of portions of the farmable land for upland and/or shallow marsh habitat purposes, provided however, the land to be farmed on the Reservoir Islands shall not be less than 60% of the current farmable acreage within the levees and the land to be farmed on the Habitat Islands shall not be less than that provided in the Incidental Take Permit (ITP Number

2081-2000-061-2). The Reclamation Plan must identify the source of funding for the habitat land share of the cost of maintaining the levees and keeping the island drained. The Final Reclamation Plan shall be prepared after construction plans and specifications for the Project levee sections and diversion facilities are complete. The requirements of the Reclamation Plan shall not be deemed fulfilled unless at the time of restoration there is a written guarantee from a financially responsible party that the habitat land portion of the future cost of such levee maintenance and drainage will be paid.

4.2 Compliance with the above Reclamation Plan provisions shall be enforceable directly through the CDWA Dispute Resolution Procedure in Section 6.

5. EBMUD PDA Dispute Resolution Procedure

5.1 Sections 8-17 of Attachment B of the EBMUD PDA establish a Dispute Resolution Procedure for interested parties to identify, for the MAB to investigate, and for Delta Wetlands to remedy, levee, seepage and related problems.

5.2 If the EBMUD PDA is modified 1) to require the approval by CDWA of one of the two appointed MAB members and his/her alternate and 2) to include the seepage determination procedures set forth in Sections 2.12 and 2.13 herein, Delta Wetlands and CDWA shall, subject to the following, utilize the EBMUD PDA Dispute Resolution Procedure to identify and remedy levee, seepage, or related problems that may be caused by Reservoir Island water storage operations.

(a) **Review of Exceedances per Section 2.12.** An exceedance of the OCL during the Initial Stage Filling process shall be subject to the EBMUD Dispute Resolution Procedure in accordance with the process and criteria of Section 2.12. If Delta Wetlands' determination in Section 2.12(c) was that the exceedance of the OCL was not caused by the Project, the MAB shall review Delta Wetlands' determination and render its own determination within seven (7) days of Delta Wetlands' determination. The MAB determination shall be supported by findings and recommendations. Either party may submit the MAB determination to the CDWA Dispute Resolution Process. The MAB determination shall be final and binding on all parties if neither party has referred the MAB determination to the CDWA Dispute Resolution Process within fifteen (15) days. CDWA may refer the Delta Wetlands' determination to the CDWA Dispute Resolution Process if the MAB has not rendered its own determination within fifteen (15) days of the exceedance.

(b) **Review of Exceedances per Section 2.14.** After the Initial Stage Filling process is complete for a reservoir and the Project is subject to the normal operations criteria of Section 2.14, an exceedance of the OCL shall be deemed a complaint to the MAB subject to the EBMUD Dispute Resolution Procedure and the following provisions. In the event the Seepage Control Plan and EBMUD PDA Dispute Resolution Procedure does not result in stopping an exceedance of the OCL within fifteen (15) days from the start of the subject exceedance, then CDWA may refer the exceedance to the CDWA Dispute Resolution Procedure.

(c) **Review of Any Other Complaint.** Notwithstanding any other deadline provided in this Agreement, in the event the EBMUD PDA Dispute Resolution Procedure does not result in a complete and satisfactory remedy for any other complaint or dispute brought by an authorized complaining party regarding whether the construction or operation of the Project has caused actual seepage and related damage within 180 days from the date the complaint of the damage was submitted to the EBMUD PDA Dispute Resolution Procedure, then the authorized complaining party may refer the complaint to the CDWA Dispute Resolution Procedure no later than four (4) years of the date of occurrence. An authorized complaining party is defined as: CDWA, the County of San Joaquin, and any Reclamation District or owner or operator of land within 10,000 feet of a Reservoir Island or Habitat Island.

(d) Once a determination or complaint pursuant to Sections 5.2(a)-(c) has been referred to the CDWA Dispute Resolution Procedure, the EBMUD PDA Dispute Resolution Procedure shall not apply to, and the MAB shall no longer have jurisdiction over. the determination or complaint.

5.3 If the EBMUD PDA is not modified as per the above, then the CDWA Dispute Resolution Procedure shall be applicable to the Parties as if the EBMUD PDA Dispute Resolution Procedure did not exist.

6. CDWA Dispute Resolution Procedure

6.1. **Complaints Subject to CDWA Dispute Resolution Procedure.** Complaints brought to the EBMUD PDA Dispute Resolution Procedure pursuant to Sections 5.2(a), (b) and (c) that have not been resolved within the time frames specified therein are subject to the CDWA Dispute Resolution Procedure of this section. Complaints that a Project levee does not meet the standards specified in Sections 3.2 and 3.3 are subject to the provisions of this section. Complaints brought pursuant to Section 3.5 that a levee is at risk of imminent failure or other emergency are subject to the provisions of Section 6.13. Complaints that the OCL has been exceeded, complaints that seepage from the Project has caused damage and complaints that the project has caused damage other than from seepage are also subject to the provisions of this section.

6.2 **Procedure for Submitting Complaint to Arbitration.** To submit a complaint to the CDWA Alternative Dispute Resolution Procedure in accordance with Sections 3.2, 3.3, 3.5, 5.2(a), 5.2(b) or 5.2(c), a Party to this Agreement (hereinafter sometimes referred to as "submitting party"), may serve upon the other parties (hereinafter referred to as "responding party") a certification documenting the complaint issued by a Reclamation District Engineer or a California Registered Civil Engineer within the time limits applicable to Sections 3.2, 3.3, 3.5, 5.2(a), 5.2(b) or 5.2(c). The time limit for complaints regarding damage caused by the Project must in any event be submitted within four (4) years of the date of occurrence.

6.3 **Certification.** The certification shall include the following:

(a) A description of the problem, including, but not limited to, a description of: (i) for levee issues, the levee section(s) not in compliance with the criteria in Sections 3.2 or 3.3 or the sections constituting the levee emergency under Sections 3.5; (ii) for OCL exceedances, the determination regarding the OCL exceedance per Sections 5.2(a) or 5.2(b); (iii) for claims that the construction or operation of the Project has caused levee, seepage and related problems pursuant to Section 5.2(c), a description of the problem;

(b) Delta Wetlands' and MAB's determinations regarding exceedance of the OCL, if any (applicable to Sections 5.2(a) or (b));

(c) A copy of the complaint submitted to MAB, Delta Wetlands' response to the complaint, MAB's response to the complaint and determination, and Delta Wetlands' response to the MAB determination, if any (applicable to Section 5.2(c));

(d) Documentation that the certification has been timely brought within the time frames of this Agreement;

(e) The relief or remedy sought by submitting party in arbitration;

(f) The specific allegations supporting the requested relief; and

(g) Documentation supporting the submitting party's allegations and requested relief, including a certification issued by a Reclamation District Engineer or a California Registered Civil Engineer, which certification shall be accompanied by a declaration under engineer's seal that the certification was prepared by the engineer.

6.4 **Response to Certification.** Responding party shall have ten (10) days after the date of delivery of the certification described in Section 6.3 in which to deliver to the submitting party a California registered Civil Engineer's certification that: 1) the determinations of the engineer of the submitting party are not correct using the methods set forth in the CDWA Monitoring Procedure, Seepage Control Plan, or other criteria provided herein (whichever is applicable); 2) the violation or threatened violation or other inadequacy is cured; or 3) the violation or threatened violation or other inadequacy cannot reasonably be cured within ten (10) days but corrective action is underway and will be complete by a reasonable date certain. In the event that the response from responding party is that the determinations of the submitting party's engineer are not correct using the methods set forth herein or there is some disagreement regarding the proper cure for a violation, or threatened violation or other inadequacy and the Parties cannot resolve the dispute, the matter may be submitted to an Arbitrator as set forth below.

6.5 **List of Arbitrators.** The Parties agree that each individual listed on Exhibit B hereto is qualified to arbitrate any dispute involving this Agreement between the Parties. The Parties shall periodically update this list of Arbitrators. No Arbitrator can be added to or deleted from the list unless CDWA and Delta Wetlands agree in writing to amend this Agreement to that effect. In the event there are no Arbitrators listed who are willing to serve and the Parties cannot agree upon additional Arbitrators to be listed, then the Presiding Judge of the Superior Court of the County of San Joaquin shall designate the Arbitrators who shall be added to the list.

6.6 **Selection of Arbitrator.** In order to submit a matter to arbitration, the submitting party shall notify responding party in writing of the description of the matter and the names of any two

Arbitrators from those listed in Exhibit B. Responding party shall, within five (5) working days of delivery of such notification, designate by written notice addressed to the submitting party which one of the two Arbitrators shall serve as the single Arbitrator for the matter. It shall then be the submitting party's responsibility to contact the Arbitrator(s) to begin the arbitration process. In the event responding party fails to respond within five (5) days of delivery, the submitting party may choose either Arbitrator proposed in the notice to responding party. If the selected Arbitrator cannot serve, then the other Arbitrator shall be asked to serve. If neither of the submitted arbitrators can serve, then selection shall follow the order of names as listed.

6.7 **Arbitration Rules.** Arbitration will be conducted independently by the Parties in accordance with the rules of the American Arbitration Association ("AAA") for arbitration of commercial disputes then existing except where such rules conflict with the terms of Section 6 of this Agreement.

6.8 **Communication with Arbitrators.** The Parties may submit any written information to the Arbitrator regarding the matter in dispute as long as a copy of all such information is provided to each of the other Parties involved in the dispute. The Parties may also speak directly to the Arbitrator as long as representatives of each of the other Parties to the dispute are present either in person or by telephone. The Arbitrator may also make site visits with all Parties to the dispute in attendance. The Parties agree to provide any information reasonably requested by the Arbitrator within five (5) days.

6.9 **Failure to Respond to Certification.** In the event responding party does not within the time specified above deliver to the submitting party its engineer's determination that the determinations of the engineer for the submitting party are incorrect, the determinations of the submitting party shall be deemed to be correct and binding upon the disputing Parties. In that event, damages and/or corrective actions must still be determined by the Arbitrator and the submitting party must present the matter of damages and corrective actions to arbitration as provided herein.

6.10 **Written Decision of Arbitrator.** Except as to emergencies under 6.15 below and unless a different time period is agreed to by the disputing Parties, the Arbitrator shall within thirty (30) days of being contacted by the submitting party, issue a written decision on the matter in dispute. The Arbitrator's written decision must be faxed, emailed or mailed to thePparties to the dispute on or before the thirtieth (30th) day. In crafting a decision the Arbitrator may seek the advice of the MAB or other independent experts on technical and engineering matters. The Arbitrator shall include in that decision 1) the actions, if any, to be undertaken by Delta Wetlands and /or the encompassing Reclamation District; 2) the time period within which such actions are to be completed; 3) the corrective actions allowed to be taken by the submitting party in the event Delta Wetlands and/or the encompassing Project Island Reclamation District do not timely perform; and 4) the amount and timing of payments to be made from the CDWA Security Fund for corrective work and or damages. Damages, if any, to be paid by Delta Wetlands to the submitting party, designation of a prevailing party and determination of costs and fees may be the subject of a subsequent arbitration decision following further proceedings.

6.11 **Arbitration Remedies.** The Parties hereby specifically agree that the Arbitrator may order specific performance or injunctive relief if deemed necessary and appropriate. The Parties recognize that the Arbitrator's decision and actions necessary to implement the decision may be subject to compliance with applicable regulatory requirements. The acting party shall be responsible for regulatory compliance as to its actions. Unless determined by the Arbitrator to be futile, authorization of the submitting party to perform corrective actions and work on the Reservoir Islands or Habitat Islands shall follow a reasonable opportunity for Delta Wetlands and/or the encompassing Reclamation District to complete the corrective actions.

6.12 **Authorization to Submitting Party to Complete Corrective Actions.** The Arbitrator's decision authorizing the submitting party to enter upon the subject Reservoir Island or Habitat Island to carry out corrective measures in the event of default of Delta Wetlands or the Reclamation District to complete the corrective actions may without limitation, include performing levee work and lowering the water level on the Reservoir Island or Habitat Island. In such event, the Arbitrator shall order payments from the CDWA Security Fund to pay the reasonable costs for such corrective measures as invoices are received. The Arbitrator may order payment for advances to the submitting party to complete the corrective work. All such costs shall be supported with appropriate invoices and other documentation submitted to the Arbitrator and Delta Wetlands. If Delta Wetlands disputes any such costs, it shall notify the submitting party within twenty (20) days of receipt of the invoice or other documentation. If not resolved between the parties, the dispute shall be submitted to arbitration for final determination in accordance with the CDWA Dispute Resolution Procedure provided herein. No refilling or storage of water shall be allowed until all corrective measures have been completed. In the event corrective measures do not result in stopping seepage caused by the Project from entering into neighboring lands or levees, then storage of water shall be permanently prohibited and the reservoirs restored to a farmable condition as per the Reclamation Plan. In carrying out corrective work the submitting party shall have the right to utilize all facilities of the Project and those of the Reclamation District encompassing the Project.

6.13 **Damages Caused by Submitting Party.** Any damage to the Reservoir or Habitat Islands or facilities resulting from grossly negligent activities of the submitting party shall be the responsibility of the submitting party. The Arbitration process set forth herein shall be used by the Parties in the event that a dispute arises regarding such damage.

6.14 **Finality and Effect of Arbitrator Decision.** The decision of the Arbitrator shall be final and binding upon the Parties to the arbitration.

6.15 **Emergency Procedure.** Notwithstanding the procedures in Section 6.2 through 6.10 above, the submitting party may, in the event the submitting party believes an emergency exists, invoke the following emergency procedure: Submitting party shall (by telephone, fax, mail or any other means) notify any two (2) Arbitrators on the list and Delta Wetlands of the time and place for an inspection of the conditions constituting the alleged emergency. If after inspection the two (2) Arbitrators jointly determine that emergency corrective action is necessary, then they may immediately authorize or order Delta Wetlands and/or the encompassing Reclamation District to conduct emergency corrective work or actions. If Delta Wetlands and/or the

encompassing Reclamation District fail to diligently commence and complete said emergency corrective work, the Arbitrators may authorize the submitting party to carry out such work, with the cost to be advanced or reimbursed from the CDWA Security Fund. The joint determination of the two (2) Arbitrators shall be final and binding upon the parties. If the Arbitrators determine that no emergency work is necessary, the Parties shall proceed pursuant to the non-emergency procedure set forth herein with only one of the two Arbitrators continuing to act on the matters. The continuing Arbitrator shall be determined by flip of a coin. An emergency or emergency situation shall exist whenever there is 1) an imminent threat of levee failure on a Reservoir Island or Habitat Island, or 2) an imminent threat of levee failure on any neighboring island where such threat is caused by or emanates from the Project Islands or operations including through seepage or under seepage affecting levee stability, or a sudden or rapid increase in fronting piezometer elevation readings that a licensed civil engineer determines to be of sufficient magnitude to be considered an emergency.

6.16. **Criteria for Levee Emergency Certifications and Arbitration Decisions.** It is recognized that some levee subsidence and erosion occurs gradually and non-uniformly and that unless the subsidence or erosion has reached the point where the levee integrity is jeopardized, the common practice in the Delta is to repair the areas of gradually occurring subsidence and erosion every few years in projects extending over considerable distances. It is agreed that any subsidence or erosion areas which do not meet the FEMA Hazard Mitigation Plan requirements adjusted to incorporate any changes to the 100 year flood elevations due to sea level rise and climate change and any other areas thought to be in a state of imminent failure must be repaired immediately. Certifying engineers and/or the Arbitrator should be guided by the above. Delta Wetlands shall provide to CDWA and neighboring landowners and Reclamation District levee profiles with readings on one hundred (100) foot intervals and cross-sections on five hundred (500) foot intervals at least every three years.

6.17. **Decision Regarding Initial Stage Filling.** An Arbitrator's decision regarding an exceedance of the OCL standard during Initial Stage Filling (Section 2.12) shall apply and address the following:

(a) An exceedance of the OCL shall constitute a presumption that seepage into the levees where the fronting piezometers are located is being caused by the Project. In such case Delta Wetlands shall have the burden of proving with the preponderance of evidence that seepage is not caused by the Project.

(b) The decision shall determine whether the exceedance of the OCL is caused by the Project. If the exceedance is not caused by the Project, the complaint shall be dismissed.

(c) If the exceedance is caused by the Project or the cause of the exceedance is undetermined, the decision shall order Delta Wetlands to improve or change operation of existing interceptor wells, to install and operate additional interceptor wells, conduct appropriate measures from the Seepage Control Plan, and to release stored water as rapidly as reasonably possible to the elevation at which the Project is no longer causing an exceedance or to an empty condition so as to allow the Arbitrator to make a decision as per Section 6.18(d) below.

(d) The Arbitrator shall retain jurisdiction to review Delta Wetlands compliance with the decision. If the exceedance is not reduced even after draining the Reservoir and a waiting period for at least thirty (30) days, the Arbitrator may conclude that the exceedance was not caused by the Project.

(e) Delta Wetlands may commence refilling of water storage only after approval by the Arbitrator of a certification from a California Registered Civil Engineer that all actions required by the decision have been completed. The refilling shall be subject to the exceedance criteria.

6.18. **Decision Regarding Normal Operations.** An Arbitrators' decision regarding a potential exceedance of the OCL during normal Project operations (Section 2.13) shall apply and address the following:

(a) An exceedance of the OCL shall constitute a presumption that seepage into the levees where the fronting piezometers are located is being caused by the Project. In such case Delta Wetlands shall have the burden of proving with the preponderance of evidence that seepage is not caused by the Project.

(b) The decision shall determine whether the exceedance of the OCL is caused by the Project. If the exceedance is not caused by the Project, the complaint shall be dismissed.

(c) If the exceedance is caused by the Project, the decision shall order Delta Wetlands to improve or change operation of existing interceptor wells. to install and operate additional interceptor wells, conduct appropriate measures from the Seepage Control Plan, to release stored water as rapidly as reasonably possible to the elevation at which the Project is no longer causing an exceedance, impose any other mitigation that may be mutually agreeable between Delta Wetlands and the affected party and if necessary require that the storage of water be terminated.

(d) The Arbitrator shall retain jurisdiction to review Delta Wetlands compliance with the decision. If the exceedance is not reduced even after draining the reservoir and a waiting period of at least thirty (30) days. the Arbitrator may conclude that the exceedance was not caused by the Project.

(e) Delta Wetlands may commence refilling of water storage only after approval by the arbitrator of a certification from a California Registered Civil Engineer that all actions required by the decision have been completed.

(f) The above steps shall be repeated as necessary to address the problems arising from time to time.

6.19 **Decision Regarding Termination of Project Water Storage.** If it is determined by the Arbitrator that (1) Delta Wetlands has implemented all feasible seepage control measures including without limitation increased operation and/or improvement of the on Reservoir Island

interceptor well system and reduced maximum water levels on the Project Islands and (2) one of the following is found, (A) that a Reservoir Island cannot be operated without causing significant seepage that poses a significant increased risk of failure of neighboring island levees, or (B) if damages resulting from said seepage awarded in a final Arbitration decision have not been fully paid within one year of the date of the decision, or (C) that the amount of unpaid claims plus unresolved pending claims plus probable future claims is determined by the Arbitrator to leave an insufficient amount in the CDWA Security Fund to assure restoration of the Reservoir Islands, then the Arbitrator shall order that the operation or operations causing the same shall be permanently terminated and the Reservoir Island restored as per the Reclamation Plan. The insufficiency in the CDWA Security Fund as set forth in (C) above may be remedied with an agreement by Delta Wetlands to increase and maintain the CDWA Security Fund in an amount in excess of the $35,000,000.00 which additional amount shall be determined by the Arbitrator to be reasonably necessary to secure the future performance of this Agreement. The determination of the Arbitrator as to significant increased risk of levee failure must be supported by a preponderance of the evidence including the opinion of at least two independent California Registered Civil Engineers with at least ten years of experience working on levees in the lowlands portion of the Delta.

6.20. **Decision Regarding Levee Standards.** An Arbitrator's decision regarding Reservoir Island or Habitat Island levee standards (Sections 3.2-3.3) shall address the following:

(a) The decision shall determine whether a Reservoir Island or Habitat Island levee section does not meet the requirements or criteria of Sections 3 and 6.2. If the levee section meets the requirements or criteria of this Agreement, the complaint shall be dismissed.

(b) If the Reservoir Island or Habitat Island levee section does not meet the requirements or criteria herein, the decision shall direct Delta Wetlands to expeditiously reconstruct the levee section to meet the same. If Delta Wetlands or the encompassing reclamation district does not expeditiously reconstruct the levee to meet the same, then the Reservoir Island shall be dewatered to the elevation four (4) feet below the lowest elevation of the levee section which does not meet or exceed the required minimum criteria or 0.0 ft (NGVD 1929 Datum), whichever is lowest and the complaining party shall be provided the option of reconstructing the levee with funds from the CDWA Security Fund.

6.21 **Advancement of Fees and Costs.** Upon the request of any submitting party claiming damage from Reservoir Island operations, the Arbitrator shall, if he preliminarily finds that the claim does not appear frivolous, order advance payments from the CDWA Security Fund to pay the reasonable attorneys' fees and consultant fees of the submitting party. Delta Wetlands shall be given the option to directly provide such funds. If upon final decision of the Arbitrator such submitting party does not prevail, then the Arbitrator shall order that the advances be repaid with interest at the rate earned by the cash portion of the CDWA Security Fund. Repayment shall be made to the source from which the advance was made.

6.22 **Assorted Provisions Regarding Decisions and Remedies.** The Arbitrator shall not be permitted to award punitive or exemplary damages. All arbitration hearings shall be conducted

in Stockton, California. The costs and fees of the Arbitrator shall initially be paid one-half by Delta Wetlands and one-half by the submitting parties. The Arbitrator may award fees and costs to the prevailing party. Legal process may be served upon the Parties in the manner provided by law or in any other manner agreed to by the parties or allowed by the Arbitrator. Decisions of the Arbitrator shall be in writing. Where damages are claimed, the Arbitrator may allow limited discovery specifically related to such damages. Judgment on the award of the arbitrator(s) may be entered in any state court in the State of California and parties to such arbitration irrevocably consent to the jurisdiction of such courts for such purpose. Any party submitting a matter to arbitration as provided herein and the Parties hereto acknowledge and agree that they are waiving all rights to a trial by court or jury as a means of resolving any disputes arising out of or relating to a matter subjected to arbitration as per the terms of this Agreement. Monetary awards shall be first paid out of the CDWA Security Fund in accordance with Section 8.10.

6.23 Any aggrieved party who is not signatory to this Agreement, but is a reclamation district or owner or operator of land within ten thousand (10,000) feet of a Project Reservoir Island or Habitat Island may elect to seek a remedy for the above causes through the regular legal process or by way of the CDWA Dispute Resolution Procedure provided herein in the same manner as provided for the CDWA Parties. If such an aggrieved party elects to utilize the CDWA Dispute Resolution Procedure, then the decision of the Arbitrator shall be final and binding upon the parties to the arbitration.

6.24 This Agreement confers rights and remedies upon the County of San Joaquin as a third-party beneficiary of this Agreement. The County of San Joaquin may enforce the provisions of this Agreement pertaining to seepage (Section 2), levee integrity (Section 3), road integrity (Section 3) and future reclamation for agricultural use of Bacon Island (Section 4) as to the portion of the Project within the San Joaquin County or any effects from the Project to lands within San Joaquin County in the same manner and subject to the same limitations as provided for herein applicable to the CDWA Parties. The Parties expressly intend to confer these rights and remedies upon the County of San Joaquin and may not materially amend this Section 6.24 or Section 9.1 of this Agreement or terminate this Agreement without the prior written consent of the County of San Joaquin, which consent shall not be unreasonably withheld.

7. Financial Assurances

7.1 **Seepage and Monitoring Fund.** Delta Wetlands shall provide and maintain the Seepage and Monitoring Fund ($500,000) described in § 19 of Attachment B of the EBMUD PDA.

7.2 **Drawdown Fund.** Delta Wetlands shall provide and maintain the Drawdown Fund ($1 million) described in § 20 of Attachment B of the EBMUD PDA.

7.3 **Remedial Action Fund.** Delta Wetlands shall provide and maintain the Remedial Action Fund ($1 million) described in § 21 of Attachment B of the EBMUD PDA.

7.4 **Insurance.** Delta Wetlands shall provide and maintain the Insurance described in § 22 of Attachment B of the EBMUD PDA.

7.5 **CDWA Security Fund.** Delta Wetlands shall establish and maintain the CDWA Security Fund as set forth below. The failure of Delta Wetlands to so establish and maintain the CDWA Security Fund shall constitute a material breach of this agreement to be remedied by injunctive relief against Delta Wetlands moving forward with any aspect of the Project and if the Project is already in place the injunction shall accomplish the following: 1) preclude the storage of water; 2) require the expeditious release of any stored water; and 3) order such other actions as necessary to avoid harm to neighboring levees, lands and the owners and operators thereon. Notwithstanding anything in this agreement to the contrary, CDWA, EBMUD and the neighboring Reclamation Districts and owners and operators of land within ten thousand (10,000) feet of any portion of the Project may commence an action seeking such relief in the Superior Court of San Joaquin County without the necessity of proceeding with arbitration or other processes provided in this agreement. In such action the prevailing party shall be awarded costs and reasonable attorneys' fees.

8. CDWA Security Fund

8.1 **Purposes.** The CDWA Security Fund may be used for the following purposes: 1) to draw down water on the Reservoir Islands; 2) to repair damaged levees on the Reservoir Islands and Habitat Islands; 3) to repair other damage to the Reservoir Islands, Habitat Islands or neighboring islands caused by the Project; 4) to restore the Reservoir Islands in accordance with the Reclamation Plan following termination of Project water storage operations; 5) to pay claims for damages caused by the Project; and 6) to pay for costs and attorneys' fees related to the above.

8.2 **Components of CDWA Security Fund.** Prior to allowing or causing the water surface elevation at any point within any Reservoir Island or Habitat Island to rise above four (4) ft above the existing land elevation, or conducting any excavation below the existing median land elevation for the purpose of providing fill for Project construction purposes or increasing capacity for water storage, Delta Wetlands shall establish and thereafter maintain, subject to the provisions of this Agreement, financial security in the continuous combined amount of thirty-five million dollars ($35,000,000.00) consisting of a combination of the following: (i) cash in the minimum amount of ten million dollars ($10,000,000.00), and (ii) a "Letter of Credit" in the amount of twenty-five million dollars ($25,000,000.00). Collectively, these amounts comprise the "CDWA Security Fund." Delta Wetlands can increase the cash contribution (dollar for dollar) as a substitute for all or a portion of the Letter of Credit.

8.3 **Draws.** Draws on the CDWA Security Fund shall be available upon presentation of a "Qualified Draw Request" and in the amount specified in the "Qualified Draw Request." "Qualified Draw Request" means (i) a notarized written instrument signed by the authorized representatives of both CDWA and Delta Wetlands, (ii) a certified final order of the Arbitrator authorizing a draw on the CDWA Security Fund pursuant to the CDWA Dispute Resolution Procedure described herein, or (iii) an interim or final order of the Arbitrator carrying out the emergency procedures as provided under Section 6.15. The request shall specify the amount of the draw to be made on the CDWA Security Fund, and specify the person or entity to whom the

draw is to be payable. All draws on the CDWA Security Fund shall be paid, at Delta Wetlands' election, from the cash portion thereof or from any Letter of Credit that is part of the security fund, or from any combination of the cash portion and Letter of Credit. In any event Delta Wetlands shall within fifteen (15) days restore the CDWA Security Fund to the required $35,000,000.00 amount and shall continuously maintain said fund at that level until termination or abandonment of the Project in compliance with Sections 8.7 and 8.8 below.

8.4 **Appointment of Independent Trustee.**

(a) CDWA shall serve as representative for the CDWA Parties with respect to Section 8 of this Agreement. CDWA may appoint a different representative for the CDWA Parties by providing a written notice to Delta Wetlands.

(b) CDWA and Delta Wetlands shall designate a financial institution trust department licensed to do business in the State of California, which will act as an independent Trustee with authority to draw on the Letter of Credit in accordance with this Agreement. The identity of the initial trustee and the duties and powers of said Trustee, any specific guidelines and limitations on the investment of funds held in the CDWA Security Fund and rules for appointing a successor trustee shall be set forth in Exhibit C, attached hereto and by this reference incorporated herein. As provided above, Delta Wetlands can, upon 30 days prior written notice from Delta Wetlands to CDWA, substitute cash for all or a portion of the Letter of Credit without the consent of the parties or the trustee.

8.5 **Terms of Letter of Credit.** As used herein, the term "Letter of Credit" means a letter of credit issued by a credit provider ("L-C Bank") that is headquartered in the United States, that resides in the United States, or is a United States corporation in good standing, and that has an investment grade credit rating from and meeting at least two (2) of the following: Moody's "A2", S & P "A", or Fitch "A" or higher. If the Moody's, S & P or Fitch credit rating criteria or methodologies materially change during the terms of this Agreement, the Parties shall meet and confer to update the credit provider credit rating criteria of this section to the new ratings that are comparable to Moody's "A2", S & P "A", or Fitch "A" as they are defined on the date of execution of this Agreement. The L-C Bank shall agree and set forth in the Letter of Credit the following: 1) that the Letter of Credit shall be exclusively governed by, construed and enforced in accordance with the laws of the State of California without regard to conflict of laws; 2) that exclusive jurisdiction for disputes arising out of or related to the Letter of Credit shall be in the Superior, Appellate and Supreme Courts of the State of California; and 3) that the Letter of Credit shall designate an agent located in the State of California for service of process. Delta Wetlands shall pay all expenses, points, fees or other charges relating to obtaining, managing or extending the Letter of Credit. The Letter of Credit shall allow partial and multiple draws up to the face amount thereof. The Letter of Credit shall be irrevocable by L-C Bank during its effective term, shall expire not less than one (1) year from the date issued, and shall automatically renew for successive one (1) year terms unless the L-C Bank provides notice of non-renewal no less than 90-days prior to expiration of its term. The Letter of Credit shall be written so as to conform to the example attached hereto as Exhibit D.

(a) If the L-C Bank at any time ceases to meet the standards specified in Section 8.5, then Delta Wetlands shall have 55 days from notice that the L-C Bank ceases to meet the standards specified in Section 8.5 to provide a substitute Letter of Credit complying with all of the requirements hereof and issued by a L-C Bank that is qualified, or to substitute cash in place of the Letter of Credit.

(b) If the L-C Bank notifies Delta Wetlands and CDWA that the Letter of Credit will not be renewed, then Delta Wetlands shall have 55 days from notice of non-renewal to provide a substitute letter of credit complying with all of the requirements hereof and issued by a L-C Bank that is qualified, or to substitute cash in place of the non-renewed Letter of Credit.
If Delta Wetlands has not provided a substitute Letter of Credit or cash within the time periods specified in Section 8.5(a)-(b), the Trustee shall, without discretion, draw the full amount of the existing Letter of Credit and deposit the proceeds into the trust account defined in Section 8.6 and shall return the proceeds to Delta Wetlands when a substitute Letter of Credit is established

8.6 **Trust Account.** The cash portion of the CDWA Security Fund shall be deposited in a trust account (the "CDWA Trust") maintained with a financial institution licensed to do business in the State of California, and approved by CDWA, which will act as instructed by the Trustee, who shall have full authority to disburse from the trust account and draw on the Letter of Credit in accordance with this Agreement. The cash deposited in the CDWA Trust shall be invested in accordance with the guidelines set forth in Exhibit C, with the earnings thereon to be distributed as received to Delta Wetlands during any period when the fund is in excess of its minimum required amount and after paying trustee and administrative fees and charges.

8.7 **Replenishment.** In the event that draws are made from the CDWA Security Fund, Delta Wetlands shall replenish the CDWA Security Fund within fifteen (15) days and in any event before Delta Wetlands diverts additional water to storage on the Reservoir Islands.

8.8 **Termination of CDWA Security Fund.** Upon termination or abandonment of all water right permits for Project water diversion and storage on the Reservoir Islands, restoration of all Reservoir Islands and Habitat Islands to farmland or habitat as per the Reclamation Plan and resolution of all remaining claims against the CDWA Security Fund, the Letter of Credit may be terminated and the amount of the remaining cash deposit shall be paid to Delta Wetlands. The Letter of Credit shall be terminated and the Trustee shall return the remaining cash portion of the CDWA Security Fund within ten (10) calendar days of submission of a written instrument signed by an authorized representative of Delta Wetlands and an authorized representative of CDWA verifying that all water right permits for water diversion and storage on the Reservoir Islands have been abandoned or terminated, that the Reservoir Islands and Habitat Islands have been restored in accordance with the Reclamation Plan and all remaining claims brought against Delta Wetlands and awarded to the claimants in accordance with the CDWA Dispute Resolution Procedure have been paid from the CDWA Security Fund.

8.9 **CDWA Security Fund is Not Exclusive Remedy.**

(a) To the extent that the CDWA Security Fund does not contain sufficient funds to pay any award as ordered by the Arbitrator and Delta Wetlands has been given the opportunity to make such payment and has not made the payment within 30 days of written notice from the Arbitrator to pay the same, then the award may be enforced in the manner provided by California Code of Civil Procedure Sections 1285, et seq.

(b) The funds provided by way of this section are not intended to limit the claims of any aggrieved party. The portion of any award not paid as provided herein may be collected in any other manner allowed by law. Monetary awards pursuant to this Agreement shall be first paid out of the CDWA Security Fund unless Delta Wetlands has elected to directly pay the award.

9. **Rights of Entry**

9.1 Perpetual non-exclusive rights of entry over and across all of the Reservoir Islands and Habitat Islands including the levees thereon shall be granted by Delta Wetlands and the Project Island Reclamation Districts to CDWA, the County of San Joaquin and neighboring Reclamation Districts for the purposes encompassed by this Agreement. Subject to the limitations set forth below, the purposes include: inspecting the facilities and operations; maintaining and operating interceptor well fields; reconstructing levee slopes; installing and maintaining wave wash protection; constructing, maintaining and operating pumps, siphons, gates and other facilities to control water levels so as to curtail seepage or facilitate restoration; maintaining, repairing and rehabilitating levees to provide adequate levee cross-sections; and to otherwise implement this Agreement.

9.2 Such rights of entry shall be subject to the following conditions:

(a) Except as to the rights of entry for inspection purposes, no right of entry shall be exercised unless pursuant to authorization or order of the Arbitrator.

(b) Except in an emergency situation or pursuant to authorization or order of the Arbitrator, the right of entry for inspection shall be limited to no more than five (5) inspectors who shall travel as a group and no more than four (4) times per year.

(c) Delta Wetlands shall be notified in advance of any entry as to the nature and duration of the entry and the names of those entering. Delta Wetlands may elect to have its representatives accompany such inspectors. The time of entry and duration shall be reasonable for the circumstances at the time of entry.

(d) Except in an emergency situation or pursuant to authorization or order of the Arbitrator, at least five (5) days prior written notice to Delta Wetlands shall be provided.

(e) Exercise of the right of inspection shall to the extent practical be confined to the levee areas so as to minimize interference with Project operations, repair and maintenance and waterfowl use of the islands.

9.3 No right of access by the general public is conveyed by this Agreement.

9.4 Those individuals and entities exercising the right of entry for inspection purposes shall, prior to entry, agree in writing to hold Delta Wetlands and the Project Island Reclamation Districts, their directors, officers, agents, contractors, affiliates, partners and successors free and harmless and indemnify them from any and all claims, actions, causes of action, demands, rights, damages, costs, losses and expenses, including reasonable attorneys' fees arising out of such entry.

9.5 The rights of entry described herein shall be irrevocable during the life of the Project and recorded in the County in which the particular Reservoir Island or Habitat Island is located.

10. Assignment

Delta Wetlands agrees that it will not sell, transfer, lease, license or assign any of its rights, title or interest in and to any of the real property on the Reservoir Islands or Habitat Islands or any of the permits or other rights related to the Project or sell, transfer, assign or otherwise reorganize the entity owning such real property or any part of the ownership thereof without having the proposed transferee execute this agreement as obligor of the covenants provided herein. Notwithstanding the above, the conservation easements required as a condition of the Incidental Take Permit, agricultural land conservation easements, customary Oil and Gas Leases and the lease of land for farming or recreational purposes, on the Reservoir Islands or Habitat Islands for a term less than fifteen (15) years which does not allow for water banking or land fallowing other than as part of customary crop set aside programs shall not be subject to this requirement.

11. Withdrawal of Protests, Dismissal of the Lawsuit, and Agreements Not to Protest or Oppose

11.1 In consideration of the agreements of Delta Wetlands made herein, CDWA Parties who have filed active Protests shall, within ten (10) working days of execution of this Agreement by CDWA and Delta Wetlands, send a letter to the SWRCB withdrawing their Protests and transmitting a fully executed copy of this Agreement to the SWRCB. The letters may request that the SWRCB incorporate Delta Wetlands' compliance with the terms of this Agreement as a condition of any permit for the Project

11.2 CDWA Parties also agree that upon full execution of this Agreement and so long as Delta Wetlands is in compliance with the Program, terms of this Agreement and the conditions of all permits pertaining to the Project, they will not protest or otherwise object to the Delta Wetlands Project in any forum or encourage others to do the same. "Program" includes the Project as

described in Recital E above and all final adopted mitigation, avoidance and minimization of impact measures incorporated in the Project documents.

11.3 Notwithstanding anything herein to the contrary, the CDWA Parties shall not be restricted in any way in any forum from 1) protesting changes in the Project including without limitation any proposed storage or use of recycled water, biosolids, sludge or waste, or 2) asserting against anyone, including Delta Wetlands, rights and claims to water on behalf of the water users within the Delta, including without limitation claims and rights based upon California Water Code sections 1215 et seq., 10505 et seq., 11460 et seq., 12200 et seq., and 12230 et seq. Additionally, nothing contained herein shall restrict CDWA or any other party from any action in any forum to protect and enhance the water supply within the Delta both as to water quality, quantity and water levels, including without limitation seeking to restrict exports from the Delta to water which is truly surplus to the present and future needs for beneficial use within the Delta and other areas and watersheds of origin. CDWA Parties will not object to: any septic system or other approved facilities or processes for the disposal of waste generated on any Reservoir Island or Habitat Island; any fertilizer used in normal farming operations on any Reservoir Island or Habitat Island; a change in Project footprint or operations that decreases the average water storage quantity or residence time or reduces the maximum permitted water storage capacity of the Reservoir Island(s); a change in Project operations or infrastructure that decreases the maximum permitted daily, monthly, and combined rates of diversion; a change in Project operations or infrastructure that reduces maximum permitted discharges from the Reservoir Islands to the central Delta; or change in the authorized place of use provided that such place of use is not on the drainage-impaired lands on the west side of the San Joaquin Valley (e.g., Westlands Water District and Grasslands Water District) and provided further that such change in place of use will not directly or indirectly increase the salinity of the flows or accretions to the San Joaquin River, or otherwise degrade water quality in the Delta.

11.4 Delta Wetlands recognizes and agrees:

(a) That its rights to store and redivert water pursuant to SWRCB permits are and will be junior to the riparian and prior appropriative rights held by Delta users and others;

(b) That any rights to divert water for use on its lands within the Delta in excess of that allowed pursuant to riparian rights and pre-1914 appropriative rights are junior to the riparian and prior appropriative rights of water users within the Delta and other areas and watersheds of origin, except that Water Right Permits and Licenses used for irrigation on the Project Islands shall while so used enjoy the priority provided by California law over other water right holders;

(c) That any rights to redivert and/or use water outside the Delta are junior to the water requirements necessary for salinity control and the water required to otherwise maintain an adequate water supply in the Delta of sufficient quality and quantity to maintain and expand agriculture, industry, urban and recreational development in the Delta; and

(d) That any right to export waters from the Delta or any other areas or watersheds of origin is junior to the present and future needs of such areas.

11.5 Delta Wetlands shall not protest or otherwise object in any forum to the efforts of any of the CDWA Parties to protect and/or improve water quality, water quantities (including flushing flows) and water levels in the Delta, however Delta Wetlands reserves the right to advocate its views with regard to Delta inflow, outflow, and water quality.

11.6 CDWA, Reclamation District No. 2038, Reclamation District No. 2072, and RC Farms, Inc. each will dismiss with prejudice all of the CDWA, Reclamation District No. 2038 (Lower Jones Tract), Reclamation District No. 2072 (Woodward Island), and RC Farms, Inc.'s appeal of the Judgment entered October 29, 2012 in *Central Delta Water Agency, et al. v. Semitropic Water Storage District, et al.*, San Francisco County Superior Court Case No. CPF-11-511753. To effect these dismissals, within ten (10) working days of execution of this Agreement by CDWA and Delta Wetlands, CDWA, Reclamation District No. 2038, Reclamation District No. 2072, and RC Farms, Inc. will file with the First District Court of Appeal a request for dismissal, with prejudice, of CDWA, Reclamation District No. 2038 (Lower Jones Tract), Reclamation District No. 2072 (Woodward Island), and RC Farms, Inc.'s appeal of the Judgment, First District Court of Appeal Case No. A137300, and any other outstanding claims in the Lawsuit, against all respondents and real parties in interest, including parties not known to the CDWA Parties. CDWA, Reclamation District No. 2038, Reclamation District No. 2072, and RC Farms, Inc. will diligently and in good faith pursue having each dismissal entered as expeditiously as possible. Within ten (10) working days of receipt of entry of dismissal, CDWA shall serve on all Parties notice of entry of that dismissal.

If other parties to the Lawsuit, including San Joaquin County, the San Joaquin County Flood Control and Water Conservation District and any party who may intervene in the Lawsuit including the Attorney General's Office of the State of California, pursue claims, causes of action and requests for relief, the CDWA Parties shall not indemnify, fund, or otherwise assist such parties to the Lawsuit.

The CDWA Parties, Delta Wetlands, and other signatories hereto shall seek no further relief with regard to the Protests and the Lawsuit, including any award or collection of costs or attorneys' fees incurred in connection with the Protests, Lawsuit and previous administrative proceedings.

12. Miscellaneous Provisions

12.1 **Other Documents**. The Parties hereto agree to execute any and all additional documents reasonably necessary to carry out the purpose and intent of this Agreement.

12.2 **Entire Agreement**. Except for the documents incorporated by reference herein, this Agreement and its exhibits contain the entire understanding among the Parties and supersedes any prior written or oral agreements between them respecting the subject matter contained herein. There are no representations, agreements, arrangements, or understandings, oral or

written, between and among the Parties relating to the subject matter of this Agreement that are not fully expressed herein.

12.3 **Amendments**. The provisions of this Agreement may be amended only by written agreement executed by the Parties hereto and recorded as required herein for this Agreement.

12.4 **Attorneys' Fees**. If any action at law or in equity, including an action for declaratory or injunctive relief, is brought to enforce or interpret the provisions of this Agreement, the prevailing party shall be entitled to reasonable attorneys' fees.

12.5 **Governing Law**. All questions with respect to the construction of this Agreement and the rights and liabilities of the Parties hereto shall be governed by the laws of the State of California.

12.6 **Successors**. Subject to the restrictions against assignment set forth in Section 10 above, this Agreement shall inure to the benefit of and shall be binding upon the assigns, successors in interest, personal representatives, estates, heirs, and legatees of each of the Parties hereto. Any successor or assignee of Delta Wetlands shall be bound to the terms of this Agreement in the same manner and to the extent as Delta Wetlands. The separate and independent rights or interests of the members or equity owners of any successor and the advocacy for the same shall not be limited by the terms of this Agreement but only to the extent the separate and independent rights or interests and the advocacy for the same are unrelated to the interpretation, enforceability and performance of this Agreement.

12.7 **Covenant to Run With the Land**. This Agreement is both a personal obligation of the Parties as well as a covenant running with the Reservoir Islands and Habitat Islands presently owned by Delta Wetlands and the lands of the other Parties hereto, wherever those lands may be situated. This Agreement shall be notarized and recorded in the counties of Contra Costa and San Joaquin within thirty (30) days of receipt by Delta Wetlands of a water right permit from the SWRCB pursuant to the Applications.

12.8 **Severability**. If any non-material provision of this Agreement is declared by a court of competent jurisdiction to be invalid, void or unenforceable, the remaining provisions shall continue in full force and effect.

12.9 **Execution; Counterparts; Additional Parties**. This Agreement may be executed in several counterparts (including counterparts by facsimile or email in portable document format (PDF)) and all counterparts so executed shall constitute one agreement which shall be binding upon any Party whose signature appears on an executed counterpart. However, this Agreement shall not be effective until CDWA, Reclamation District No. 2038, Reclamation District No. 2072, RC Farms, Inc., Delta Wetlands, Reclamation District No. 756. Reclamation District No. 2025, Reclamation District No. 2026, and Reclamation District No. 2028 have each executed the Agreement, and the failure of any other Party to execute the Agreement shall not affect the obligations of the Parties that have executed the Agreement. Other Reclamation Districts neighboring any Project Island and owners and operators of lands within ten thousand (10,000)

feet of any Project Island may become a Party to this Agreement by executing a joinder to this Agreement approved in writing by both CDWA and Delta Wetlands.

12.10 **Headings**. The headings preceding the paragraphs of this Agreement are for convenience of reference only, are not a part of this Agreement, and shall be disregarded in the interpretation of any portion of this Agreement.

12.11 **Agents**. All rights and obligations agreed to herein by any Party may be exercised and fulfilled by the Party's authorized agent.

12.12 **Notices**. Any notice, demand, request or communication that the Parties desire or are required to give in writing pursuant to this Agreement shall be deemed to have been duly given if delivered by hand or mailed, postage prepaid, certified or registered mail, return receipt requested and addressed to the appropriate Party as set below with copies to all of the other Parties to this Agreement. Notice of change of address shall be effective only when given in accordance with this Paragraph. All notices, demands and other communications made in compliance with this paragraph shall be deemed to have been received on the earlier to occur of the date of delivery or on the third business day after mailing.

DELTA WETLANDS PROPERTIES
c/o Rick Stephens
Stephens Real Estate Partners, LLC
1330 Arnold Drive, Suite 142
Martinez, CA 94553-6538
Phone: (925) 932-0251
Fax: (925) 932-0277
stephens@zks.com

With copies to:

George Childs
Zurich Alternative Asset Management
165 Broadway - One Liberty Plaza
New York, NY 10006
Phone: (212) 871-1578
Fax: (866) 457-7296
george.childs@zurich.com

Peter J. Kiel
Ellison, Schneider & Harris L.L.P.
2600 Capitol Avenue, Suite 400
Sacramento, CA 95816
Phone: (916) 447-2166
Fax: (916) 447-3512
pjk@eslawfirm.com

CENTRAL DELTA WATER AGENCY
RECLAMATION DISTRICT NO. 2030
RECLAMATION DISTRICT NO. 2038
RECLAMATION DISTRICT NO. 2072
c/o Dante John Nomellini
P.O. Box 1461
Stockton, CA 95201
Phone: (209) 465-5883
ngmplcs@pacbell.net

RC FARMS, INC.
3211 S. Holt Road
Stockton, CA 95206

CCRC FARMS, LLC
20750 W. Mandeville Levee Rd
Stockton, CA 95219

RECLAMATION DISTRICT NO. 2027
P.O. Box 248
Holt, CA 95234
Phone: (209) 464-2959

TUSCANY RESEARCH INSTITUTE
222 Via Marnell Way
Las Vegas, NV 89119

SEMITROPIC WATER STORAGE DISTRICT
1101 Central Avenue
Wasco, CA 93280
Phone: (661) 758-5113

With a copy to:

Ernest Conant
Law Offices of Young Wooldridge, LLP
1800-30th Street, Fourth Floor
Bakersfield, CA 93301
Phone: (661) 327-9661 ext. 132
Fax: (661) 327-0720
econant@youngwooldridge.com

RECLAMATION DISTRICT NO. 756
RECLAMATION DISTRICT NO. 2025
RECLAMATION DISTRICT NO. 2026
RECLAMATION DISTRICT NO. 2028
c/o Al Warren Hoslett
311 E. Main St., Suite 504
Stockton, CA 95202
Phone: (209) 943-5551

12.13 **Hold Harmless, Indemnification and Waiver.** Delta Wetlands agrees to hold the CDWA Parties signatory hereto, their directors, officers, agents and contractors free and harmless and indemnify them from any and all claims, actions, causes of action, demands, rights, damages, costs, loss and expense including reasonable attorneys' fees arising out of seepage determined by the Arbitrator to be caused by the Reservoir Islands and Habitat Islands, Reservoir Islands and Habitat Island levee inadequacy, any breach of this Agreement and enforcement of any remedy pertaining to the same except to the extent that damage is caused by the grossly negligent or intentionally wrongful action of the CDWA Parties.

Delta Wetlands agrees that it will not make any claim for water quality benefits (if any) resulting from the Project as against the CDWA Parties or any water user applying water to Delta lands. Delta Wetlands for itself and any successor hereby waives the right to make any such claim.

12.14 **Covenant Not To Apply or Store Wastewater or Biosolids.** Within thirty (30) days of receipt of a water right permit for water storage from the SWRCB, Delta Wetlands agrees to execute and record the covenant provided in Exhibit E prohibiting the application and/or storage of wastewater (including reclaimed wastewater), sewage sludge (including treated sewage sludge sometimes called biosolids) and septage (treated or otherwise) on any Reservoir Island or Habitat Island. Said covenant shall run with the land, and will thereby burden the Reservoir Islands and Habitat Islands and benefit the other lands in the Delta.

The prohibition contained in the covenant shall only apply so long as the designated Reservoir Islands or Habitat Islands are planned for use or used for water storage or developed wetland purposes.

12.15. **Operator's Covenant**: Delta Wetlands agrees that it will not delegate, transfer or join with any Party in the operation of the Project unless such party has agreed in writing to comply with the terms hereof and has become a party signatory hereto by execution of a copy of this

Agreement in counterpart. Such party shall be bound to the terms of this Agreement in the same manner and to the same extent as Delta Wetlands.

12.16. **No Degradation of the San Joaquin River**. Delta Wetlands agrees that it will not sell or transfer water to any party if such will directly or indirectly increase the salinity of the flows and accretions to the San Joaquin River.

12.17. **Effective Date**. This Agreement shall become effective when CDWA, Reclamation District No. 2038, Reclamation District No. 2072, RC Farms, Inc., Delta Wetlands, Reclamation District No. 756, Reclamation District No. 2025, Reclamation District No. 2026, and Reclamation District No. 2028 have executed the Agreement.

12.18 **Termination Date**. This Agreement shall terminate upon the later of the following: the termination or abandonment of all water right permits for Project water diversion and storage on the Reservoir Islands; the restoration of all reservoir islands to farmland or habitat as per the Reclamation Plan; resolution of all remaining claims against the CDWA Security Fund; and return of any remaining cash deposit to Delta Wetlands in accordance with paragraph 8.8 of this Agreement.

12.19 **No Admission of Liability**. Execution of this Agreement and compliance with its terms do not constitute an admission of liability or wrongdoing by any Party.

12.20 **Time is of the Essence**. Time is of the essence with respect to the performance or observance of each of the obligations, covenants and agreements under this Agreement.

12.21 **Specific Performance**. The Parties agree that monetary damages alone would be an inadequate remedy in the event any Party breaches this Agreement, and that any Party's breach of this Agreement will result in immeasurable and irreparable harm to the other Parties. Any non-breaching Party may seek specific performance of this Agreement, including but not limited to injunctive relief, in addition to any other remedy to which it may be entitled by reason of the other Party's breach of this Agreement.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement as of the Effective Date first set forth above.

DELTA WETLANDS PROPERTIES
An Illinois general partnership

By KLMLP 2, LLC
A Delaware limited liability company,
Managing General Partner of Delta Wetlands Properties

By KLMLP, L.P.
A Delaware limited partnership,
Managing Member of KLMLP 2, LLC

By Zurich American Corporation
(fka Kemper Corporation)
A Delaware corporation,
Managing General Partner of KLMLP, L.P.

By _____

Date: 7/2/2013

CENTRAL DELTA WATER AGENCY
a political subdivision of the State of California

By _____
President of the Board of Directors

Date: _____

APPROVED AS TO FORM:

By _____
Dante Nomellini, Sr.
General Counsel

Date: _____

ACKNOWLEDGMENT

State of New York)
) ss
County of New York)

On July 2nd, 2013, before me, Ronald Rambeo, Notary Public, personally appeared Elizabeth Lawn, who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of New York that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____(SEAL)

RONALD RAMBEO
Notary Public, State of New York
No.: 01RA6182165
Qualified in New York County
Commission Expires March 10, 2016

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement as of the Effective Date first set forth above.

DELTA WETLANDS PROPERTIES
An Illinois general partnership

By KLMLP 2, LLC
A Delaware limited liability company,
Managing General Partner of Delta Wetlands Properties

By KLMLP, L.P.
A Delaware limited partnership,
Managing Member of KLMLP 2. LLC

By Zurich American Corporation
(fka Kemper Corporation)
A Delaware corporation,
Managing General Partner of KLMLP, L.P.

By _____

Date: _____

CENTRAL DELTA WATER AGENCY
a political subdivision of the State of California

By _____
President of the Board of Directors

Date: 7-9-13

APPROVED AS TO FORM:

By _____
Dante Nomellini, Sr.
General Counsel

Date: 7-9-13

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of California

County of SAN JOAQUIN

On July 9, 2015 before me, JEAN MARIE URBANI, notary public,

personally appeared GEORGE BIAGI, JR.,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

JEAN MARIE URBANI
NOTARY PUBLIC - CALIFORNIA
COMMISSION # 1982484
SAN JOAQUIN COUNTY
My Comm. Exp. December 30, 2015

Jean Marie Urbani
Signature of Notary Public

(Notary Seal)

OPTIONAL INFORMATION

The acknowledgment contained within this document is in accordance with California law. Any certificate of acknowledgment performed within the State of California shall use the preceding wording pursuant to Civil Code section 1189. An acknowledgment cannot be affixed to a document sent by mail or otherwise delivered to a notary public, including electronic means, whereby the signer did not personally appear before the notary public, even if the signer is known by the notary public. In addition, the correct notarial wording can only be signed and sealed by a notary public. The seal and signature cannot be affixed to a document without the correct notarial wording.

DESCRIPTION OF ATTACHED DOCUMENT

_____
(Title of document)

Number of Pages _____ (Including acknowledgment)

Document Date _____

_____
(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of California

County of San Joaquin

On July 9, 2013 before me, Jean Marie Urbani, notary public,

personally appeared Dante John Nomellini,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

JEAN MARIE URBANI
NOTARY PUBLIC - CALIFORNIA
COMMISSION # 1962484
SAN JOAQUIN COUNTY
My Comm. Exp. December 30, 2015

Jean Marie Urbani
Signature of Notary Public

(Notary Seal)

OPTIONAL INFORMATION

The acknowledgment contained within this document is in accordance with California law. Any certificate of acknowledgment performed within the State of California shall use the preceding wording pursuant to Civil Code section 1189. An acknowledgment cannot be affixed to a document sent by mail or otherwise delivered to a notary public, including electronic means, whereby the signer did not personally appear before the notary public, even if the signer is known by the notary public. In addition, the correct notarial wording can only be signed and sealed by a notary public. The seal and signature cannot be affixed to a document without the correct notarial wording.

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(Title of document)

Number of Pages _____ (Including acknowledgment)

Document Date _____

_____
(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

RECLAMATION DISTRICT NO. 756

By _____
Chair/President of the Board of Trustees

Date: 7/11/13

APPROVED AS TO FORM:

By _____
Al Warren Hoslett
District Counsel

Date: July 11, 2013

RECLAMATION DISTRICT NO. 2026

By _____
Chair/President of the Board of Trustees

Date: 7/11/13

APPROVED AS TO FORM:

By _____
Al Warren Hoslett
District Counsel

Date: July 11, 2013

RECLAMATION DISTRICT NO. 2028

By _____
Chair/President of the Board of Trustees

Date: 7/11/13

APPROVED AS TO FORM:

By _____
Al Warren Hoslett
District Counsel

Date: July 11, 2013

RECLAMATION DISTRICT NO. 2025

By _____
Chair/President of the Board of Trustees

Date: 7/11/13

APPROVED AS TO FORM:

By _____
Al Warren Hoslett
District Counsel

Date: July 11, 2013

ON BEHALF OF RECLAMATION DISTRICT NO. 756

STATE OF CALIFORNIA
COUNTY OF SAN JOAQUIN

On July 11, 2013 before me, PAMELA A. FORBUS, Notary Public, personally appeared DAVID A. FORKEL, who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature Pamela a Forbus
PAMELA A. FORBUS. Notary Public.

MEP-1 PAMELA A. FORBUS COMM. # 2000633 NOTARY PUBLIC-CALIFORNIA SAN JOAQUIN COUNTY My Commission Expires December 13, 2016 MEP-1

ON BEHALF OF RECLAMATION DISTRICT NO. 2025

STATE OF CALIFORNIA
COUNTY OF SAN JOAQUIN

On July 11, 2013 before me, PAMELA A. FORBUS, Notary Public, personally appeared DAVID A. FORKEL, who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature Pamela a Forbus
PAMELA A. FORBUS. Notary Public.

MEP-1 PAMELA A. FORBUS COMM. # 2000633 NOTARY PUBLIC-CALIFORNIA SAN JOAQUIN COUNTY My Commission Expires December 13, 2016 MEP-1

ON BEHALF OF RECLAMATION DISTRICT NO. 2026

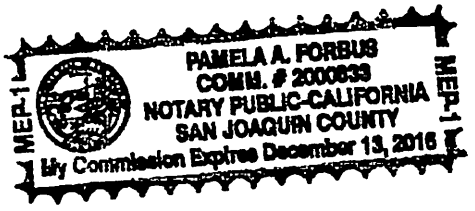
STATE OF CALIFORNIA
COUNTY OF SAN JOAQUIN

On July 11, 2013 before me, PAMELA A. FORBUS, Notary Public, personally appeared DAVID A. FORKEL, who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____
PAMELA A. FORBUS. Notary Public.



ON BEHALF OF RECLAMATION DISTRICT NO. 2028

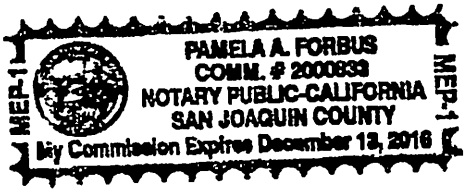
STATE OF CALIFORNIA
COUNTY OF SAN JOAQUIN

On July 11, 2013 before me, PAMELA A. FORBUS, Notary Public, personally appeared DAVID A. FORKEL, who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____
PAMELA A. FORBUS. Notary Public.



RECLAMATION DISTRICT NO. 2038

By _____
Chair/President of the Board of Trustees

Date: 7/3/13

APPROVED AS TO FORM:

By _____
Dante Nomellini, Sr.
District Counsel

Date: 7-8-13

RECLAMATION DISTRICT NO. 2030

By _____
Chair/President of the Board of Trustees

Date: 7/23/13

APPROVED AS TO FORM:

By _____
District Counsel

Date: 7/23/13

RECLAMATION DISTRICT NO. 2072

By Coleman Foley
Chair/President of the Board of Trustees

Date: 7-12-13

APPROVED AS TO FORM:

By _____
Dante Nomellini, Sr.
District Counsel

Date: 7-8-13

RC FARMS, INC.
A California corporation

By Yvonne Sharp

Date: 7/12/2013

State of California)
) ss
County of San Joaquin)

On July 23, 2013, before me, Carolyn E. Hartmann, Notary Public, personally appeared DENNIS GARDEMEYER and GEORGE V. HARTMANN, who proved to me on the basis of satisfactory evidence to be the persons whose names are subscribed to the within instrument and acknowledged to me that they executed the same in their authorized capacity, and that by their signatures on the instrument the persons, or the entity upon behalf of which the persons acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Carolyn E. Hartmann

Notary Public

CAROLYN E. HARTMANN
Commission # 2011383
Notary Public - California
San Joaquin County
My Comm. Expires Mar 11, 2017

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of California

County of SAN JOAQUIN

On July 3, 2013 before me, JEAN MARIE URBANI, notary public,

personally appeared KEVIN JONES,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/~~their~~ authorized capacity(ies), and that by his/her/~~their~~ signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

Jean Marie Urbani

Signature of Notary Public

JEAN MARIE URBANI
NOTARY PUBLIC - CALIFORNIA
COMMISSION # 1982484
SAN JOAQUIN COUNTY
My Comm. Exp. December 30, 2015

(Notary Seal)

OPTIONAL INFORMATION

The acknowledgment contained within this document is in accordance with California law. Any certificate of acknowledgment performed within the State of California shall use the preceding wording pursuant to Civil Code section 1189. An acknowledgment cannot be affixed to a document sent by mail or otherwise delivered to a notary public, including electronic means, whereby the signer did not personally appear before the notary public, even if the signer is known by the notary public. In addition, the correct notarial wording can only be signed and sealed by a notary public. The seal and signature cannot be affixed to a document without the correct notarial wording.

DESCRIPTION OF ATTACHED DOCUMENT

_____
(Title of document)

Number of Pages _____(Including acknowledgment)

Document Date _____

_____
(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of California

County of SAN JOAQUIN

On July 12, 2013 before me, JEAN MARIE URBANI, notary public,

personally appeared YVONNE SHARP,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

JEAN MARIE URBANI
NOTARY PUBLIC - CALIFORNIA
COMMISSION # 1982454
SAN JOAQUIN COUNTY
My Comm. Exp. December 30, 2015

Jean Marie Urbani
Signature of Notary Public

(Notary Seal)

OPTIONAL INFORMATION

The acknowledgment contained within this document is in accordance with California law. Any certificate of acknowledgment performed within the State of California shall use the preceding wording pursuant to Civil Code section 1189. An acknowledgment cannot be affixed to a document sent by mail or otherwise delivered to a notary public, including electronic means, whereby the signer did not personally appear before the notary public, even if the signer is known by the notary public. In addition, the correct notarial wording can only be signed and sealed by a notary public. The seal and signature cannot be affixed to a document without the correct notarial wording.

DESCRIPTION OF ATTACHED DOCUMENT

_____
(Title of document)

Number of Pages _____(Including acknowledgment)

Document Date _____

_____
(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of California

County of SAN JOAQUIN

On July 12, 2013 before me, JEAN MARIE URBANI, notary public,

personally appeared COLEMAN FOLEY,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

JEAN MARIE URBANI
NOTARY PUBLIC - CALIFORNIA
COMMISSION # 1982494
SAN JOAQUIN COUNTY
My Comm. Exp. December 30, 2015

Jean Marie Urbani
Signature of Notary Public

(Notary Seal)

OPTIONAL INFORMATION

The acknowledgment contained within this document is in accordance with California law. Any certificate of acknowledgment performed within the State of California shall use the preceding wording pursuant to Civil Code section 1189. An acknowledgment cannot be affixed to a document sent by mail or otherwise delivered to a notary public, including electronic means, whereby the signer did not personally appear before the notary public, even if the signer is known by the notary public. In addition, the correct notarial wording can only be signed and sealed by a notary public. The seal and signature cannot be affixed to a document without the correct notarial wording.

DESCRIPTION OF ATTACHED DOCUMENT

_____
(Title of document)

Number of Pages _____ (Including acknowledgment)

Document Date _____

_____
(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

RECLAMATION DISTRICT NO. 2027

By _____
Chair/President of the Board of Trustees

Date: 7-22-13

APPROVED AS TO FORM:

By _____
District Counsel

Date: 7-9-13

CCRC FARMS, LLC
A California limited liability company

By _____

Date: 7-22-13

TUSCANY RESEARCH INSTITUTE
A Nevada corporation

By _____

Date: 7-22-13

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT CERTIFICATE

State of ~~California~~ Nevada

County of Clark

On July 22 2013 before me, Meredith C. Ellis, notary public,

personally appeared Anthony A. Marnell II,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under Penalty of Perjury under the laws of the state of ~~California~~ Nevada that the foregoing paragraph is true and correct.

WITNESS MY HAND AND OFFICIAL SEAL.

Meredith C. Ellis
Signature of Notary Public

MEREDITH C. ELLIS
Notary Public State of Nevada
No. 92-0275-1
My Appt. Exp. Feb. 20, 2016
(Notary Seal)

OPTIONAL INFORMATION

The acknowledgment contained within this document is in accordance with California law. Any certificate of acknowledgment performed within the State of California shall use the preceding wording pursuant to Civil Code section 1189. An acknowledgment cannot be affixed to a document sent by mail or otherwise delivered to a notary public, including electronic means, whereby the signer did not personally appear before the notary public, even if the signer is known by the notary public. In addition, the correct notarial wording can only be signed and sealed by a notary public. The seal and signature cannot be affixed to a document without the correct notarial wording.

DESCRIPTION OF ATTACHED DOCUMENT

_____
(Title of document)

Number of Pages _____ (Including acknowledgment)

Document Date _____

_____
(Additional Information)

CAPACITY CLAIMED BY THE SIGNER

_____ Individual
_____ Corporate Officer
_____ Partner
_____ Attorney-In-Fact
_____ Trustee
_____ Other: _____

Exhibit A

Protest Dismissal Agreement between EBMUD and Delta Wetlands Properties

PROTEST DISMISSAL AGREEMENT BETWEEN DELTA WETLANDS PROPERTIES AND EAST BAY MUNICIPAL UTILITY DISTRICT

This Protest Dismissal Agreement is entered into and effective this 13th day of Sept., 2000, by and among Delta Wetlands Properties ("Delta Wetlands") and the East Bay Municipal Utility District ("EBMUD").

RECITALS

WHEREAS, Delta Wetlands has applied to the State Water Resources Control Board to appropriate water pursuant to Application Nos. 29062, 29066, 30268 and 30270 and petitions for change thereto ("Delta Wetlands Applications");

WHEREAS, EBMUD filed with the State Water Resources Control Board a protest of the Delta Wetlands Applications, said protest based upon (a) fishery and (b) levee and Mokelumne Aqueduct security grounds;

WHEREAS, the State Water Resources Control Board has conducted a hearing on the Delta Wetlands Applications and will resume the hearing on October 10, 2000;

WHEREAS, EBMUD has appeared as a protestant and an interested party in the hearing on the Delta Wetlands Applications;

WHEREAS, Delta Wetlands and EBMUD desire to resolve issues between them regarding the Delta Wetlands Applications;

WHEREAS, EBMUD has implemented and continues to implement a comprehensive program to protect and enhance the lower Mokelumne River anadromous fishery; to further protect that fishery, EBMUD and Delta Wetlands wish to ensure that Delta Wetlands implements measures to minimize potential Delta Wetlands Project impacts upon that fishery;

WHEREAS, Delta Wetlands wishes to ensure the security of its Bacon Island and Webb Tract reservoir island levees and seepage control systems;

WHEREAS, EBMUD owns and operates the Mokelumne Aqueducts, which convey water across the Delta to supply EBMUD's East San Francisco Bay service area with approximately 95% of its water;

WHEREAS, Bacon Island, a proposed reservoir island of the Delta Wetlands Project, is located just north of and adjacent to the Mokelumne Aqueducts as they pass through the Delta;

WHEREAS, EBMUD wishes to ensure that the Bacon Island levees are secure and do not fail and that the levees on adjacent islands around Bacon Island are not damaged by the Project, either of which EBMUD contends could damage or destroy the Mokelumne Aqueducts; and

WHEREAS, EBMUD wishes to ensure that all seepage from Delta Wetlands' reservoir operations on Bacon Island to neighboring islands is controlled to prevent damage to the Mokelumne Aqueducts;

NOW, THEREFORE, the parties agree as follows:

1. Delta Wetlands and EBMUD agree to present Attachment A, Fisheries Terms and Conditions, Attachment B, Geotechnical Terms and Conditions, and Attachment C, Delta Wetlands Seepage Control Plan, to the State Water Resources Control Board and to support inclusion of those terms and conditions in any and all permits or licenses issued by the State Water Resources Control Board for the Delta Wetlands Project, including any permits or licenses issued pursuant to Application Nos. 29062, 29066, 30268 and 30270.

2. EBMUD agrees not to oppose the issuance of water right permits or licenses to Delta Wetlands pursuant to the Delta Wetlands Applications and agrees to withdraw its protest on the condition that the terms and conditions contained herein as Attachments A, B and C are included in such permits and licenses where applicable.

3. Whether or not the State Water Resources Control Board includes the terms and conditions contained in Attachments A, B and C, Delta Wetlands and its successors shall be subject to and comply with the terms, conditions and requirements of Attachments A, B and C, including the procedures regarding the Design Review Board and the Monitoring and Action Board.

4. At the resumed water rights hearing on its applications, Delta Wetlands will offer this Agreement into evidence as part of its submission to the State Water Resources Control Board.

5. EBMUD may elect to participate in the Delta Wetlands Project Fishery Technical Advisory Committee. Delta Wetlands shall notify the Department of Fish and Game that EBMUD may participate on the Technical Advisory Committee and is to be provided notice of all Technical Advisory Committee meetings and discussions.

6. This Agreement shall be binding upon and inure to the benefit of the successors in interest and legal representatives of the respective parties.

7. All changes or modifications to this Agreement shall be in writing and signed by EBMUD and Delta Wetlands or their successors.

8. The signatories hereto represent that they are authorized to enter into this Agreement on behalf of the party for whom they sign. This document may be executed in duplicate originals.

DELTA WETLANDS PROPERTIES, an Illinois general partnership

By: KLMLP, L.P., a Delaware limited partnership, Special Partner

By: ZKS Real Estate Partners, LLC, a Delaware limited liability company, its authorized agent.

Dated: Sep 7, 2000

By _____
Frederick L. Stephens, President

EAST BAY MUNICIPAL UTILITY DISTRICT

Dated: 9/14/00

By _____
Dennis M. Diemer, General Manager

ATTACHMENT A
FISHERIES TERMS AND CONDITIONS

Webb Tract Operations

From January 1 to June 30, Permittee's Webb Tract operations shall be in accordance with the following diversion protocol:

1. Diversions to storage shall be made through the southeastern siphon station, except that;

2. Only after the southeastern station siphon is operating at full capacity, or in excess of 90% of full capacity due to maintenance and repair, may diversions to storage be made through the northeastern siphon station;

3. Any reductions in diversions to storage shall first be accomplished by curtailing diversions at the northeastern siphon station. Only after diversions to storage at the northeastern siphon station are reduced to less than 50 cfs shall reductions in diversions begin at the southeastern station.

4. Permittee may operate the northeastern siphon station only when diversions through the southeastern siphon station are projected to be insufficient to completely fill storage on Webb Tract within 30 days. Permittee shall then operate the northeastern siphon station at or below the rates projected to fill said storage by the end of this same 30-day period. Permittee shall report Webb Tract diversion rates and storage amounts to the Technical Advisory Committee on an annual and monthly basis, in accordance with the provisions outlined in the Water Quality Management Plan or other applicable terms and conditions.

5. This diversion operations protocol is not applicable (1) if the U.S. Fish and Wildlife Service ("USFWS") determines that delta smelt eggs, larvae, juvenile or adult life stages are found at the Webb Tract southeastern siphon monitoring stations, as set forth in the USFWS Final Biological Opinion, or (2) if the 3-day running average of salinity or dissolved organic carbon ("DOC") at the northeastern siphon station is more than 10% lower than the 3-day running average of salinity or DOC at the southeastern siphon station. This 10% salinity/DOC exception to the protocol is not expected to occur more than once every five years. If, however, this 10% salinity/DOC exception occurs more frequently than once every five years, then the diversions at the northeastern siphon station resulting from this exception may not exceed 25 thousand acre feet per year nor exceed a diversion rate of 1,375 cfs, without express written authorization from EBMUD. In the event that this salinity/DOC exception is triggered, Permittee shall reimburse EBMUD up to an additional $5,000 as provided and pursuant to paragraph 16 set forth below.

6. The diversion operations protocol is not applicable during routine repairs and maintenance of the southeastern siphon station, with such exception limited to a maximum of three days per month.

7. Any additional siphons or screening capacity constructed by Permittee will also be subject to the diversion protocol. Any such additional siphons or screening capacity will be added to the southeastern siphon station whenever possible.

Siphon Removal

8. Permittee shall limit the number of existing siphons on Bouldin Island to no more than 14. This will require Permittee to remove a number of existing siphons. This reduction shall be applied uniformly around the island. All remaining siphons shall be screened as set forth in the USFWS' Final Biological Opinion.

9. Permittee shall limit the number of existing siphons on Webb Tract to no more than 7. This will require Permittee to remove a number of existing siphons. This reduction shall be applied uniformly around the island, except that at least 50% of the existing siphons along the San Joaquin River shall be removed so that no more than 4 siphons remain on the San Joaquin River. All remaining siphons shall be screened as set forth in the USFWS' Final Biological Opinion.

10. Permittee shall complete the above-referenced siphon removal prior to beginning diversions on Webb Tract under Permittee's new water rights. Permittee shall provide EBMUD with written notice of removal within thirty days of completion of siphon removal.

Boat Docks

11. Permittee shall limit the addition of new boat docks on the exterior of Bouldin Island to no more than 150. New boat docks on the Mokelumne River shall be limited to no more than 75.

12. Permittee shall limit the addition of new boat docks on the exterior of Webb Tract to no more than 198. New boat docks on the San Joaquin River shall be limited to no more than 30.

13. The location of Permittee's new boat docks on Bouldin Island and Webb Tract shall be based on recommendations by the Technical Advisory Committee with consideration given to the proximity of the proposed new boat docks to proposed new shallow water habitat.

Webb Tract Fisheries Monitoring Program

From January 1 to June 30, Webb Tract diversions to storage from the northeastern siphon station that exceed 50 cfs shall require fishery monitoring as described below:

14. No later than January 1, February 1, and March 1 of each year, Permittee shall provide to EBMUD a monthly operations plan showing when diversions to Webb Tract and Bouldin Island are anticipated to take place for the subsequent four month period.

15. No less than three days prior to commencing diversions which exceed 50 cfs to Webb Tract or Bouldin Island, Permittee shall notify EBMUD of its proposed diversion.

16. In any year when Permittee operates its northeastern Webb Tract diversion station and EBMUD finds juvenile chinook salmon have begun outmigrating from the Mokelumne River as determined by a two-day running average of over 25 fish per day at Woodbridge Dam, Permittee will reimburse EBMUD up to $50,000 per year in year 2000 dollars (adjusted annually for inflation by the Consumer Price Index for All Items - All Urban Consumers for the San Francisco-Oakland-San Jose Metropolitan Statistical Area) for monitoring expenses and the cost to obtain any necessary permits for monitoring in the immediate vicinity of the northeastern Webb Tract diversion station and associated boat docks.

17. Monitoring shall be performed for the first five years of actual operation (these might not be consecutive years) of Permittee's northeastern Webb Tract diversion station. If the Mokelumne River juvenile anadromous fish are not present on the screens of the northeastern diversion structure or are not in the stomachs of predators in the immediate vicinity of the northeastern diversion structure during this period, then no further monitoring shall be required.[1] If, however, Mokelumne River juvenile anadromous fish are present on the screens of the northeastern diversion structure or in the stomachs of predators in the immediate vicinity of the northeastern diversion structure, this monitoring program and its associated mitigation (described in Paragraph 18, below) will continue until such time as the monitoring program fails to detect the presence of these fish for three consecutive years of operation.

18. If this monitoring program identifies that Mokelumne River juvenile anadromous fish are present on the screens of the northeastern diversion structure or in the stomachs of predators in the immediate vicinity of the northeastern diversion structure, Delta Wetlands will immediately reduce its diversions at the northeastern Webb Tract diversion station by 50% of the then current diversion rate, or down to an instantaneous diversion rate of 50 cfs, whichever is greater.

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[1]For purposes of this agreement, Mokelumne River juvenile anadromous fish are any juvenile salmonids bearing an adipose fin clip. In the event tagging techniques are modified by EBMUD, or others, that eliminates the ability to distinguish Mokelumne River juvenile anadromous fish, EBMUD shall notify Permittee and modify this definition to enable proper identification of the Mokelumne River juvenile anadromous fish.

ATTACHMENT B
GEOTECHNICAL TERMS AND CONDITIONS

Reservoir Island Design Review Board ("DRB")

1. Members:

   a. Number: Three.

   b. Qualifications: Registered professional civil engineers with experience providing engineering services in the Sacramento-San Joaquin Bay-Delta. At least one member shall be a geotechnical engineer.

   c. Appointed by: Delta Wetlands Properties ("DW" or "Permittee").

   d. While not members of the Design Review Board ("DRB"), parties such as EBMUD that hold property interests adjacent to Bacon Island or Webb Tract (the Project reservoir islands) or parties that could be substantially affected by the reservoir operations and have appeared in the DW water rights hearing, shall have the ability to participate in DRB meetings, comment on design, and shall be provided a copy of all DRB minutes so that such parties can monitor the design and construction of the Project reservoir islands.

2. Duties: Permittee shall submit Project reservoir island plans and specifications to the DRB. The DRB shall review and comment on the plans and specifications during staged design review and during construction for the Bacon Island and Webb Tract Project improvements, confirming that Project design meets the stated objectives of the Project description as defined in the 2000 Revised Draft Environmental Impact Report/Statement and the Delta Wetlands Seepage Control Plan (Attachment C), including but not limited to: levee factors of safety, wave protection for levees, levee slopes, seepage control, and monitoring programs. Comments of the DRB shall be provided to the SWRCB, Permittee, EBMUD, and to local reclamation districts adjacent to the Project reservoir islands.

3. Compensation: Members of the DRB are to be compensated by Permittee for their time, in an amount up to but not to exceed $300,000. The DRB shall cease to exist once its duties, as set forth in paragraph 2, are completed.

Reservoir Island Monitoring & Action Board ("MAB")

4. Members:

   a. Number: Three, with two alternates.

   b. Qualifications: The two primary members shall be registered professional civil geotechnical engineers with experience providing engineering services in the

Sacramento-San Joaquin Bay-Delta. The third member and the two alternate members shall be licensed professionals with experience in seepage in the Sacramento-San Joaquin Bay-Delta.

c. Appointment Process: The State Water Resources Control Board ("SWRCB") shall appoint one member and DW shall appoint one member. In the event the SWRCB does not so appoint one MAB member, then DW shall instead appoint that member after first meeting and conferring with EBMUD on the independence and objectivity of the proposed appointment and after allowing EBMUD an opportunity to object to the appointment. No appointment of this one MAB member shall be made over the objection of EBMUD. These two members ("primary members") shall appoint the third member and the two alternate members. Any party to the Delta Wetlands SWRCB hearing may provide suggestions to the SWRCB as to who to appoint to the MAB. Each of the MAB members shall be appointed for a term of four years. At the end of the four-year term, the same selection process will be used to select the MAB.

5. Term: The MAB shall be established prior to the first diversions to storage on Bacon Island or Webb Tract and shall continue thereafter for the duration of Project reservoir operations on Bacon Island and/or Webb Tract.

6. Compensation: Members of the MAB are to be compensated by Permittee for their time on an hourly basis. Such costs, including costs of reports which may be prepared and studies which may be undertaken by the MAB shall be part of the annual operation and maintenance costs of the Project.

7. Duties:

a. Permittee shall submit Project monitoring and seepage data to the MAB so that the MAB can fulfill its duties. During the first year of Project reservoir island operations, the MAB shall serve as a neutral technical engineering advisor and shall review monitoring and seepage data at each stage of initial reservoir filling. Following that initial filling, the MAB shall review monitoring and seepage data at a minimum of every three months during the remainder of the first year of Project reservoir island operation.

b. The MAB shall serve as a neutral technical engineering advisory panel, hearing and investigating identified problems purportedly caused by Permittee's reservoir operations, including but not limited to levee weakness, overtopping of levees, levee failure, scour at EBMUD's Mokelumne Aqueduct river crossings, and seepage. The MAB shall also issue Reports containing its recommendations on remedial actions to correct problems, as set forth in paragraph 14.

c. The terms of the Delta Wetlands Seepage Control Plan (Attachment C) may be adjusted over time by the SWRCB as set forth below. The SWRCB reserves jurisdiction over changes in the Delta Wetlands Seepage Control Plan to coordinate

or modify its terms for the protection of other legal users of water, fish, wildlife, instream beneficial uses, and the public interest as future conditions may warrant. The SWRCB delegates authority to the Executive Director of the SWRCB to take actions under this reservation of jurisdiction as set forth below.

(i) During the third year of Project operations, the MAB shall review the Delta Wetlands Seepage Control Plan to determine if changes in any of the Seepage Control Plan's terms are advisable. In its review, the MAB shall examine actual operation of the Project to date and any adverse effects of Project reservoir operations, including impacts on neighboring levees and islands. The MAB will base each of its recommended changes to Plan terms, if any, on its independent, professional judgment. At the conclusion of its review, the MAB shall issue a written list of its recommended changes, if any. The list shall be sent by the MAB to the SWRCB, Permittee, EBMUD, all Interested Parties who have notified Permittee as set forth in paragraph 9, and all parties to the Delta Wetlands SWRCB hearing ("Noticed Parties").

(ii) If Permittee, EBMUD, Noticed Parties and Interested Parties (as limited above) do not object to a change recommended by the MAB within 30 days of service of any proposed change, then the Executive Director of the SWRCB may approve the change without the need for a comment period or hearing. In the event of any objection, the SWRCB may only approve the change after it provides notice of and an opportunity to comment on the proposed change to Permittee, EBMUD, Noticed Parties and Interested Parties (as limited above). If requested by Permittee, EBMUD, a Noticed Party or an Interested Party (as limited above), the SWRCB may hold a hearing on the proposed change.

d. After its initial three-year review of the Delta Wetlands Seepage Control Plan as set forth above, the MAB may thereafter periodically review and change the terms of the Delta Wetlands Seepage Control Plan so long as the review and approval process set forth above is followed.

Dispute Resolution Procedure

8. Delta Wetlands and EBMUD set forth the following process to identify and remedy levee, seepage and related problems which may be caused by Project reservoir islands operations. The parties recognize, however, that in the event of an emergency, such as an imminent levee failure, there is a need for rapid action such that there may not be time for this process to take place. In the event of emergency, an Interested Party or reclamation district may notify Permittee of a problem by any available method.

9. Any entity or individual who may be injured by the reservoir operations of the Delta Wetlands Project ("Interested Party") may elect to seek a remedy through the Dispute Resolution Procedure set forth below. If such an Interested Party elects to utilize said Dispute Resolution Procedure, then the Interested Party shall notify Permittee and MAB in

writing of such election and shall be bound by all provisions set forth therein, including but not limited to paragraph 16.

10. Method of Notification: Except in cases of emergency, all notifications, determinations, completion notices, objections, and reports shall be in writing delivered by U.S. Mail, courier, messenger, facsimile or electronic mail. All written notifications, determinations, completion notices, objections, and reports must be signed by a registered engineer.

11. Notification of Problem: EBMUD, or any Interested Party that has elected to use the Dispute Resolution Procedure as set forth in paragraph 9, may notify Permittee of perceived problems caused by the Project, including but not limited to, indications of levee failure and/or seepage on Project reservoir islands or on adjacent islands. EBMUD or Interested Party shall hereafter be referred to as "Complainant."

    a. Contents of Notification: The Notification shall specify the type of problem identified, its location and when it was observed.

    b. Notification Sent to: The Notification shall be sent by Complainant to the SWRCB, Permittee, the MAB, and to the secretary of any reclamation district for land on which the identified problem is occurring.

12. Determination by Permittee: Upon receiving a written Notification pursuant to paragraph 11, Permittee shall investigate the problem. Within five working days of receiving said written Notification, Permittee shall provide a written Determination to the SWRCB, Complainant, the MAB, and to the secretary of any reclamation district to whom the Notification was sent.

    a. Contents of Determination: The Determination shall outline what actions Permittee took to investigate the identified problem, Permittee's conclusions as to the nature of the problem, an explanation of what remedial actions, if any, Permittee will take to correct the problem, and when any such remedial actions will be commenced and completed.

    b. Upon Permittee's completion of any such remedial actions, Permittee shall provide a written completion notice to the SWRCB, Complainant, the MAB, and the secretary of any reclamation district to whom the Notification was sent. The notice shall state what remedial actions were taken and when they were completed.

13. Objection to Permittee's Determination: In the event Complainant disagrees with all or part of Permittee's Determination, Complainant within five working days of receipt of Permittee's Determination, shall send to the SWRCB, Permittee, the MAB and to the secretary of any reclamation district to whom the Notification was sent, a written Objection to the Determination.

a. Contents of Objection: The Objection shall outline to which portions of the Determination Complainant objects and why. Complainant may also state its view of the problem and remedy.

14. MAB Report: Upon receipt of an Objection pursuant to paragraph 13, the MAB shall commence its own independent investigation of the matter. Permittee and/or Complainant may submit additional material to the MAB to assist in its investigation, so long as the other party is copied. If, in the opinion of the MAB, additional technical studies are necessary to its investigation, it may undertake or authorize such studies. The costs of any such studies shall be paid for as set forth in paragraph 6.

a. Within seven working days of receiving the written Objection, the MAB shall issue a written Report. Said Report shall be sent to the SWRCB, Permittee, Complainant and to the secretary of any reclamation district to whom the Notification was sent.

b. Contents of Report: The Report shall include the MAB's independent opinion on the nature of the problem, its recommendation on what remedial actions should be taken by Permittee to correct the problem, if any, and a schedule of when any such remedial actions should be commenced and completed by Permittee. The MAB shall only recommend remedial actions which address problems determined to be caused by Project reservoir operations though, if necessary, it may identify other causes only for explanatory purposes.

15. Permittee's Compliance with the Report: Permittee shall implement all recommended remedial measures listed in the MAB's Report by the deadlines included therein, and shall be solely responsible for the costs of said measures.

16. Frivolous Claims: If the Permittee believes the Complainant has filed a frivolous Notification pursuant to paragraph 11, then Permittee may, within fifteen days of receiving the MAB Report, request the MAB to determine whether the Notification by Complainant is totally and completely without merit (frivolous). If the Notification is determined to be frivolous, Complainant shall pay all costs and fees of investigating the claim incurred by the MAB.

17. Judicial Remedy: Nothing in these terms and conditions shall constitute a waiver of the rights of Permittee or Complainant to pursue judicial remedies in state court regarding an MAB Report.

Financial Assurances

18. The following four classes of financial assurances shall be required so long as the Project is owned by any party other than the state and/or federal government(s). In the event the Project is owned and operated by the state and/or federal government(s), then these provisions shall not apply. However, any governmental entity that purchases or leases the Project shall hold a financial reserve account for the Project that is sufficient to cover the annual costs of Project operations or shall provide equivalent assurances.

19. **Seepage and Monitoring Fund:** The parties wish to ensure that, prior to any diversions to storage on Bacon Island or Webb Tract in each and every year of Project operation, the Permittee have sufficient capital resources on hand to operate the seepage control and monitoring systems for the full year. To meet this objective, the following funding mechanism shall be utilized.

First Year of Operation. Prior to the first diversion to storage on a Project reservoir island, Permittee shall deposit, in an interest-bearing account in a financial institution licensed to do business in the State of California who will act as the escrow agent, with interest accruing to Permittee, $500,000 to be used for the first year's annual operating expenses of the Project's reservoir island seepage control and monitoring systems. Permittee may draw upon said monies over the course of the year only to cover routine incurred expenses for seepage control and monitoring on the two Project reservoir islands.

Following Years. Prior to the first diversion to storage on a Project reservoir island in each and every water year thereafter, Permittee shall deposit into said account a sum of money the MAB estimates, as provided below, will be required for the complete annual operating costs of the Project's reservoir island seepage control and monitoring systems for that upcoming water year. Permittee may draw upon said monies over the course of the water year only to cover routine incurred expenses for seepage control and monitoring on the two Project reservoir islands.

Estimate. No later than September 1 of each year, Permittee shall file with the MAB a written estimate of the amount of money required for the complete annual operating costs of the Project's reservoir islands seepage control and monitoring systems for the upcoming water year. (The water year shall be October 1 through September 30.) The MAB shall review that estimate and, in its own discretion, set an amount of money it estimates will be needed to operate the Project reservoir islands seepage control and monitoring systems for that upcoming water year. Said sum shall not be less than the prior year's actual seepage and monitoring costs. Permittee shall then deposit that amount of money in the designated account, as provided above.

Records. Permittee shall provide proof of deposit of the estimated annual seepage and monitoring costs to the MAB prior to the first diversion to storage on a Project reservoir island in each year of operation. Permittee shall maintain all books and records on the utilization of said account monies for each year of Project operation and shall submit to the SWRCB and MAB, no later than October 15 of each year, an accounting of how said monies were expended in the prior water year.

20. **Drawdown Fund:** The parties wish to ensure that, in the event Permittee abandons the Project or otherwise does not operate the Project after water has been diverted to storage on a Project reservoir island, there are sufficient capital resources on hand to empty the Project reservoir islands.

First Year of Operation. Prior to the first year of reservoir operations, Permittee shall deposit, in an interest-bearing account in a financial institution licensed to do business in the State of California who will act as the escrow agent, with interest accruing to Permittee, $1,000,000 to cover the expense of emptying the Project reservoir islands. Permittee may draw upon said monies over the course of the year to cover routine expenses of discharging water from the Project reservoir islands as part of normal operations.

Following Years. Prior to the first diversion to storage on a Project reservoir island in each and every water year thereafter, Permittee shall deposit into said account a sum of money the MAB estimates, as provided below, will be required for the complete annual operating costs of the Project's discharge operations for that upcoming water year. Permittee may draw upon said monies over the course of the water year only to cover routine incurred expenses for discharge of stored water on the two Project reservoir islands.

Estimate. No later than September 1 of each year, Permittee shall file with the MAB a written estimate of the amount of money required for the complete annual operating costs to discharge water from the Project reservoir islands for the upcoming water year. (The water year shall be October 1 through September 30.) The MAB shall review that estimate and, in its own discretion, set an amount of money it estimates will be needed to discharge water from the Project reservoir islands for that upcoming water year. Said sum shall not be less than the prior year's actual discharge costs. Permittee shall then deposit that amount of money in the designated account, as provided above.

Records. Permittee shall provide proof of deposit of the estimated annual discharge costs to the MAB prior to the first diversion to storage on a Project reservoir island in each year of operation. Permittee shall maintain all books and records on the utilization of said account monies for each year of Project operation and shall submit to the SWRCB and the MAB, no later than October 15 of each year, an accounting of how said monies were expended in the prior water year.

21. **Remedial Actions:** The parties wish to ensure that, in the event Permittee determines to take corrective actions in response to a Complainant's Notification or if the MAB recommends remedial actions to correct identified problems, Permittee will have sufficient capital resources on hand to implement those actions.

Prior to the first diversion to storage on a Project reservoir island, Permittee shall deposit, in an interest-bearing account in a financial institution licensed to do business in the State of California who will act as the escrow agent, with interest accruing to Permittee, $1,000,000. This fund shall be available for use by Permittee only to implement corrective actions in response to a Complainant's Notification or to implement remedial measures recommended by the MAB.

In the event this Remedial Action Fund is so used by Permittee, Permittee shall, prior to again diverting to storage on a Project reservoir island, deposit sufficient monies into said account so that its balance returns to its minimum required level. Its minimum required level shall be $1,000,000, as adjusted annually for inflation by the ENR Construction Cost Index

for San Francisco (ENR CCI-SF) for the life of the Project. In the event this Remedial Action Fund is not used by Permittee during ten years of reservoir operations, then such fund shall be canceled and the monies deposited shall revert back to Permittee.

Records. Permittee shall provide proof of deposit of the Remedial Action Fund to the MAB prior to the first diversion to storage on a Project reservoir island, and if the Remedial Action Fund is drawn upon, Permittee shall again provide proof of deposit of sufficient funds to maintain the balance at the minimum required level prior to again diverting to storage on a Project reservoir island. Permittee shall maintain all books and records on the utilization of said account monies for each year of Project operation and shall submit to the SWRCB and the MAB, no later than October 15 of each year, an accounting of how said monies were expended in the prior water year.

22. **Insurance:** The parties wish to ensure that in the event of damage caused by the Project, sufficient capital resources are available to reimburse damaged parties.

Permittee shall take out and maintain, during the life of the Project, General Liability Insurance that provides protection from claims that may arise from Project reservoir islands operations. Permittee shall annually submit certificates of said insurance to EBMUD. The policy shall not be cancelled or materially altered unless 30 days' written notice is given EBMUD. The amounts of insurance coverage shall not be less than $25,000,000/ Occurrence, Bodily Injury, Property Damage - General Liability.

ATTACHMENT C
DELTA WETLANDS SEEPAGE CONTROL PLAN

I. INTRODUCTION

A. Description of Seepage

The Delta Wetlands ("DW") Project consists of four islands. Water will be stored on the two reservoir islands (Bacon Island and Webb Tract) up to elevation +6 feet. On the habitat islands (Bouldin Island and Holland Tract), water levels will be managed for a range of crops and habitats, some of which include shallow flooding. DW intends to control groundwater in the vicinity of its reservoir islands in such a way that there is no seepage beyond that which would be produced by other uses of the DW reservoir islands currently allowed (such as intensive agriculture or shallow flooded wetlands). Controlling seepage to within these limits is referred to as "no net seepage impact".

The method by which a reservoir on Bacon Island and/or Webb Tract could create a seepage impact on an adjacent island is flow through a connecting sand aquifer extending beneath both islands. Seepage flowing from one island to the next will raise the hydrostatic head in the aquifer beneath the neighboring (receiving) island. The presence or absence of a connecting aquifer is not known at many locations. If there is a connecting aquifer and if seepage is occurring from a reservoir island through the aquifer to a neighboring island, the hydrostatic head in the aquifer beneath the neighboring island will rise and fall with the filling and emptying of the reservoir. DW will monitor the hydrostatic head in the aquifers beneath neighboring island levees to check that no seepage is occurring from DW Reservoirs. Several types of "wells" are used to control and monitor seepage. Their definition and relative location are shown on Figure C-1 (attached).

B. Groundwater Monitoring Wells

Two suites of groundwater monitoring wells will be installed.

To check whether the reservoir water level on Bacon Island or Webb Tract is affecting an adjacent island, Permittee will install seepage monitoring wells along a neighboring island's perimeter directly across from the Bacon Island and Webb Tract Reservoir islands.[1] These will be the primary tool for detecting seepage from a reservoir island. If water stored on a DW reservoir island creates added seepage toward a neighboring island, the increased hydrostatic head that would be part of the seepage can be measured in monitoring wells penetrating the aquifer transmitting the water.

To check the overall groundwater behavior in the Delta, unrelated to operation of the DW Project, a series of background monitoring wells will be installed at locations sufficiently far removed from the Bacon Island and Webb Tract reservoirs as to not be influenced by water storage

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[1]The installation of monitoring wells is subject to the approval of the neighboring island owner(s). If approval is unreasonably withheld, alternative locations will be utilized.

within the reservoirs. The measured groundwater levels will be normalized (as described below) and averaged to develop an overall characterization of the groundwater trends in the central portion of the Delta.

C. Pre-Project Baseline

To collect baseline[2] data on the overall groundwater system performance as it relates to agricultural practices or wetlands management, the groundwater monitoring wells (both seepage monitoring wells and background monitoring wells) will be monitored by DW continually for at least one year prior to the start of reservoir filling. The same measurements will be taken by DW year round, once the Project is implemented.

D. Detecting Seepage

To assess whether filling Bacon Island or Webb Tract may be impacting the groundwater level beneath neighboring islands, the groundwater levels in the seepage monitoring wells beneath adjacent islands will be compared by DW to the baseline records at those same locations. Concurrently, the overall groundwater performance of the Delta will be measured by DW in the background monitoring wells. Those locations showing increases above baseline range (adjusted for extreme variations in overall Delta groundwater performance), that coincide with filling the reservoir, will be the basis for suspending water diversion onto the nearby reservoir island. Details regarding how the various data will be compared are described in Section III set forth below. The above monitoring observations will be made on a continuing basis, allowing DW to observe the start of trends that may indicate possible seepage from the reservoirs. The goal of DW is to be proactive and to make needed groundwater control adjustments far in advance of the Diversion Suspension Limits.

E. Initial Stage Filling of Reservoirs

When the Project first begins to operate, water storage will be implemented on a vertical stage-filling basis. Water within the reservoir will first be brought to a fairly low level, not more than 25% of storage capacity, and held constant for a period of time until sufficient data are collected to verify that no net seepage impacts are occurring on neighboring islands. If impacts are found that require controlling measures, filling of the reservoir will be put on hold until appropriate measures can be brought on line so as to not cause additional risk to neighboring island levees. Such actions could include increasing the pumping capacity of interceptor wells, installing additional interceptor wells, installing relief wells on a neighboring island, and/or other mitigation that may be agreed upon among DW, the adjacent landowners, and the reclamation districts.

If impacts are not detected, the reservoir will be further filled to the next vertical stage (approximately 50% of reservoir capacity) and again held constant to allow adequate time for data collection and assessing of possible seepage impacts. This cycle of staged-filling, monitoring

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[2]"Baseline" data refer to data collected prior to the first filling of the reservoir islands. The baseline may be updated during subsequent years of no water storage on the reservoir islands.

seepage, assessing impacts, and correcting impacts will be repeated until the reservoir can be safely brought to full operational level with suitable seepage control measures in place.

F. Routine Operations

The reservoirs will commonly begin filling in late fall to early winter. Both prior to and during filling, the groundwater levels in the seepage monitoring wells will be carefully tracked by DW. The interceptor wells will begin to operate as the reservoir level is raised. Pumping rates will be increased as the pool elevation in the reservoir is raised. All this time, the seepage monitoring wells will be tracked and serve as a control for adjusting the interceptor well pumping rates. The interceptor wells will be pumped such that the water levels in the seepage monitoring wells are kept near the normal seasonal levels.

DW will continually evaluate the efficiency of the interceptor wells to verify that there is sufficient additional capacity to allow the pool elevation to continue to be raised. If the efficiency of a well drops off such that the ability of the well to pump greater volumes of water is in question, DW will redevelop the well to improve its efficiency prior to approaching the well's limits. If additional capacity is not readily available from an existing well, a new well can be drilled to increase the pumping capacity at the reservoir island's perimeter.

The reservoir pool elevation will lower as water is later exported into the adjacent slough or river. As the pool elevation decreases, the pumping rates from the interceptor wells will be gradually lowered, with the goal of keeping the water levels in the neighboring islands seepage monitoring wells near their normal seasonal levels.

During the period with little to no water storage, a thorough evaluation of the efficiency of the wells will be undertaken by DW to identify those wells that may show signs of decreasing efficiency and may be susceptible to overstressing during the following season's storage cycle. The need for additional wells will also be evaluated. To the extent practical, redevelopment of existing wells and installation of additional wells will occur during the off-season.

II. LOCATIONS OF GROUNDWATER MONITORING WELLS

A. Background Monitoring Wells

At least twenty-five (25) background monitoring wells will be sited by DW at an appropriate distance from the reservoir islands. These background monitoring wells will be at least one mile from a reservoir island and most likely will be greater than 11/2 miles from a reservoir island. Recommended typical locations of background monitoring wells are shown on Figure C-2. The purpose of these background monitoring wells is to monitor regional groundwater elevations beyond the reasonable influence of the DW reservoir islands.

B. Seepage Monitoring Wells

At least 100 seepage monitoring wells will be placed on or near levees directly opposite the perimeter of the reservoir islands. The five neighboring islands around the south half of Bacon

Island are Lower Jones Tract, Upper Jones Tract, Woodward Island, Orwood Tract and Palm Tract. Around the northern half of Bacon Island are Holland Tract, Little Mandeville Island (currently flooded), Mandeville Island and Mildred Island (currently flooded). Around Webb Tract are Bradford Island, Twitchell Island, Brannan/Andrus Island, Bouldin Island, Venice Tract, Mandeville Island, Franks Tracts (currently flooded), and Little Franks Tract (currently flooded).

Passing across Upper Jones Tract, Woodward Island and Orwood Tract is the Mokelumne Aqueduct, a critical structure. Flooding on any of the five neighboring islands (Lower Jones Tract, Upper Jones Tract, Woodward Island, Orwood Tract and Palm Tract) around the southern half of Bacon Island may increase the risk of service disruption for the aqueduct. The shortest distance between the levee on the southern half of Bacon Island and a neighboring island levee (centerline to centerline) is about 700 feet. A seepage monitoring well spacing of 1,500 to 2,000 feet on a neighbor island levee will provide essentially full coverage of a continuous aquifer at these distances. However, allowing for an importance or risk factor associated with the Mokelumne Aqueduct, DW will use minimum seepage monitoring well spacings of 500 to 1,000 feet for center-to-center levee distances of between 700 to 1,200 feet. For levees beyond a distance of 1,200 feet from a Bacon Island levee, seepage monitoring well spacing will be 1,500 to 2,000 feet. The approximate locations for seepage monitoring wells are shown on Figure C-3.

C. Other Water Level Monitoring

Reservoir stage recording stations will be established within Bacon Island and Webb Tract to document the water surface elevations in the reservoirs. A river stage recording station will be established on the outside perimeters of Bacon Island and Webb Tract to document the water surface elevations in the surrounding rivers and sloughs.

III. EVALUATION OF GROUNDWATER MONITORING WELL DATA

A. Collecting Data Prior to Filling Reservoir and Developing Reference Envelopes

Groundwater monitoring wells (both seepage and background monitoring wells) will be installed by DW at least one year prior to commencement of reservoir filling. Groundwater levels will be recorded using automatic data loggers, measuring and recording the groundwater elevation at least once each hour. The groundwater elevations recorded each day will be averaged to compute the mean groundwater elevation each day ("daily mean") at each groundwater monitoring well location (see Figure C-4). This "daily mean" value will be the primary data used by DW in assessing whether seepage impacts are occurring.

At least one year of groundwater elevation data will be collected from the groundwater monitoring wells prior to the filling of a DW reservoir island. These baseline data will be used as a measure of the initial conditions at these individual groundwater monitoring well locations.

Using the daily means as the data, the annual mean will be computed for each groundwater monitoring well (see Figure C-5). The daily means will be compared with the annual mean and the standard deviation of the difference between the daily means and the annual mean will be computed

for the baseline period. A reference envelope will be developed that is two standard deviations above and below the annual mean for each groundwater monitoring well.

B. Background Monitoring Wells

Data will be collected by DW from background monitoring wells over the same time period as data are collected for the seepage monitoring wells located directly across sloughs from the reservoirs. Daily means of the water level elevations will be calculated for each background monitoring well. Reference envelopes will be computed using at least one full year of pre-reservoir groundwater data to identify plus and minus two standard deviations relative to the annual mean.

After the two standard deviation reference envelopes are created for each background monitoring well for the baseline (pre-reservoir filling) period, subsequent daily mean data for each background monitoring well will be compared with its reference envelope, Figure C-6a. To normalize the data, the lower reference line value will be subtracted from the daily mean. The algebraic difference will then be divided by the height of the envelope (plus or minus two standard deviations). The daily mean for each background monitoring well will be reported as a percent of its envelope height, Figure C-6b. A normalized plot will be prepared comparing the current background groundwater data to the height of the plus or minus two standard deviation baseline envelope for the same well and presented as a percentage of its envelope, Figure C-6c.

The above computed normalized percentage results from each of the background monitoring wells will be combined with the results for all other background wells and averaged for each day. They will be plotted versus time, with the hydraulic head expressed as a percent of the background groundwater monitoring wells' reference envelopes, Figure C-6d. The intent of this last plot is to track general groundwater variations that may be occurring in the central portion of the Delta but that are unrelated to water stored by the Project.

DW anticipates that this plot will show increases in groundwater levels during sustained periods of locally heavy rainfall and low evapotranspiration and during higher water levels in the rivers and sloughs as a flood stage passes through. Many fields are flooded from mid-fall to winter for a variety of reasons. This shallow flooding will also be detected. Low background groundwater levels are expected during late spring through early autumn when evapotranspiration is high and rainfall negligible.

Individual seepage monitoring wells or groups of seepage monitoring wells showing similar responses to those indicated by the average background conditions will indicate that the individual seepage monitoring wells or groups of seepage monitoring wells are responding to the same regional conditions that are affecting the background monitoring wells.

C. Reservoir Stages

Reservoir stage will be measured by DW within the reservoir islands. The daily means of reservoir stage will be computed and recorded. The reservoir stage daily mean will be shown on a graph of pool elevation versus time, similar in format to the daily mean groundwater elevation plots for groundwater monitoring wells.

D. River and Slough Stages

River and slough stage will be measured by DW and daily means computed. The daily mean of slough and river stage will be shown on a graph of water surface elevation versus time, similar in format to the daily mean groundwater elevation plots for groundwater monitoring wells.

E. Limiting Conditions Using Groups of Groundwater Monitoring

1. General

If the groundwater in a group of three or more contiguous seepage monitoring wells located on neighboring islands surrounding a reservoir island rises more than 0.25 foot above their upper bound envelopes of baseline data and if the timing of the increase correlates with the filling of the reservoir or storage of water in the reservoir (adjusted for changes in the daily means for the background groundwater monitoring wells), the reservoir filling will be stopped. This limiting condition is referred to as the Diversion Suspension Limit. Reservoir filling will not resume until the increased hydrostatic head condition is corrected or otherwise satisfactorily remediated. The details of this evaluation are described below.

2. Correlation with Local Activities

If an individual background monitoring well exceeds its upper base data reference envelope, then the land use practices in the general vicinity of each groundwater monitoring well will be checked to see if the irrigation and/or drainage practices have recently changed. Some groundwater variations may result from changes in land management practices, including irrigation patterns, shallow flooding for leaching the soil and suspension of ditch maintenance for land in a set-aside program. Activities in the nearby river or slough will also be checked. Dredging of rivers or sloughs can have substantial impacts on groundwater levels. DW will contact and query reclamation districts on dredging activity or other substantial marine activity near their islands if a marked increase in groundwater levels is observed.

3. Regional Corrections

The background monitoring well data will track the regional variations occurring in the groundwater levels beyond the influence of the reservoir islands. This evaluation will be both qualitative and quantitative. There is considerable imprecision in attempting to correlate one or more seepage monitoring wells with another well, including the background monitoring wells. DW will use a quantitative correction to the extent that the average background condition is above 80% of the full height of the background reference envelope, shown in Figure C-7a. The additional percentage above the 80% level in the background monitoring wells will be multiplied by the plus or minus two standard deviation baseline envelope for each seepage monitoring well. The resulting product will be added to the upper envelope for each seepage monitoring well as shown in Figure C-7b.

4. Initial Evaluation

The daily mean will be computed by DW for each individual seepage monitoring well for the period of time under consideration (referred to as "current" data). The current data for each seepage monitoring well will be compared with the reference (baseline) envelope for the same groundwater monitoring well. (The reference envelope will have been prepared based on a pre-reservoir-filling period as described above in section III.A and adjusted for average changes in background groundwater levels described in the previous paragraph.)

For each seepage monitoring well in the group, the difference between the current groundwater level and the upper envelope will be computed (see Figure C-8). The differences will be averaged for three or more contiguous seepage monitoring wells. The Diversion Suspension Limit for a group of three or more wells will be defined as exceeding the average difference between the current data and upper reference envelopes by 0.25 feet or more, contingent on the conditions in the following sections.

5. Correlation with DW Activities

Finally, the variation over time for the average of the differences between the current data and the upper envelope for the group of wells under consideration will be compared by DW with the changes in reservoir stages (and interceptor pumping rates) over the same period. This comparison will be used to check whether there is a correlation between the reservoir pool elevation and the measured increased head at the groundwater monitoring wells. If the increased head in the groundwater monitoring well correlates with the fluctuations in reservoir pool elevation and the average increase is 0.25 feet above the envelope after adjustments, this will define the Diversion Suspension Limits. DW will be required to suspend diversions of water into the reservoir and to implement measures to lower the groundwater level at the neighboring island perimeters facing the reservoir island. DW will not be allowed to resume diversions until the indicated seepage is resolved.

F. Limiting Conditions Using Individual Groundwater Monitoring Wells

The following procedure will be used by DW to assess whether an individual groundwater monitoring well on a neighboring island is being impacted by water storage on a reservoir island.

1. The daily mean for an individual groundwater monitoring well will be plotted for a current year against time. The current data will be compared with the reference envelope for this groundwater monitoring well. (The reference envelope will have been prepared based on a pre-reservoir filling period as described in section III.A. and adjusted for average changes in background levels as described in section III.B.3.) If the current water level is less than or equal to one foot above the upper reference line, no action will be indicated based on the single groundwater monitoring well data. If the current groundwater level is greater than one foot above the upper reference line, a seepage impact may be indicated, and the evaluation will continue to the following steps.

2. The land use practices in the general vicinity of the individual groundwater monitoring well, including flooding fields and dredging in the river or slough, will be checked to see if practices have changed as discussed in the previous section.

3. The variation of the individual groundwater monitoring well's daily means will be compared with the changes in reservoir stages recorded over the same period of time and/or marked decreases in interceptor well pumping across from the groundwater monitoring well. If the increased head in the groundwater monitoring well correlates with the fluctuations in reservoir pool elevation (or with marked decreases in interceptor well pumping rates) and the head in the aquifer is more than one foot above the adjusted upper reference envelope, this will be a Diversion Suspension Limit, and DW will be required to suspend diversions of water into the reservoir island. DW will not be allowed to resume diversions into that reservoir island until the indicated seepage is resolved.

G. Future Modifications

The methods described herein are intended to provide a rational and responsive evaluation of changes in groundwater levels and seepage that may be attributed to water storage on Bacon Island and Webb Tract. These methods have been assessed using samples of data collected during the initial groundwater monitoring program previously conducted by DW. If, after implementation of this procedure deficiencies are discovered, EBMUD and/or DW will report such deficiencies to the Monitoring and Action Board for consideration as set forth in paragraph 7.c of Attachment B to the EBMUD and DW Protest Dismissal Agreement.

H. Data Availability

Delta Wetlands will make the following groundwater data publicly available on the internet or similarly accessible means as soon as readily available:

- Daily mean of groundwater level in each seepage and background monitoring well, reference envelope, and any Project adjustments based on background monitoring wells.
- Average normalized groundwater level for all background monitoring wells, presented as a percentage of their reference envelopes.
- Daily mean of pool elevations for both reservoirs.
- Daily mean of water level in slough/river.

Delta Wetlands will also maintain a historical database of the above information.

IV. ACTIONS BY DELTA WETLANDS

Delta Wetlands shall take actions to control seepage. These actions may include the following, and are intended to be taken before seepage reaches the Diversion Suspension Limits.

1. Increase pumping rates in interceptor wells.

2. Lower outfall head at relief wells.

3. Redevelop interceptor wells to improve specific capacity of the wells.

4. Redevelop relief wells to improve specific capacity.

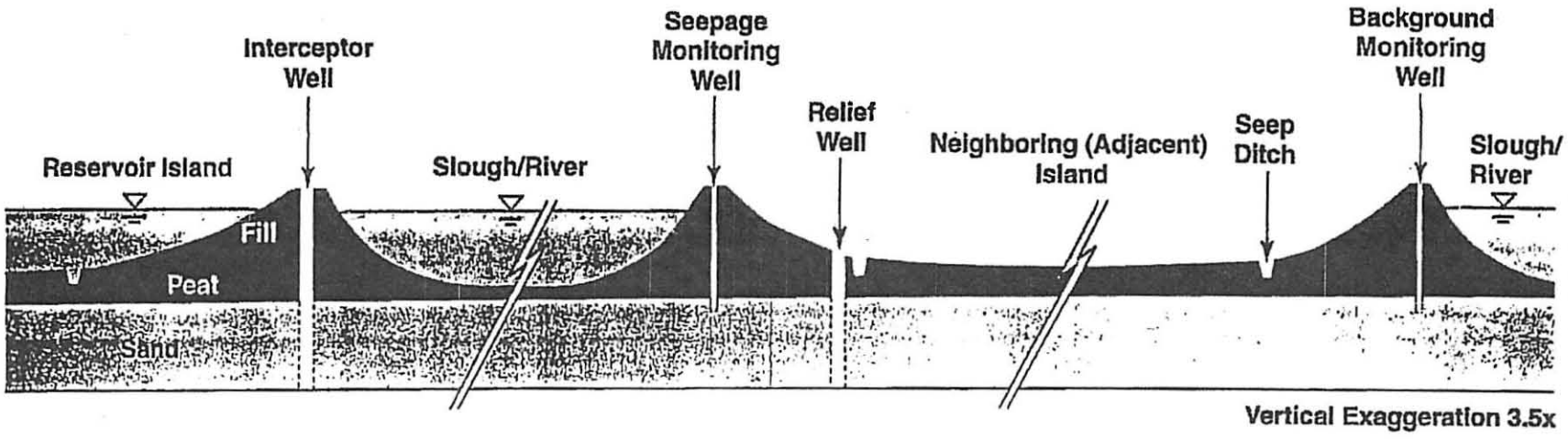
5. Install additional interceptor wells.

6. Install additional relief wells.

7. Implement other mitigation that may be mutually agreeable between Delta Wetlands, the affected adjacent landowners and the neighboring island reclamation district.

8. Stop diversion.

If the Diversion Suspension Limits are reached, DW shall immediately suspend additional water diversion into the reservoir island. Diversions may not renew until groundwater levels are brought below the Diversion Suspension Limits. If DW cannot lower the groundwater to below Diversion Suspension Limits within one week, the reservoir pool elevation shall be lowered at a rate of at least 0.5 feet per day until groundwater levels fall below Diversion Suspension Limits.



Groundwater Monitoring Wells

Seepage Monitoring Wells - Placed at the perimeter of an adjacent island, seepage monitoring wells will detect increased groundwater elevation if increased seepage occurs from slough or reservoir island.

Background Monitoring Wells - Placed far from reservoir islands, often on the far opposite perimeter of an adjacent island. Background monitoring wells will be used as a group to record Delta-wide variations in groundwater levels.

Groundwater Extraction Wells Note: All extraction wells, whether interceptor wells or relief wells, will have slotted screens extending through the full depth of the underlying aquifer.

Interceptor Wells - Pumped wells placed on the perimeter of a resevoir island. The pumping rate will be controlled to essentially capture all water tending to seep from beneath the reservoir perimeter.

Relief Wells - Placed at toe of adjacent island levee. Elevations of the tops of wells will be set such that the wells flow as artesian wells as groundwater surface rises. Where groundwater is not artesian, low head pumps may be used.

Figure C-1
Idealized Cross Section of Well Locations

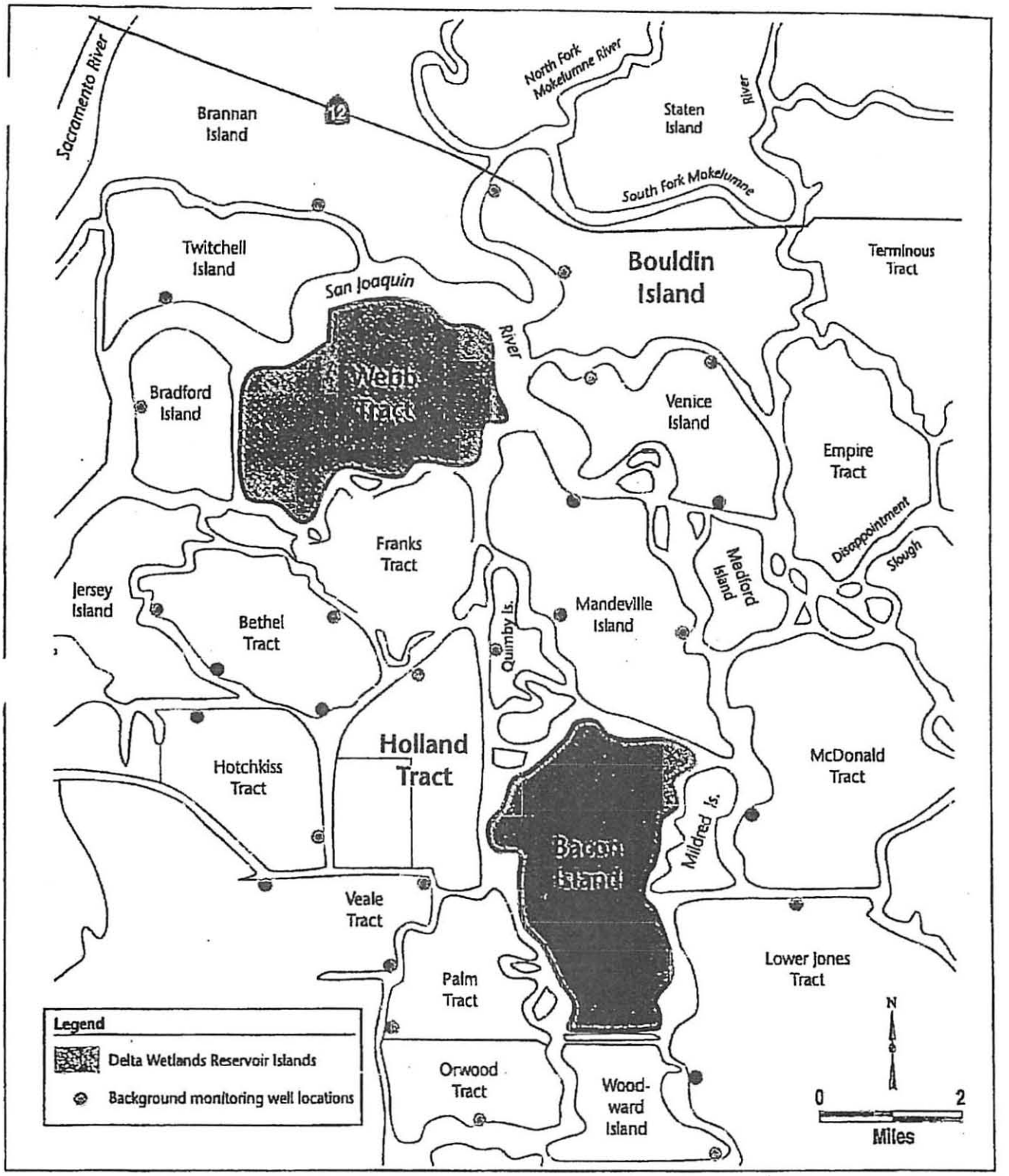


Figure C-2
Approximate Locations of Background Monitoring Wells

Exhibit DW-103

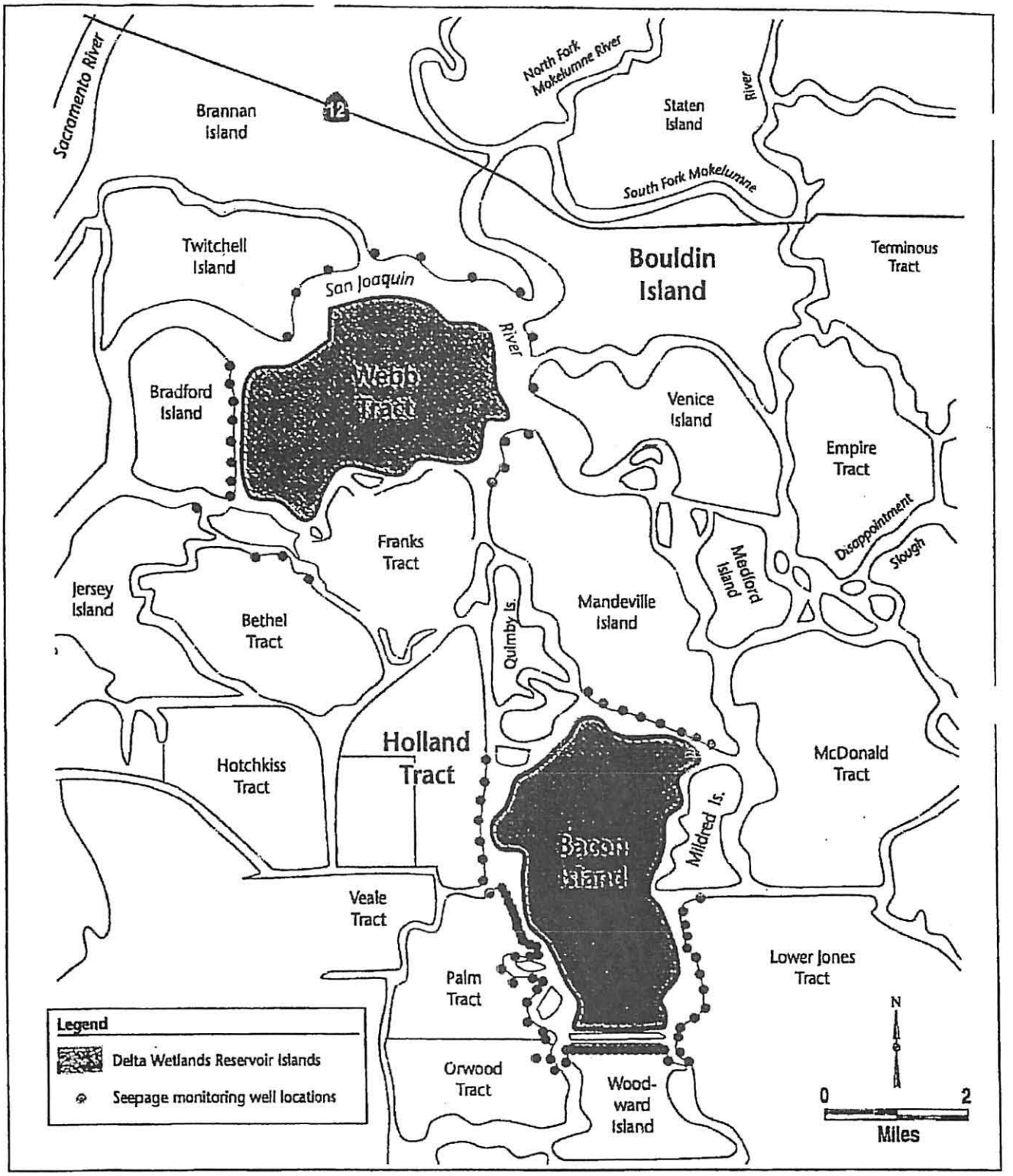


Figure C-3
Seepage Monitoring Well Locations

Exhibit DW-103

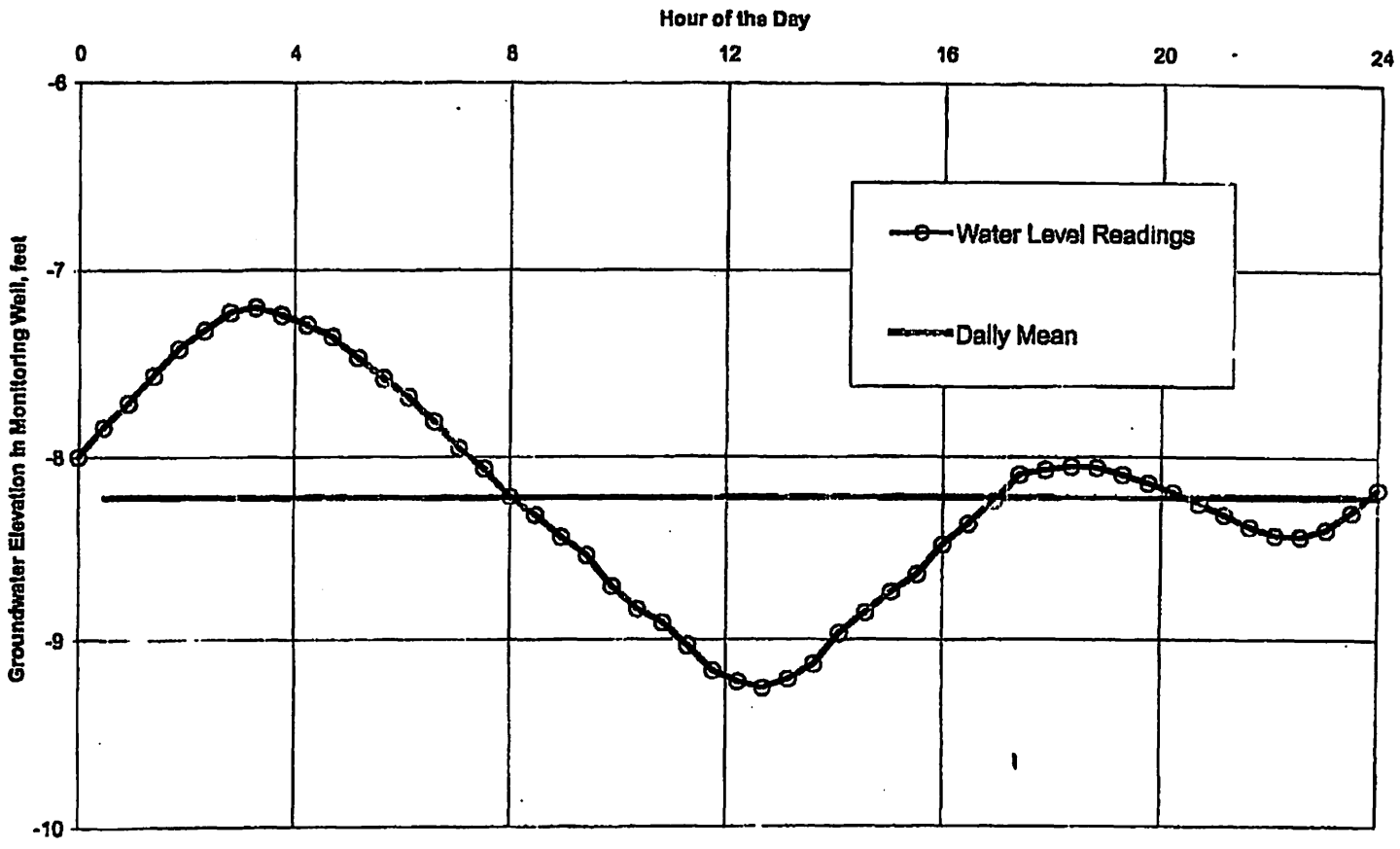
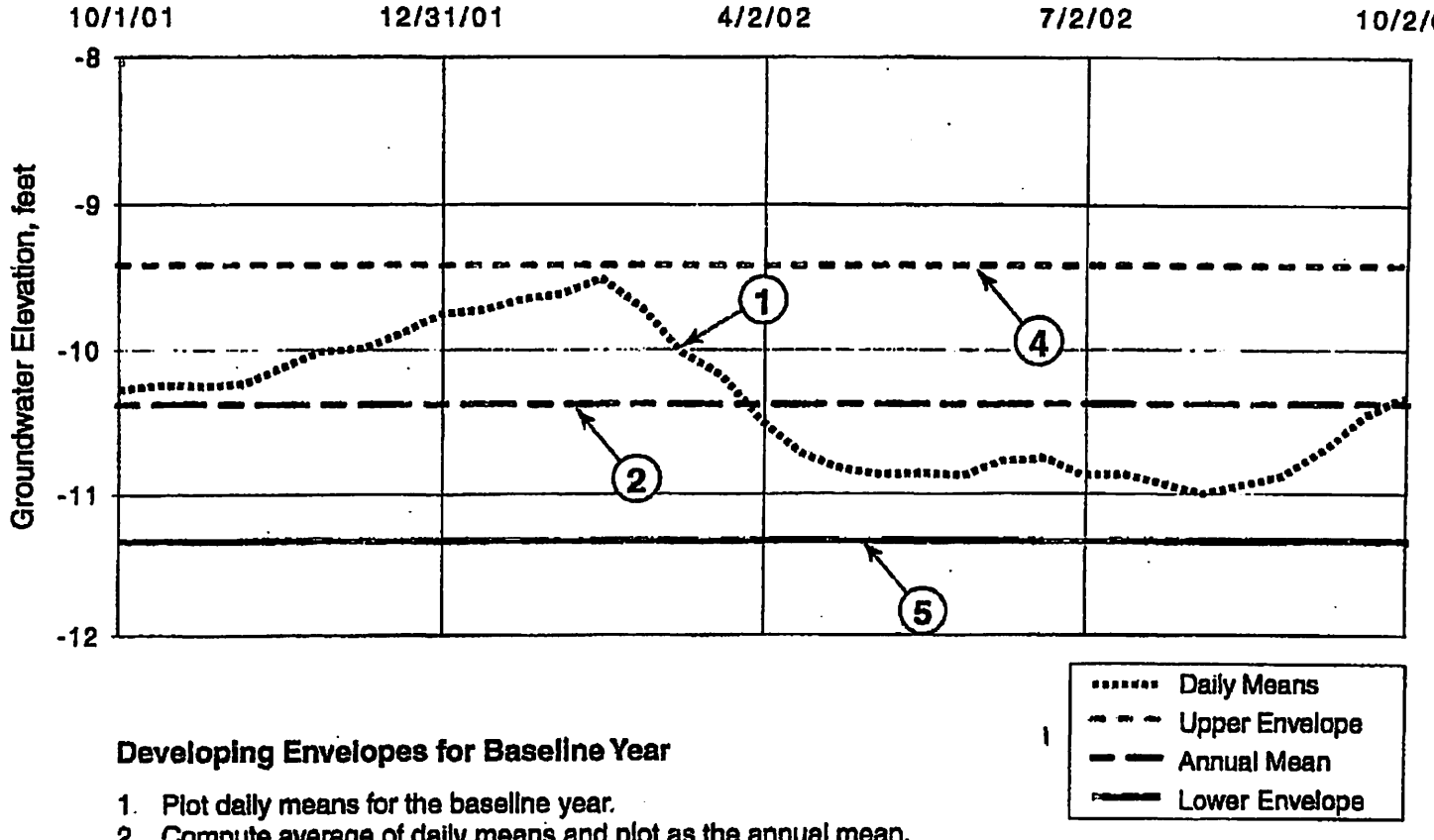


Figure C-4
Daily Mean

Exhibit DW-103



Developing Envelopes for Baseline Year

1. Plot daily means for the baseline year.
2. Compute average of daily means and plot as the annual mean.
3. Compute standard deviations of daily means around annual mean.
4. Compute and plot upper envelope as annual mean plus two standard deviations.
5. Compute and plot lower envelope as annual mean minus two standard deviations.

Figure C-5
Reference Envelope for Baseline Year

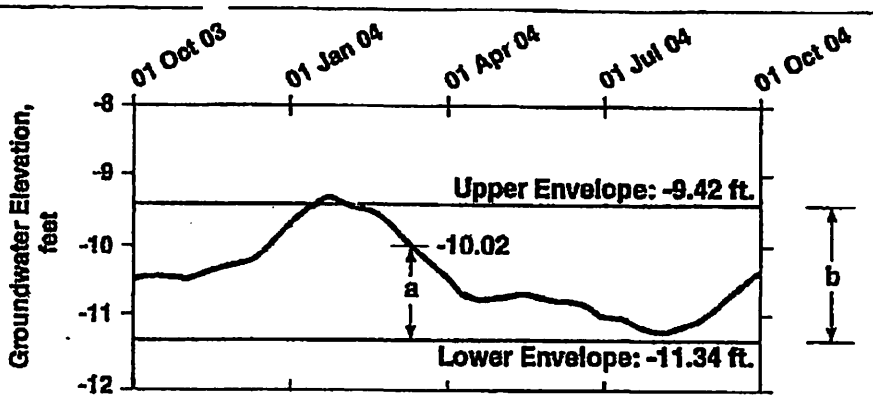


Figure C-6a. Background Monitoring Well Data for a Single Well

To normalize background monitoring well data to its unique envelope, subtract the lower envelope elevation from the daily mean and divide the remainder by the height of the envelope:

a/b = [(-10.02) - (-11.34)] / [(-9.42) - (-11.34)] = 65%

Figure C-6b. Computation for Normalizing Background Monitoring Well Data

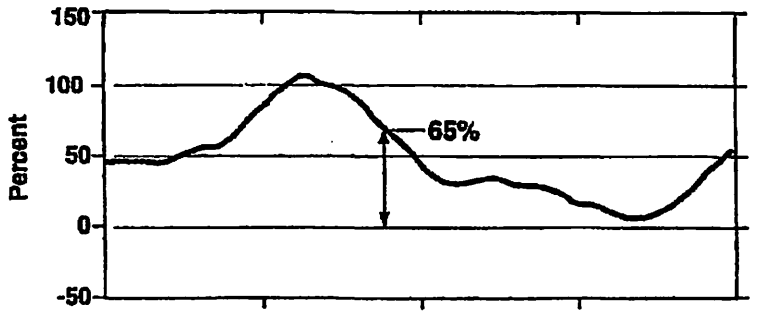


Figure C-6c. Plot of Normalized Background Monitoring Well Data for a Single Well

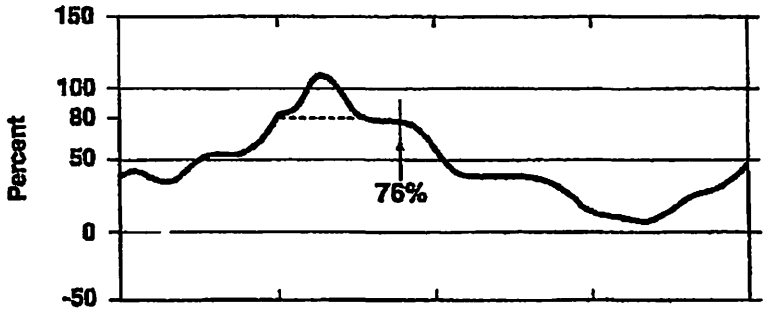


Figure C-6d. Average of Normalized Data for All Background Monitoring Wells

Figure C-6
Normalizing and Averaging Background Well Data

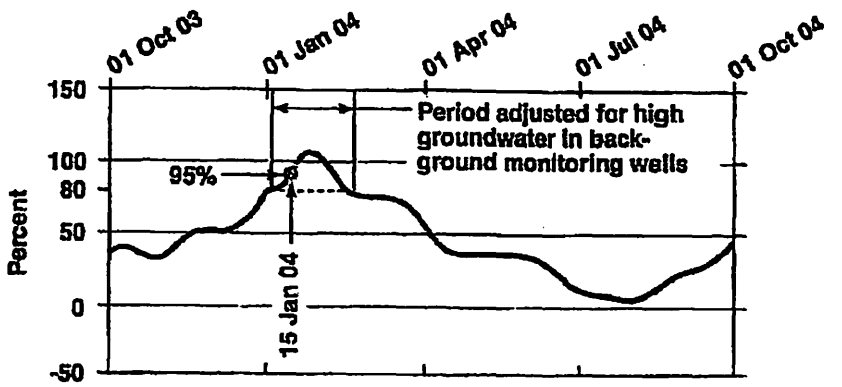


Figure C-7a. Average Normalized Data for All Background Monitoring Wells

On January 15, 2004, the average normalized data from the background monitoring well is 95%. At Seepage Monitoring Well A, the groundwater is at elevation -13.59 feet. To adjust Seepage Monitoring Well A's upper envelope for high groundwater conditions in the background monitoring wells:

1) Subtract 80% from the average for the background conditions:
   95% - 80% = 15%

2) Multiply the height of Seepage Monitoring Well A's envelope by the above percentage remainder:
   [(-13.84) - (-14.86)] x 15% = 0.17 ft.

3) Add the above product to the upper envelope:
   -13.84 + 0.17 = 13.67 ft.

4) The above value is the adjusted upperbound envelope for this particular well on the particular day.

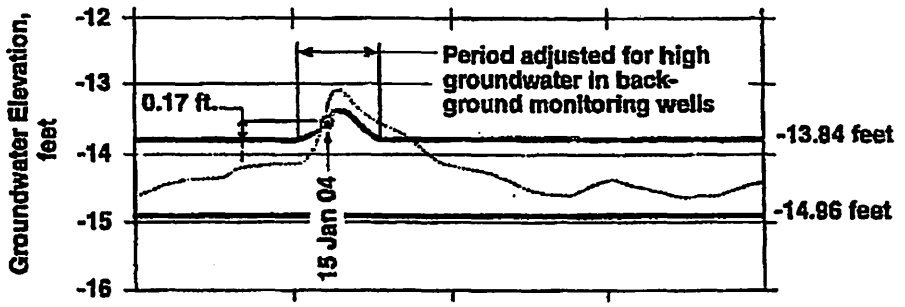
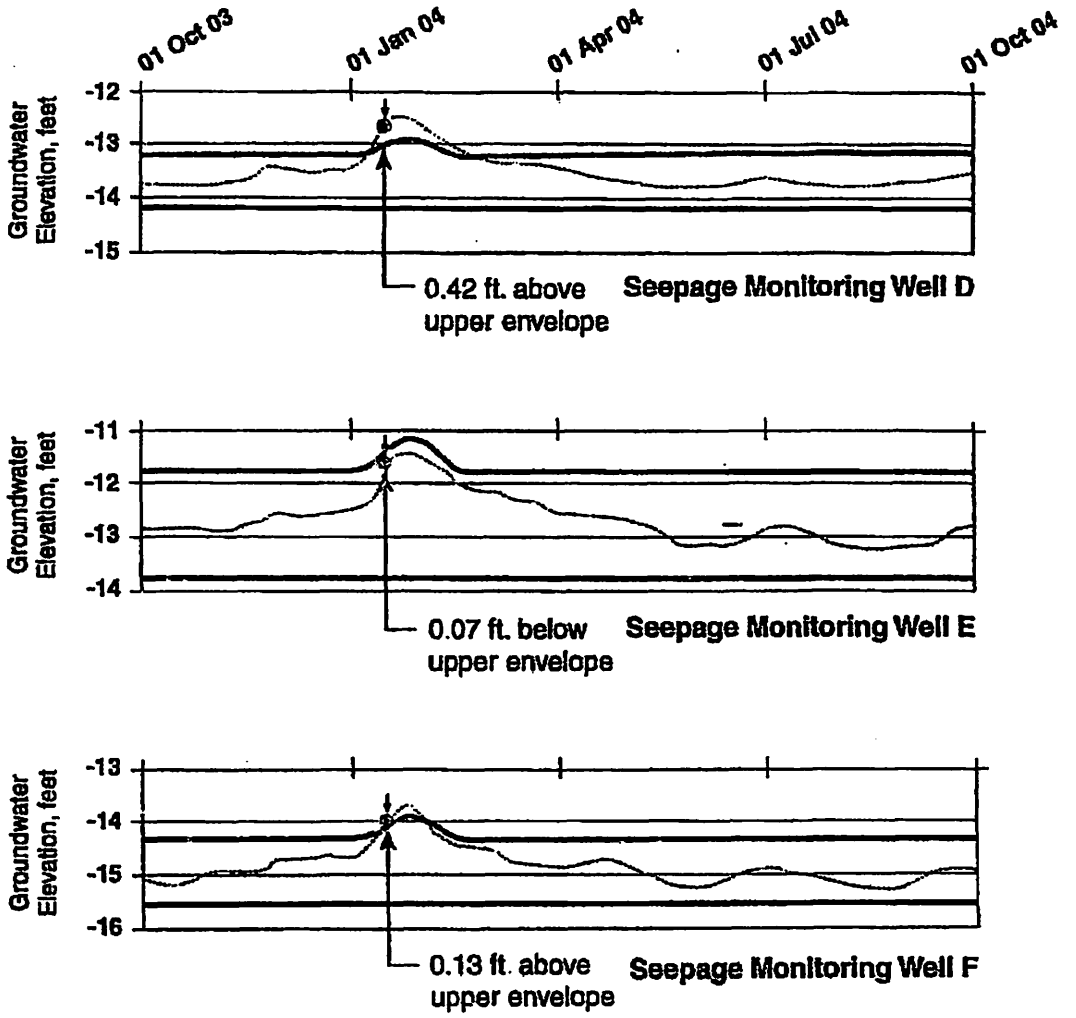


Figure C-7b. Upper Envelope of Seepage Monitoring Well A Corrected for High Groundwater in Background Monitoring Wells

Figure C-7
Correcting Upper Envelope for High Groundwater



Well No.	Groundwater Height Above Upper Envelope
D	0.42
E	-0.07
F	0.13
	0.48 ft ÷ 3 wells = 0.16 ft.

On January 15, 2004, the average groundwater height above upper envelopes for 3 wells is 0.16 ft. If the average is less than 0.25 feet above the upper envelope, the average groundwater level for these three wells is below the diversion suspension limit.

Figure C-8
Groundwater Evaluation Using Three Seepage Monitoring Wells

Exhibit DW-103

Exhibit B

Arbitrator List

Arbitrators Qualified to Arbitrate Disputes Under the Protest Dismissal and Settlement Agreement between Delta Wetlands Properties and Central Delta Water Agency, et al.

The following neutral arbitrators with JAMS, 2520 Venture Oaks Way, Suite 400, Sacramento, CA 95833, (916) 921-5300, are qualified to arbitrate any dispute involving this Agreement between the Parties in accordance with Section 6 of the Agreement. This list of arbitrators may be amended in writing by CDWA and Delta Wetlands.

Agliano (Ret.) - Hon. Nat A.
Agretelis (Ret.) - Hon. Demetrios P.
Ambler (Ret.) - Hon. Read
Baines (Ret.) - Hon. Robert A.
Bates, Jr., Esq. - John B.
Bennett (Ret.) - Hon. Richard
Bettinelli (Ret.) - Hon. William L.
Biafore, Jr. (Ret.) - Hon. Joseph F.
Bond (Ret.) - Hon. Cecily
Brainerd, Esq. - Alexander "Lex"
Brazil (Ret.) - Hon. Wayne D.
Cahill (Ret.) - Hon. William J.
Chernick, Esq. - Richard
Claiborne, Esq. - Zela "Zee" G.
Davis, Esq. - Gary S.
DeBene, Esq. - Linda
Edwards, Esq. - Bruce A.
Falk, Jr., Esq. - Jerome B.
Flaherty (Ret.) - Hon. John A.
Folberg, Esq. - Jay
Gack, Esq. - Kenneth D.
Gallagher (Ret.) - Hon. Catherine A.
Garcia (Ret.) - Hon. David A.
Gibbs, Esq. - Kenneth C.
Hagen (Ret.) - Hon. David Warner
Haning III (Ret.) - Hon. Zerne P.
Hanlon (Ret.) - Hon. Daniel "Mike"
Herlihy (Ret.) - Hon. John F.
Hunter (Ret.) - Hon. David E.
Jacobs-May (Ret.) - Hon. Jamie
James (Ret.) - Hon. Ellen Sickles
Kawaichi (Ret.) - Hon. Ken M.
Komar (Ret.) - Hon. Jack
Kurland, Esq. - Gerald A.
Larson (Ret.) - Hon. James
Legge (Ret.) - Hon. Charles A.
Levy, Esq. - Lester J.
Loeb, Esq. - Michael J.
Low (Ret.) - Hon. Harry W.
Luft, Esq. - Robert S.
Lynch (Ret.) - Hon. Eugene F.
Mahoney (Ret.) - Hon. Patrick J.
Marlo (Ret.) - Hon. John A.
McAdams (Ret.) - Hon. Richard J.
McDonald (Ret.) - Hon. V. Gene
Meredith, Esq. - Craig S.
Mills, Esq. - Lawrence R.
Morrison (Ret.) - Hon. Fred K.
Newsome (Ret.) - Hon. Randall J.
Ornstil - Michael G.
Panelli (Ret.) - Hon. Edward A.
Person, Esq. - Donald R.
Polsky, Esq. - Alexander S.
Quinn - Martin
Ranahan, Esq. - Michael D.
Rushing (Ret.) - Hon. Elaine
Sabraw (Ret.) - Hon. Ronald M.
Sawyer (Ret.) - Hon. Laurence K.
Sheppard (Ret.) - Hon. Harry R.
Silver (Ret.) - Hon. Richard M.
Smith (Ret.) - Hon. Fern M.
Snowden (Ret.) - Hon. W. Scott
Stevens, Esq. - Charles J.
Stone (Ret.) - Hon. Peter G.
Strankman (Ret.) - Hon. Gary E.
Ware (Ret.) - Hon. James
Warren (Ret.) - Hon. James L.
Westerfield (Ret.) - Hon. Rebecca
Yanni, Esq. - Catherine A.

Exhibit C

Indenture of Trust

INDENTURE OF TRUST

This Indenture of Trust ("Indenture"), made and entered as of _____, 2013 is by and between the parties to the Protest Dismissal and Settlement Agreement dated _____, 2013 ("Settlement"), pertaining to the Delta Wetlands Project and Wells Fargo Bank, National Association, a banking association organized and existing under the laws of the United States of America with a principal corporate trust office in San Francisco, California and being qualified to accept and administer the trust created hereby ("Trustee").

Witnesseth

WHEREAS, the Protest Dismissal and Settlement Agreement dated _____, 2013 ("Settlement") a copy of which is attached hereto was entered to resolve issues pertaining to the Delta Wetlands Project; and

WHEREAS, there are two groups of parties to said agreement, the Delta Wetlands related parties consisting of Delta Wetlands Properties, an Illinois General Partnership, and any successor entity that owns and/or operates the Delta Wetlands Project ("Delta Wetlands Parties") and the Central Delta Water Agency and related parties defined in the Settlement ("Central Delta Parties"); and

WHEREAS, the Settlement provides for specific Financial Assurances, including a fund called the CDWA Security Fund, which is a continuously maintained combined amount of thirty-five million dollars ($35,000.000.00) consisting of cash in the minimum amount of ten million dollars ($10,000,000.00) and a "Letter of Credit" in the amount of twenty-five million dollars ($25,000,000.00); and

WHEREAS, Sections 8.2 and 8.4 the Settlement provide that the Delta Wetlands Parties can, upon 30 days prior written notice from Delta Wetlands Parties to the Central Delta Parties, substitute cash for all or a portion of the Letter of Credit without the consent of the parties or the Trustee;

WHEREAS, Sections 8.3 and 8.7 of the Settlement provide that the Delta Wetlands Parties shall within fifteen days after any disbursement reducing the CDWA Security Fund below $35.000,000.00 restore the CDWA Security Fund to the required $35,000,000.00 amount and shall continuously maintain said fund at that level until termination or abandonment of the Project in compliance with Section 8.8 of the Settlement; and

WHEREAS, the Settlement provides that the Delta Wetlands Parties shall maintain a Letter of Credit in accordance with Section 8.5 of the Settlement if the Delta Wetlands Parties have not elected to substitute cash for the Letter of Credit; and

WHEREAS, the Settlement provides for the appointment of a Trustee to hold the cash and Letter of Credit comprising the CDWA Security Fund and to manage and disburse the same as set forth herein.

NOW THEREFORE, in consideration of the promises and of the mutual covenants herein contained, the Delta Wetlands Parties, Central Delta Parties and Trustee agree as follows:

1. **Management of CDWA Security Fund.** Trustee shall hold, invest and disburse the cash and hold, draw upon and disburse the "Letter of Credit" portion of the CDWA Security Fund in accordance with the provisions herein.

(a) Trustee shall immediately draw from the CDWA Security Fund and shall disburse the funds upon presentation of a "Qualified Draw Request" and in the amount specified in the "Qualified Draw Request". "Qualified Draw Request" means (i) a notarized written instrument signed by the authorized representatives of both the Central Delta Parties and the Delta Wetlands Parties, or (ii) a certified final order of the Arbitrator authorizing a draw on the CDWA Security Fund pursuant to the CDWA Dispute Resolution Procedure described in the Settlement, or (iii) a certified interim or final order of the Emergency Arbitrator as provided under paragraph 6.15 of the Settlement. The request shall specify the amount of the draw to be made on the CDWA Security Fund, and specify the person or entity to whom the draw is to be payable. All draws on the CDWA Security Fund shall be paid. at Delta Wetlands Parties election, from the cash portion thereof or from any Letter of Credit that is part of the security fund, or from any combination of the cash portion and Letter of Credit. Said election shall be made in writing in advance of, or simultaneously with, the submittal of any Qualified Draw Request, and if not so made the draw shall be first made from the cash and then from the Letter of Credit. Trustee shall upon receipt of a Qualified Draw Request in excess of the cash on hand forthwith submit the request for payment certification and a copy of the Letter of Credit as per the terms of the attached Letter of Credit. The certified orders of the Arbitrator or Emergency Arbitrator shall state under penalty of perjury that the Arbitrator is acting pursuant to the Settlement. The Trustee shall act upon such certified order without further inquiry or determination of any part of the arbitration proceeding.

(b) Trustee shall draw the full amount of the existing Letter of Credit and deposit the proceeds into the trust account defined in Section 1(c) below in event that the Delta Wetlands Parties have not provided a substitute Letter of Credit complying with all of the requirements of Section 8.5 of the Settlement within either (1) 55 days from notice that the Letter of Credit provider ceases to meet the standards specified in Section 8.5 of the Settlement or (2) 55 days from notice that the Letter of Credit provider will not renew the Letter of Credit at the end of its term Trustee shall return the proceeds to Delta Wetlands Parties when a substitute Letter of Credit is established or if the Delta Wetlands Parties elect to substitute cash for the Letter of Credit.

(c) The cash portion of the CDWA Security Fund shall be deposited in an interest bearing trust account (the "CDWA Trust") maintained with a financial institution licensed to do business in the State of California, and approved by Central Delta Parties, which will act as instructed by the Trustee, who shall have full authority to disburse from the trust account and draw on the Letter of Credit in accordance with this Agreement. The cash deposited in the CDWA Trust shall be held in a manner which will provide FDIC insurance for the entire amount. The earnings thereon shall be distributed on July 1st and January 1st of each year to

Delta Wetlands Parties during any period when the fund is in excess of its minimum required amount and after paying trustee and administrative fees and charges. The Trustee may disburse from the CDWA Trust to itself to pay the administration fees and charges as provided herein.

(d) Upon termination or abandonment of all water right permits for Project water diversion and storage on the Reservoir Islands, restoration of all Reservoir and Habitat Islands to farmland or habitat as per the Reclamation Plan and resolution of all remaining claims against the CDWA Security Fund, the Letter of Credit may be terminated and the amount of the remaining cash in the CDWA Trust shall be paid to Delta Wetlands Parties. The Letter of Credit shall be Terminated and the Trustee shall return the remaining cash portion of the CDWA Security Fund within ten (10) calendar days of submission of a written instrument signed by an authorized representative of the Delta Wetlands Parties and an authorized representative of the Central Delta Parties verifying that all water right permits for water diversion and storage on the Reservoir Islands have been abandoned or terminated, that the Reservoir and Habitat Islands have been restored in accordance with the Reclamation Plan and all remaining claims brought against Delta Wetlands Parties and awarded to the claimants in accordance with the CDWA Dispute Resolution Procedure have been paid from the CDWA Security Fund.

(e) The Central Delta Parties and Delta Wetlands Parties may modify the terms of the Settlement, including terms for the Security Fund and Letter of Credit, without consent of trustee. The Central Delta Parties and Delta Wetlands Parties shall notify Trustee of any material changes to the Settlement affecting this Indenture of Trust.

2. **Appointment of Trustee.** Wells Fargo Bank, National Association, in San Francisco, a national banking association organized and existing under and by virtue of the laws of the United States of America, is hereby appointed Trustee by the parties for the purpose of receiving all moneys required to be deposited with the Trustee hereunder and to allocate, use and apply the same as provided in this Indenture. The Delta Wetlands Parties and Central Delta Parties agree that any successor Trustee appointed hereunder shall be: (a) authorized by law to perform all the duties imposed upon it by this Indenture, (b) shall have (or, in the case of a bank or trust company which is part of a bank holding company system, the related bank holding company shall have) a combined capital and surplus of at least Fifty Million Dollars ($50,000,000), and (c) be subject to supervision or examination by Federal or State authority, so long as any cash or Letters of Credit for the CDWA Security Fund are outstanding. If such bank or trust company publishes a report of condition at least annually pursuant to law or to the requirements of any supervising or examining authority above referred to, then for the purpose of this Section the combined capital and surplus of such bank or trust company shall be deemed to be its combined capital and surplus as set forth in its most recent report of condition so published.

The Trustee shall keep accurate records of all funds administered by it and of all disbursements. The Trustee shall provide an accounting to the parties quarterly.

3. **Acceptance of Trusts.** The Trustee hereby accepts the trusts imposed upon it by this Indenture, and agrees to perform said trusts, but only upon and subject to the following express terms and conditions:

(a) The Trustee undertakes to perform such duties and only such duties as are specifically set forth in this Indenture and no implied covenants shall be read into this Indenture against the Trustee. The Trustee may exercise such of the rights and powers vested in it by this Indenture, and shall use the same degree of care and skill and diligence in their exercise, as is consistent with the fiduciary responsibilities of a trustee.

(b) The Trustee may execute any of the trusts or powers hereof and perform the duties required of it hereunder by or through attorneys, accountants, agents, or receivers, and shall not be liable for the acts or omissions of such attorneys, agents, accountants, and receivers appointed with due care, and shall be entitled to advice of counsel concerning all matters of trust and its duty hereunder. The Trustee may conclusively rely on an opinion of counsel, as full and complete protection for any action taken or suffered by it hereunder.

(c) The Trustee shall not be responsible for any recital herein, or in the Settlement, or for any of the supplements thereto or instruments of further assurance, or for the sufficiency of the CDWA Security Fund and the Trustee shall not ascertain or inquire as to the observance or performance of any covenants, conditions or agreements on the part of the Delta Wetlands Parties or Central Delta Parties hereunder or under the Settlement.

(d) The Trustee shall be protected in acting, in good faith and without negligence, upon any notice, request, consent, certificate, order, affidavit, letter, telegram or other paper or document believed by it to be genuine and correct and to have been signed or sent by the proper person or persons. The Trustee shall not be bound to recognize any person as a representative of the parties hereto unless such representation is supported by a writing from Delta Wetland Properties in the case of the Delta Wetland Parties, and in the case of the Central Delta Parties, a writing from the Central Delta Water Agency.

(e) As to the existence or non-existence of any fact or as to the sufficiency or validity of any instrument, paper or proceeding, the Trustee shall be entitled to rely upon a Certificate of any arbitrator under the Settlement as sufficient evidence of the facts therein contained.

(f) The permissive right of the Trustee to do things enumerated in this Indenture shall not be construed as a duty and it shall not be answerable for other than its negligence or willful misconduct. The immunities and exceptions from liability of the Trustee shall extend to its officers, directors, employees and agents.

(g) The Trustee shall not be required to take notice or be deemed to have notice of any breach of the Settlement. Notices or other instruments required by this Indenture to be delivered to the Trustee must, in order to be effective, be delivered at the Trust Office, and in the absence of such notice so delivered the Trustee may conclusively assume there is no requirement for disbursement from the CDWA Security Fund.

(h) The Trustee shall not be required to give any bond or surety in respect of the execution of the said trusts and powers or otherwise in respect of the premises hereof.

(i) All moneys received by the Trustee shall, until used or applied as herein provided, be held in trust for the purposes for which they were received and maintained as a separate account.

(j) Whether or not therein expressly so provided, every provision of this Indenture and the Settlement relating to the conduct or affecting the liability of the Trustee shall be subject to the provisions of this Section.

(k) Trustee hereby waives all rights set forth in California Probate Code Section 17200.

4. **Fees, Charges and Expenses of Trustee.** The Trustee shall be entitled to payment and reimbursement for reasonable fees for its services rendered hereunder and all advances, counsel fees (including expenses) and other expenses reasonably and necessarily made or incurred by the Trustee in connection with such services.

5. **Removal of Trustee.** Delta Wetlands Parties and Central Delta Parties, together, may at any time remove the Trustee initially appointed, and any successor thereto, by an instrument or concurrent instruments in writing delivered to the Trustee, whereupon such parties shall appoint a successor or successors thereto; provided that any such successor shall be a bank or trust company meeting the requirements set forth in Section 8 above.

6. **Resignation by Trustee.** The Trustee and any successor Trustee may at any time give thirty (30) days' written notice of its intention to resign as Trustee hereunder, such notice to be given to Delta Wetlands Parties and Central Delta Parties by registered or certified mail. Upon receiving such notice of resignation, the parties shall promptly appoint a successor Trustee. Any resignation or removal of the Trustee and appointment of a successor Trustee shall become effective upon acceptance of appointment by the successor Trustee.

7. **Appointment of Successor Trustee.** In the event the parties shall for any reason whatsoever fail to appoint a successor Trustee within ninety (90) days following the delivery to the Trustee of the instrument described in Section 5or within ninety (90) days following the receipt of notice by the parties pursuant to Section 6, the Trustee may, at the expense of the CDWA Security Fund, apply to a court of competent jurisdiction for the appointment of a successor Trustee meeting the requirements herein. Any such successor Trustee appointed by such court shall become the successor Trustee hereunder until a successor Trustee is appointed by the parties.

8. **Merger or Consolidation.** Any company into which the Trustee may be merged or converted or with which it may be consolidated or any company resulting from any merger, conversion or consolidation to which it shall be a party or any company to which the Trustee may sell or transfer all or substantially all of it corporate trust business, provided that such company shall meet the requirements set forth in Section 2, shall be the successor to the Trustee and vested with all of the title to the trust estate and all of the trusts, powers, discretions, immunities, privileges and all other matters as was its predecessor, without the execution or filing of any paper or further act, anything herein to the contrary notwithstanding.

9. **Concerning any Successor Trustee.** Every successor Trustee appointed hereunder shall execute, acknowledge and deliver to its predecessor and also to the parties an instrument in writing accepting such appointment hereunder and thereupon such successor, without any further act, deed or conveyance, shall become fully vested with all the estates, properties, rights, powers, trusts, duties and obligations of its predecessors; but such predecessor shall, nevertheless, on the Request of the Parties, or of the Trustee's successor, execute and deliver an instrument transferring to such successor all the estates, properties, rights, powers and trusts of such predecessor hereunder; and every predecessor Trustee shall deliver all Letters of Credit and moneys held by it as the Trustee hereunder to its successor. Should any instrument in writing from the parties be required by any successor Trustee for more fully and certainly vesting in such successor the estate, rights, powers and duties hereby vested or intended to be vested in the predecessor Trustee, any and all such instruments in writing shall, on request, be executed, acknowledged and delivered by the parties.

10. **Appointment of Co-Trustee.** It is the purpose of this Indenture that there shall be no violation of any law of any jurisdiction (including particularly the law of the State) denying or restricting the right of banking corporations or associations to transact business as Trustee in such jurisdiction. It is recognized that in the case of litigation under this Indenture, and in particular in case of the enforcement of the rights of the Trustee as to collection of funds or any Letter of Credit the Trustee deems that by reason of any present or future law of any jurisdiction it may not exercise any of the powers, rights or remedies herein granted to the Trustee or hold title to the properties, in trust, as herein granted, or take any other action which may be desirable or necessary in connection therewith, it may be necessary that the Trustee appoint an additional individual or institution as a separate co-trustee. The following provisions of this Section are adopted to these ends.

In the event that the Trustee appoints an additional individual or institution as a separate or co-trustee, each and every remedy, power, right, claim, demand, cause of action, immunity, estate, title, interest and lien expressed or intended by this Indenture to be exercised by or vested in or conveyed to the Trustee with respect thereto, shall be exercisable by and vest in such separate or co-trustee but only to the extent necessary to enable such separate or co-trustee to exercise such powers, rights and remedies, and every covenant and obligation necessary to the exercise thereof by such separate or co-trustee shall run to and be enforceable by either of them.

Should any instrument in writing from the parties be required by the separate trustee or co-trustee so appointed by the Trustee for more fully and certainly vesting in and confirming to it such properties, rights, powers, trusts, duties and obligations, any and all such instruments in writing shall, on request, be executed, acknowledged and delivered by the parties. In case any separate trustee or co-trustee, or a successor to either, shall become incapable of acting, resign or be removed, all the estates, properties, rights, powers, trusts, duties and obligations of such separate trustee or co-trustee, so far as permitted by law, shall vest in and be exercised by the Trustee until the appointment of a new trustee or successor to such separate trustee or co-trustee.

17. **Indemnification; Limited Liability of Trustee.** The parties further covenant and agree to indemnify and save the Trustee and its officers, directors, agents and employees, harmless against any loss, expense and liabilities which it may incur arising out of or in the exercise and

performance of its powers and duties hereunder, including the costs and, expenses of defending against any claim of liability, but excluding any and all losses, expenses and liabilities which are due to the negligence or willful misconduct of the Trustee, its officers, directors, agents or employees. No provision in this Indenture shall require the Trustee to risk or expend its own funds or otherwise incur any financial liability hereunder if it shall have reasonable grounds for believing repayment of such funds or adequate indemnity against such liability or risk is not assured to it. The obligations of the parties under this paragraph shall survive the resignation or removal of the Trustee under this Indenture.

18. **Trustee Compensation**. Trustee shall be entitled to compensation and reimbursement as per Exhibit A attached hereto which the parties and Trustee may modify from time to time.

19. **Amendment of Indenture.** This Indenture may be modified by written agreement executed by the Trustee, and the designated agent of both the Delta Wetlands Parties and the Central Delta Parties.

20. **Duty of Trustee to Perform.** In the event Trustee fails or refuses to act in the manner herein set forth, the parties hereto shall have the right to compel such performance and to seek all remedies at law or equity.

21. **Time is of the Essence.** Time is of the essence in the execution by the Trustee in making disbursements pursuant to this indenture.

22. **Effective Date.** This indenture shall be effective as of the date of the deposit with Trustee of the $10,000,000.00 cash by the Delta Wetlands Parties and/or the delivery to the Trustee of the Letter or Letters of Credit for the balance of the CDWA Security Fund.

Wells Fargo Bank, National Association,
as Trustee

by _____

Delta Wetlands Parties

by _____

Central Delta Parties

by _____

Exhibit D

Form of Letter of Credit

_____ BANK
IRREVOCABLE LETTER OF CREDIT

Letter of Credit Number:	_____
Date:	_____, 2013
Amount:	Twenty-Five Million Dollars ($25,000,000)
Expiration Date:	_____, 2014 (5:00 p.m. Pacific time), subject to renewal as provided below
Issuer:	_____ Bank _____ _____ _____
For Account of:	[Delta Wetlands Properties, an Illinois general partnership; or its successor] _____ _____ _____
To Beneficiary:	[insert name of Trustee under Section 8.4 of the Protest Dismissal and Settlement Agreement] _____ _____ _____
For Notification:	_____ _____ _____ _____ _____

Ladies and Gentlemen:

We hereby irrevocably authorize [insert name of Trustee under Section 8.4 of the Protest Dismissal and Settlement Agreement] or its successors or assigns (collectively, "Trustee") to draw on us up to an aggregate amount of US $25,000,000 available by the Trustee's draft at sight. Partial drawings are permitted.

Documents required for payment:

1. A written request for payment under this Letter of Credit purporting to be signed by an officer or other authorized person on behalf of Trustee; the request shall include the statement:

> "The undersigned hereby certifies that it is the duly appointed and acting Trustee under Section 8.4 of the Project Dismissal and Settlement Agreement, dated as of _____, 2013, between Delta Wetlands Properties, an Illinois general partnership ("Delta Wetlands"), Central Delta Water Agency and certain others (the "Settlement Agreement"). The undersigned is authorized to make this request. The amount requested is $_____. and

2. The original or a copy of this Letter of Credit.

All payments by us will be in immediately available funds. The Beneficiary may designate, by any writing accompanying a demand for payment or otherwise delivered to us prior to the actual payment of a drawing under this Letter of Credit, that any drawing shall be honored by wire transfer to a custodian designated by the Beneficiary, and we agree to abide by any such instructions.

Any draft must be presented to our place of business set forth above for payment at any time no later than the Expiration Date and time set forth above, provided, the Expiration Date shall be automatically extended, without amendments, for successive one-year periods from the Expiration Date unless, at least ninety (90) days prior to the then applicable Expiration Date, the Beneficiary and those listed for notification receive notification in writing from us (which notification shall be sent by registered mail or overnight delivery to the addresses set forth herein), that we do not elect to extend the Expiration Date for any such additional period. If the Expiration Date is not a date on which we are open for business, then the Expiration Date shall be the next day on which we are open for business.

This Letter of Credit shall be governed by and construed in accordance with the laws of the State of California without regard to its conflict of laws rules.

The exclusive jurisdiction for disputes arising out of or related to this Letter of Credit shall be in the state courts of the State of California. The Issuer in issuing this Letter of Credit and Beneficiary in accepting this Letter of Credit consent to such exclusive jurisdiction.

The Issuer agrees that legal process related to this Letter of Credit may be served on it in the State of California at the following address: _____

This Letter of Credit sets forth our undertaking and such undertaking shall not in any way be modified, amended, amplified or limited without the Beneficiary's written consent.

We hereby agree that all drafts under this Letter of Credit, in whole or in part, and in compliance with the terms and conditions of this credit, will be duly honored without delay or objection if drawn and presented for payment on or before the initial Expiration Date or any automatic extended date as set forth above.

In the event we elect not to renew this Letter of Credit prior to expiration according to its terms, and no notice has been provided to us that a replacement Letter of Credit of equal terms has been obtained and is in force within 35 days prior to expiration hereof, then, without the further act or consent of any person, we agree to, and shall, then pay the entire face amount of this Letter of Credit to the Trustee in the manner and method specified in instructions from the Trustee as if a conforming unconditional draw request for the full amount hereof had been received by us in a timely manner.

Very truly yours,

_____ Bank

By _____
Name: _____
Title: _____

Exhibit E

Covenant Not to Apply or Store Wastewater or Biosolids

RECORDING REQUESTED BY AND WHEN RECORDED, RETURN TO:	THIS SPACE RESERVED FOR RECORDER ONLY (Govt. Code § 27361.6)

RESTRICTIVE COVENANT

This Restrictive Covenant dated _____, 2013 ("Covenant"), is made by the undersigned property owner, Delta Wetlands Properties, an Illinois General Partnership ("Delta Wetlands"), as the grantor, with reference to the following:

WHEREAS, Delta Wetlands is proposing to develop a project (the "Project") on that involves water storage reservoirs for diversion and storage of water on and discharge of water from Bacon Island and Webb Tract and seasonal diversion and use of water on Bouldin Island and Holland Tract for farming and wildlife habitat;

WHEREAS, the Project "Reservoir Islands" will be constructed on Bacon Island and Webb Tract on the following parcels:
Bacon Island (San Joaquin County APNs _____);
Webb Tract (Contra Costa County APNs _____);

WHEREAS, the Project "Habitat Islands" will be constructed on Bouldin Island and Holland Tract on the following parcels:
Bouldin Island (San Joaquin County APNs _____);
Holland Tract (Contra Costa County APNs _____).

COVENANT

NOW, THEREFORE, based on the foregoing recitals, which are incorporated into the operative provisions of this Covenant, and pursuant to the laws of California, Delta Wetlands covenants as follows:

Delta Wetlands shall not apply and/or store wastewater (including reclaimed wastewater), sewage sludge (including treated sewage sludge sometimes called biosolids) and septage (treated or otherwise) on any Reservoir Island or Habitat Island. Said covenant shall run with the land, and will thereby burden the Reservoir Islands and Habitat Islands and benefit the other lands in the Delta.

The prohibition contained in the covenant shall only apply so long as the designated Reservoir Islands or Habitat Islands are planned for use or used for water storage or developed wetland purposes'

IN WITNESS WHEREOF, Delta Wetlands has executed this Covenant as of the day and year written above.

DELTA WETLANDS PROPERTIES
An Illinois general partnership

By KLMLP 2, LLC
A Delaware limited Liability Company,
Managing General Partner of Delta Wetlands Properties

By KLMLP, L.P.
A Delaware limited partnership,
Managing Member of KLMLP 2, LLC

By Zurich American Corporation (fka Kemper Corporation)
A Delaware corporation,
Managing General Partner of KLMLP, L.P.

By _____

Date: _____

On Extinction's Edge: Fall Fish Survey Finds Zero Delta Smelt

by

For the first time ever, a fish survey that the California Department of Fish and Wildlife (CDFW) conducts every autumn turned up zero Delta smelt throughout the monitoring sites in the Sacramento-San Joaquin River Delta in September, October, November and December 2018.

The smelt, a 2 to 3 inch fish listed under both federal and state Endangered Species Acts, is found only in the Delta estuary. It is regarded as an indicator species, a fish that demonstrates the health of the entire Delta ecosystem.

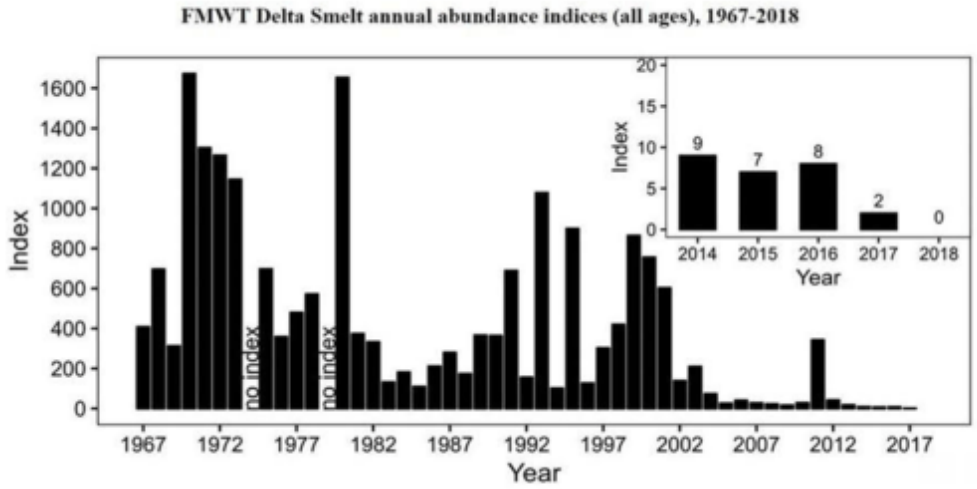
Once the most abundant fish in the entire estuary, the population has collapsed to the point where not one fish was found in the 2018 Fall Midwater Trawl survey. The 2018 abundance index (0), a relative measure of abundance, is the lowest in FMWT history.

"No Delta Smelt were collected from any station during our survey months of September-December," wrote James White, environmental scientist for the CDFW's Bay Delta Region.

This is not the only survey of Delta smelt populations that the CDFW conducts — and the other assessments have found smelt, although in alarmingly low numbers.

White noted, "While this survey did not catch any Delta Smelt, it does not mean they are not present. Spring Kodiak Trawl (SKT) survey caught 5 Delta Smelt in December."

White also said another survey, the Enhanced Delta Smelt Monitoring (EDSM) survey, caught 13 Delta Smelt during December.



While decades of water exports and environmental degradation under previous governors and federal administrations have brought the smelt, once the most abundant fish in the Delta, to the edge of extinction, Governor Jerry Brown and his administration did nothing to reverse the trend, but only helped to worse the endangered fish's status, according to fishermen and

environmentalists.

Before this fall, the 2017 abundance index (2) was lowest in FMWT history. Only 2 Delta smelt were collected at index stations in the survey during the fall of 2017.

The Delta smelt is not the only fish absent during the fall 2018 survey. The CDFW didn't observe any Sacramento splittail, a native minnow species that was formerly listed under the Endangered Species Act until Bush administration delisted the species and the Obama administration agreed with the delisting, in the 2018 fall survey either.

The striped bass, a popular gamefish that migrates from the ocean, San Francisco Bay and Delta up into the Sacramento and San Joaquin rivers every spring to spawn, also showed an alarming drop in abundance during the survey.

The 2018 abundance index (42) for striped bass was the lowest in FMWT history, slightly less than the previous low value (43) in 2010. Thirty-one age-0 striped bass were collected at index stations, noted White.

The longfin smelt, a cousin of the Delta smelt, isn't faring very well either in the estuary. "The 2018 abundance index (52) was the 5th lowest value in FMWT history, a 63% reduction from the previous year. Thirty-one Longfin Smelt were collected at index stations," said White.

The number of threadfin shad, an introduced forage fish species, continued to decline. The 2018 abundance index (198) was the 4th lowest in survey history, a 32% reduction from the previous year. The CDFW found 150 threadfin shad at index stations.

The abundance of American shad in the trawl is also disappointing. The 2018 abundance index (1064) was the 21st lowest value on record, a 66% reduction from the previous year. Seven-hundred and two American shad were collected at index stations.

The January 2 memo summarizing the Fall Midwater Trawl results is available here: nrm.dfg.ca.gov/...

The link to the Fall Midwater Trawl monthly abundance indices is available here: www.dfg.ca.gov/...

Bill Jennings, Executive Director of the California Sportfishing Protection Alliance (CSPA), commented on the disastrous decline of Delta smelt and other fish species in the Fall Midwater Trawl by the California Department of Fish and Wildlife (CDFW).

"The abundance of both Delta smelt and striped bass is the lowest in the trawl's history," said Jennings. "Longfin is the fifth lowest, threadfin shad is the fourth lowest, American shad is a 66 percent reduction from the previous year and the splittail is zero. This is a very comprehensive trawl and the results were a disaster for Delta fisheries."

"Not only is the Delta smelt on the brink of extinction but there are several species lined up behind it," noted Jennings. "Governor Brown's legacy is likely to be several extinctions of fish that flourished in this estuary for millennia."

"We know what fish need. Fish prosper when they have adequate flows and quality water. They suffer when they don't. The question is how do we get them to survive on less water of poorer quality than they evolved with for thousands of years. The answer appears to be they can't," Jennings concluded.

Dr. Jonathan Rosenfield, the Lead Scientist for The Bay Institute, emphasized in a tweet that Delta smelt are "not extinct," since other sampling programs still catching them.

"Extinction is not imminent (if agencies take action)," he noted. "'Flexible", 'adaptive' implementation of the ESA (Endangered Species Act) has not worked. It's time to enforce protections."

Scientists don't have any easy answer for the precipitous decline of Delta smelt over the past couple of years, particularly in 2017, a record water year when biologists would have expected a rebound.

"The answer is that we really don't know," said Dr. Peter B Moyle, Distinguished Professor, Emeritus, at the Department of Wildlife, Fish, and Conservation Biology, Center for Watershed Sciences, UC Davis, in December 2017. "The best explanation I can think of is that numbers are so low that an increase (or decrease) in the index would not be detectable with the FMT sampling."

"Another is that there was so much water last winter (2017) that smelt were more dispersed than usual and had a hard time finding mates; this would keep numbers low. When numbers are as low, as they clearly are for smelt, random factors in sampling, in distribution, in spawning success etc can make a big difference to the total population or the index," said Moyle.

"Note that Delta smelt are still abundant enough in places so that focused sampling can find them. For example, Tien-Chieh Hung had no problem collecting a 100 smelt in one day for his smelt culture program," he noted

A number of factors have resulted in the decline of Delta smelt and the other pelagic species, including increases in toxics and invasive species, but no factor has helped precipitate the collapse of Delta fish species more than the export of big quantities of water to agribusiness and Southern California water agencies from the state and federal pumping facilities in the South Delta over the past 50 years, according to fish advocates.

The record total for water exports, including water diverted by the Contra Costa Canal and North Bay Aqueduct, was 6,633,000 acre-feet in 2011 under the Brown administration. That was 163,000 acre-feet more than the previous record of 6,470,000 acre-feet set in 2005 under the Schwarzenegger administration, according to DWR data.

Found only in the Sacramento-San Joaquin River Delta, the Delta smelt mainly inhabits the freshwater-saltwater mixing zone of the estuary, except during its spawning season. That's when it migrates upstream to freshwater following winter "first flush" flow events, around March to May.

The smelt is very susceptible to changes in the environmental conditions of its habitat due to its one-year lifecycle and relatively low fecundity. Because of this, the fish is regarded as an "indicator species" that demonstrates the health of the Delta ecosystem.

It is imperative that the Gavin Newson administration break with the failed water policies of Brown and his predecessors and adopt rational water policies, based on science, that restore Delta smelt, Chinook salmon, steelhead and other fish species and the San Francisco Bay Delta ecosystem while providing a reliable and sustainable water supply for all Californians.

Remember: Extinction is forever. If the smelt becomes extinct, salmon, steelhead and other fish species will soon follow.

Background from CDFW: The California Department of Fish and Wildlife has conducted the Fall Midwater Trawl Survey (FMWT) to index the fall abundance of pelagic fishes nearly annually since1967. FMWT equipment and methods have remained consistent since the survey'sinception, which allows the indices to be compared across time. These relative abundance indices are not intended to approximate population sizes. However, we expect that our indices reflect general patterns in population change.

The FMWT conducts monthly surveys from September through December. The annual abundance index is the sum of the September through December monthly survey indices. During each monthly survey, one 12-minute oblique midwater trawl tow is conducted at each of 100 index stations used for index calculation and at an additional 22 non-index stations that provide enhanced distribution information.

The 2018 sampling season completed on December 18. Field crews successfully conducted tows at all index and non-index stations during the first three survey months. Two non-index stations in Cache Slough (stations 713 and 721) were not sampled in December due to heavy vegetation damaging sampling gear.

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UC Davis
San Francisco Estuary and Watershed Science

Title
The Role of Tidal Marsh Restoration in Fish Management in the San Francisco Estuary

Permalink
https://escholarship.org/uc/item/1147j4nz

Journal
San Francisco Estuary and Watershed Science, 12(1)

ISSN
1546-2366

Authors
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Publication Date
2014

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MARCH 2014

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Sponsored by the Delta Science Program and the UC Davis John Muir Institute of the Environment

The Role of Tidal Marsh Restoration in Fish Management in the San Francisco Estuary

Bruce Herbold[1], Donald M. Baltz[2], Larry Brown[3], Robin Grossinger[4], Wim Kimmerer[5], Peggy Lehman[6], Peter B. Moyle[7], Matt Nobriga[8], and Charles A. Simenstad[9]

INTRODUCTION

Tidal marsh restoration* is an important management issue in the San Francisco Estuary (estuary). Restoration of large areas of tidal marsh is ongoing or planned in the lower estuary (up to 6,000 ha, Callaway et al. 2011). Large areas are proposed for restoration in the upper estuary under the Endangered Species Act biological opinions (3,237 ha) and the Bay Delta Conservation Plan (26,305 ha). In the lower estuary, tidal marsh has proven its value to a wide array of species that live within it (Palaima 2012). In the Sacramento–San Joaquin Delta (Delta), one important function ascribed to restoration of freshwater tidal marshes is that they make large contributions to the food web of fish in open waters (BDCP 2013). The Ecosystem Restoration Program ascribed a suite of ecological functions to tidal marsh restoration, including habitat and food web benefits to native fish (CDFW 2010). This background was the basis for a symposium, *Tidal Marshes and Native Fishes in the Delta: Will Restoration Make a Difference?* held at the University of California, Davis, on June 10, 2013. This paper summarizes conclusions the authors drew from the symposium.

* Restoration as used here implies a reversal of impaired ecological features and processes in order to support desired species of wildlife, not a return to historic conditions.

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CONSENSUS CONCLUSIONS

From the scientific work done in the estuary and elsewhere we conclude:

1. Restoration of tidal marshes benefits many fish, mammals, and birds. These benefits can be extremely important for growth and survival of individuals of desirable species on site. Site location of restored marshes will determine which species will use them. Site-specific design is, therefore, required to support targeted species and to reduce the effects of invasive species. Important design considerations include area, elevations, residence time, extent of edge and channels, the nature of adjacent habitats, and connectivity with adjacent habitats.

2. Movement of plankton from a tidal marsh (beyond the immediate area of tidal exchange) is likely to be limited and to decrease strongly with distance. Even under ideal circumstances, plankton in water discharged from tidal marsh cannot greatly affect the standing crop of plankton in large, deep channels. Feeding by clams and other introduced species can further reduce contributions of marsh plankton to open-water foodwebs.

3. Large areas with diverse physical structure will enhance habitat diversity and help meet the various needs of targeted species. No quantitative guidelines exist to relate restoration extent to functional contributions at the population scale, but a good starting point is to focus on areas large enough to support tidal channels of diverse size and density similar to natural Delta tidal marshes. Diverse habitat types provide benefits to an array of desirable species at multiple life stages.

4. Effective tidal marsh planning requires a landscape-level perspective at a decadal, or greater, scale. Large-scale construction of tidal marsh will change tidal dynamics and alter the tidal inundation regime over a broad area. Sea level rise and inundation of Delta islands will also change tidal dynamics, as will changes in timing or quantity of freshwater flow that results from management or climate change. Tidal wetland design must plan for future tidal and flow regimes.

5. Information gaps about functions and processes in Delta tidal marshes are large but can be filled by designing restoration projects as experiments. In particular, larger restoration areas may produce changes in system response that are large enough to be detected. Planning for new tidal marsh should use site-specific modeling to develop realistic expectations and testable hypotheses, incorporate experimental design to test hypotheses, actively investigate ecological mechanisms that develop in new environments, and contribute toward landscape-level ecological models.

Tidal wetlands elsewhere make broad, multi-faceted contributions to fish habitat, productivity and resilience. However, the present Delta has comparatively little tidal marsh (less than 5% of the historical extent) and so its role is little understood. Experience from previous restoration efforts throughout the estuary, both intentional and accidental, can guide future work. The consensus of the group was that restoration of tidal marsh should proceed both boldly and carefully. Restoration should be accompanied by studies that fill crucial information gaps to help navigate the environmental changes expected in the coming decades.

SELECTED FINDING

Tidal marsh was the dominant component of the primeval Delta (over 90% of its area) and was probably key to historical fish productivity, now largely lost. Other elements of the landscape—including the natural hydrograph, floodplains, sediment supply, and slough networks—are also greatly altered. These alterations and abundant alien species preclude a return to the original Delta. Climate change, earthquakes, and future species invasions will further alter the Delta. Creation and management of tidal marshes can help protect species and ecosystem services that humans value.

Historical records and maps reveal an intricate mosaic of diverse habitats dispersed across three main Delta regions: a floodplain region off the Sacramento River, a meandering channel region from the San Joaquin River and a tidal region where the rivers join before flowing into Suisun Bay (Whipple et al. 2012). Lakes and marshes, riparian forests and seasonal wetlands, and other landscape forms were inundated to different depths and durations during different seasons and years, providing a diverse portfolio of aquatic habitats. Overall, wetland area exceeded open-water area by about 14:1; today, wetland area is less than open water area by a ratio of 1:6, an 80-fold switch in dominant habitat types (Whipple et al. 2012).

Shallow areas like those of the ancient San Francisco Estuary are nurseries for fish in estuaries along the Gulf Coast, the Pacific Northwest, and Chesapeake Bay. Small fish use edges of wetlands to feed and to avoid predation by larger fish (Baltz et al. 1993, 1998). Fish-eating wading birds enhance nursery function by preying on larger fish, thus reducing the risk of predation for small fish. The nursery value of a wetland for a particular species is affected by both accessibility and areal extent. In Louisiana, marsh value is affected by both edge and area. In early stages of degradation, shrinking wetlands retain their value for young fish because the amount of edge increases as wetlands are initially fragmented, which increases fish access (Chesney et al. 2000). On the other hand, harvest-per-hectare of commercial shrimp increases with marsh area, presumably because shrimp are not restricted to the edge (Turner 1977). Thus, the processes that benefit wetland species differ strongly from species to species. Black rails and clapper rails in the lower estuary have a minimum marsh size of about 50 ha and clapper rails have an optimum patch shape with minimum edge-to-area ratio (Spautz and Nur 2002; Liu et al. 2012). Thus, it is crucial to understand marsh characteristics important to each species when size, location, and configuration of new tidal marshes are determined.

Reclaiming tidal wetlands from salt harvest, military use, and agriculture has been a major effort in the estuary for the last 40 years and has improved our understanding of tidal marsh processes. A 2003 summary of the value of tidal wetlands to native fishes found large gaps in knowledge and many unfounded assumptions about tidal marsh function for fishes (Brown 2003). Much knowledge has been gained since 2003 and a revised summary of the current knowledge and knowledge gaps is expected in 2014 (L. Brown, USGS, pers. comm., 2014). Most knowledge has been garnered incidental to restoration activity, rather than as an integrated part of it. For example, isotope studies have been conducted in several tidal marshes with different restoration histories along the Napa River. These studies showed that fish draw much of their nutrition from upstream sources during wet periods, but that nutrition comes largely from tidal marsh and marine sources when river flow declines and tidal influence increases (Howe and Simenstad 2007, 2011). Three broad themes have emerged about fish use of restored tidal marsh:

1. Food web pathways for fish within a marsh are largely detritus-based, rather than phytoplankton-based (Howe and Simenstad 2007, 2011).
2. The vegetated edge is important for small fish foraging and predator avoidance (Gewant and Bollens 2012).
3. Newly-constructed marshes are rapidly occupied by fish and their prey; new marshes provide habitat and food web support comparable to reference sites (Howe and Simenstad 2007, 2011; Cohen and Bollens 2008).

In the modern San Francisco Estuary, tidal wetlands can be important habitats for many fishes, but likely will have little effect on the export of food available to fish at any significant distance. Measured flux of organic material into and out of Liberty Island (flooded in 1997, now tidal marsh and open water) suggests that little of the productivity that supports pelagic food webs on-site is exported (Lehman et al. 2010). For small fishes like delta smelt, the value of on-site productivity is presumably enhanced by low populations of invasive clams, aquatic plants, and predators in Liberty Island (Sommer and Mejia 2013) and similar areas in Suisun Marsh (P. Moyle, UCD, unpublished data). Seasonal floods bring riverine materials into Liberty Island, but daily tidal action seems not to move much material off-site; data are lacking on export of material that may occur during occasional large-scale flood events. Tidal wetland channels can facilitate phytoplankton growth and accumulation if they are shallow and clear enough that light penetrates most of the water column. Long residence time allows buildup of high biomass, which can fuel further phytoplankton and zooplankton development. Benthic algae can be important parts of primary productivity in shallow or low-turbidity areas. Conversely, the grazing effects of clams are

heightened in shallow water with long residence time (Lucas and Thompson 2012). Therefore, optimizing tidal wetland benefits to fish requires a balance between water depth and residence time to promote planktonic and benthic algal growth while minimizing clam effects. Such balancing requires site-specific design considerations and improved understanding of factors that affect clam abundance.

Restored tidal wetlands are unlikely to have much effect on food webs in the upper estuary's open waters. The shallow depth and small volume of water on tidal wetlands compared to the vast volume of open water in Delta channels and Suisun Bay means that flux of wetland phytoplankton and zooplankton would be inconsequential to pelagic food webs. We are unaware of reports from the worldwide literature in which substantial quantities of zooplankton are exported from marshes to open waters, whereas several studies show net import of zooplankton to fish consumption on site.

Tidal wetland restoration without analysis of processes in the developing ecosystem and in the landscape overall, wastes opportunities to learn from ongoing projects and to improve design of future projects. For example, breaching of dikes at Blacklock in Suisun Marsh was accompanied by little effort to study evolution of the site, so insights to guide future restoration are limited. If levee work does not keep pace with sea level rise, more of Suisun Marsh may become tidal than the amount considered in the Suisun Marsh Plan (USBR 2011). Inundation of large parts of Suisun Marsh would reduce tidal energy entering the Delta and change inundation patterns (and salinity) at other tidal wetland sites. Similarly, inundation of lands in the Delta will alter tidal dynamics throughout the Delta. Thus, studies are needed on restored sites, in areas adjacent to restored sites, and in areas that are affected by changes in hydrodynamics resulting from the restored sites. In short, landscape-level analyses of restoration effects are essential.

Tidal marsh restoration outcomes are site-specific, in that different sites will support different species and functions based on location, elevation, adjacent habitats, and degree of hydrodynamic connectivity. Tidal marsh restoration can benefit a wide variety of birds, mammals, and plants but to support target fish populations, tidal wetland restoration must target sites that can be accessed by desired fish species and that are minimally affected by invasive species. In the western Delta, the reach from Suisun Marsh to Liberty Island may provide an opportunity for landscape-scale restoration and increase the habitat suitability for a variety of native fish (Moyle et al. 2012; Hanak et al. 2013). Integrated, multi-purpose designs have been developed for some specific sites, including McCormack–Williamson Tract, Dutch Slough, and Prospect Island.

Achieving successful restoration outcomes is severely constrained by many external factors including: alien species, Delta water management, sea level rise, climate change, sediment supply, and contaminants. Alien species and altered habitats dominate most of the Delta and have profound effects on the aquatic ecosystem. The value of tidal wetland restoration to native species will be greatest where aliens are less abundant or where conditions can be altered to reduce their effects. Climate change, sea level rise, and invasive species will require knowledge and flexibility if desirable traits are to be restored to estuarine ecosystems. Early restoration efforts must be approached as experiments in management that will guide later efforts, and be integrated over the entire estuary. We must increase our knowledge of the trajectories of restoration if we are to achieve our goals and adequately respond to future challenges.

ACKNOWLEDGEMENTS

The authors thank the Delta Science Program, the University of California, Davis' Center for Aquatic Biology and Aquaculture, and the California–Nevada Chapter of the American Fisheries Society for their funding and logistical support of this symposium.

REFERENCES

Baltz DM, Rakocinski C, Fleeger JW. 1993. Microhabitat use by marsh-edge fishes in a Louisiana estuary. Env Biol Fish 36:109–126.

Baltz DM, Fleeger JW, Rakocinski C, McCall JN. 1998. Food, density, and microhabitat: factors affecting growth and recruitment potential of juvenile saltmarsh fishes. Env Biol Fish 53:89–103.

Brown LR. 2003. Will tidal wetland restoration enhance populations of native fishes? San Fran Est Water Sci [Internet]. [cited 03 March 2014]; (1)1. Available from: *http://escholarship.org/uc/item/2cp4d8wk.*

Callaway JC, Parker VT, Vasey MC, Schile LM, Herbert ER. 2011. Tidal wetland restoration in San Francisco Bay: history and current issues. San Fran Est Water Sci [Internet]. [cited 03 March 2014]; 9(3). Available from: *http://www.escholarship.org/uc/item/5dd3n9x3.*

Chesney EJ, Baltz DM, Thomas RG. 2000. Issues and trends in estuarine and coastal fisheries and fish habitat in Louisiana: perspectives from a fish's eye view. Ecol App 10(2):350–366.

Cohen SE, Bollens SM. 2008. Diet and growth of non-native Mississippi silversides and yellowfin gobies in restored and natural wetlands in the San Francisco Estuary. Mar Ecol Prog Ser 368:241–254.

[CDFW] California Department of Fish and Wildlife. 2010. Ecosystem Restoration Program conservation strategy for Stage 2 implementation, Sacramento–San Joaquin Delta ecological management zone. Sacramento (CA): The Resources Agency.

Gewant D, Bollens SM. 2012. Fish assemblages of interior tidal marsh channels in relation to environmental variables in the upper San Francisco Estuary. Env Biol Fish 94(2):483–499.

Hanak E, Lund J, Durand J, Fleenor W, Gray B, Medellín–Azuara J, Mount J, Moyle P, Phillips C, Thompson B. 2013. Stress relief prescriptions for a healthier Delta ecosystem. San Francisco (CA): Public Policy Institute of California. Available from: *http://www.ppic.org/main/publication.asp?i=1051*.

Howe ER, Simenstad CA. 2007. Characterizing restoration trajectories through food web linkages in San Francisco Bay's estuarine marshes: a manipulative translocation experiment. Mar Ecol Prog Ser 351:65–76.

Howe ER, Simenstad CA. 2011. Isotopic determination of food web origins in restoring and ancient estuarine wetlands of the San Francisco Bay and Delta. Estuar Coasts 34:597–617.

Lehman PW, Mayr S, Mecum L, Enright C. 2010. The freshwater marsh at Liberty Island, CA, was both a source and sink of inorganic and organic matter to the San Francisco Estuary. Aquat Ecol 44:359–372.

Liu L, Wood J, Nur N, Salas L, Jongsomjit D. 2012. California clapper rail (*Rallus longirostris obsoletus*) population monitoring: 2005–2011. Technical report to the California Department of Fish and Game. San Rafael (CA): PRBO Conservation Science.

Lucas LV, Thompson JK. 2012. Changing restoration rules: exotic bivalves interact with residence time and depth to control phytoplankton productivity. Ecosphere 3(12):117. Available from: *http://dx.doi.org/10.1890/ES12-00251.1*.

Moyle PB, Bennett W, Durand J, Fleenor W, Gray B, Hanak E, Lund J, Mount J. 2012. Where the wild things aren't: making the Delta a better place for native species. San Francisco (CA): Public Policy Institute of California. Available from: *http://www.ppic.org/main/publication.asp?i=1025*.

Palaima A, editor. 2012. Ecology, conservation and restoration of tidal marshes San Francisco Estuary. Berkeley (CA): UC Press. 265 p.

Sommer T, Mejia F. 2013. A place to call home: a synthesis of delta smelt habitat in the upper San Francisco Estuary. San Fran Est Water Sci [Internet]. [cited 03 March 2014]; 11(2). Available from: *http://www.escholarship.org/uc/item/32c8t244*.

Spautz H, Nur N. 2002. Distribution and abundance in relation to habitat and landscape features and nest site characteristics of California black rail (*Laterallus jamaicensis coturniculus*) in the San Francisco Bay Estuary. A report to the U.S. Fish and Wildlife Service, Coastal Program. Petaluma (CA): PRBO Conservation Science. Available from: *http://www.prbo.org/cms/docs/wetlands/BLRA_PRBO_Mar2002.pdf*.

Turner RE. 1977. Intertidal vegetation and commercial yields of Penaeid shrimp. Trans Am Fish Soc. 106(5):411–416.

[USBR] U.S. Bureau of Reclamation 2011. Suisun Marsh habitat management, preservation and restoration plan. Available from: *http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=781*.

Whipple AA, Grossinger RM, Rankin D, Stanford B, Askevold RA. 2012. Sacramento–San Joaquin Delta historical ecology investigation: exploring pattern and process. Prepared for the California Department of Fish and Wildlife's Ecosystem Restoration Program. A Report of SFEI–ASC's Historical Ecology Program, Publication #672. Richmond (CA): San Francisco Estuary Institute–Aquatic Science Center. Available from: *http://www.sfei.org/DeltaHEStudy*.

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Via U.S. Mail and email

July 15, 2014

Reclamation District 2130
Dr. Terry Huffman
Huffman-Broadway Group, Inc.
828 Mission Avenue
San Rafael, CA 94901

RE: COMMENTS ON INITIAL STUDY/MITIGATED NEGATIVE DECLARATION FOR THE MALLARD FARMS CONSERVATION BANK

Dear Dr. Huffman:
The California Department of Water Resources (DWR) appreciates the opportunity to provide comments on the Initial Study/Mitigated Negative Declaration (IS/MND) for the proposed Mallard Farms Conservation Bank (hereafter, "Project"). These comments are prepared in response to the State Clearinghouse Filing Number 2013042006. As currently proposed, DWR cannot support the Project.

These comments serve to memorialize the issues raised over the past year during our cooperative efforts to further analyze the impacts of the Project and the corresponding information/actions that DWR would like to see included in your IS/MND. DWR is concerned with the adequacy of your environmental analysis review and corroborating environmental documentation in your IS/MND in several areas. However, we hope to continue working collaboratively with you to achieve your Project goals while avoiding impacts to DWR facilities and operations and important Suisun Marsh habitats.

I. THE IS/MND FAILS TO ACCURATELY IDENTIFY ENVIRONMENTAL IMPACTS TO PUBLIC SERVICES, RECREATION AND WATER QUALITY AND NECESSARY MITIGATION MEASURES TO REDUCE THESE IMPACTS TO LESS THAN SIGNIFICANT.

A. PUBLIC SERVICES

The Project site shares approximately 10,000 feet of an existing interior levee with DWR's Roaring River Distribution System (RRDS); this section of levee will become an external levee (exposed to full tidal action) if the Project is carried out. This particular section of the RRDS levee was designed by DWR as an interior levee and is currently exposed to muted tidal action (due to a natural breach in the one of the Project proponent's exterior levees).

This particular section of the RRDS levee was designed by DWR as an interior levee, and DWR's current obligations are to maintain this levee as an internal levee between the minimum elevation of 6.7 feet (NAVD88) and 7.7 feet. This standard does not provide adequate which no flood protection for levees exposed to full tidal action (Stage Frequency Curve Sacramento River at Collinsville, Corps of Engineers, 1992). Under the current muted tidal conditions on the Project site, tidal stage against the RRDS levee can be within a few inches of the top of the RRDS levee. With Project implementation, the probability of levee overtopping, breaching, and flooding would be significantly increased.

The IS/MND indicates that DWR's 2013 Roaring River Levee Rehabilitation Project will be sufficient to reduce the Project's impact on flooding to less than significant (IS/MND page 43). However, this Project has not been fully designed, funded, or a timeline developed for implementation. This would be a multi-million dollar rehabilitation Project reliant on state and Federal funding. Given the current fiscal conditions at the state and national level, as well as, historical fiscal unpredictability, there are no guarantees that funding will come available in the foreseeable future. Relying on a hypothetical Project for flood protection for the Project is not an appropriate future condition baseline under CEQA, and is not acceptable to DWR.

To provide adequate flood protection to the RRDS and neighboring properties, including California Department of Fish and Wildlife's (DFW) Grizzly Island Wildlife Area, the RRDS levee along the Project site needs to be improved to HMP (Hazard Mitigation Plan) external levee standards. For this location, those standards include an elevation of approximately 10.2 feet (NAVD88) with an appropriate width to allow legal vehicle access, and bank-stabilization (to protect the levee from tidal/wind damage).

DWR requests that at a minimum the IS/MND be revised to acknowledge Project impacts to the existing levees (as the appropriate baseline for CEQA review) and identify appropriate mitigation to ensure that necessary improvements to the RRDS levee are committed to as part of the Project. DWR requests the Project proponents specifically identify: (i) impacts to existing levees from Project implementation; (ii) appropriate levee improvements to mitigate the impacts of the Project including impacts to wetlands, (iii) who will carry-out the required levee improvements and permitting for the improvements, (iv) the source and quality of the required levee fill material, (v) a timeline to accomplish the levee improvements that protects all interests, (vi) who will perform maintenance on this section of levee, (vii) and who will offset the costs associated with the aforementioned issues.

Additionally, the Project's IS/MND does not address seven (7) unused water control structures (culverts) that historically provided water to the Project site and are owned by the property owners of their respective locations. These unused culverts will impair the structural integrity of the levee if they are exposed to full-tidal action. Several of the culverts are currently leaking water and represent an operational hazard to the RRDS. DWR requests that the Project proponents address these culverts including identifying the responsible party for removing them.

The Project will impact the RRDS levee maintenance/flood protection and could jeopardize DWR's regulatory compliances with the Suisun Marsh Preservation Agreement (SMPA), the State Water Resources Control Board Water Right Decision 1641 (D-1641), the Suisun Marsh Preservation Act, the Suisun Marsh Protection Plan, and the Plan of Protection for the Suisun Marsh. These impacts are not analyzed or discussed in the IS/MND. Discussion needs to be

provided with appropriate mitigation measures including coordination with DWR during construction and post-construction phases to ensure impacts are reduced to less than significant.

The Project proponents and DWR's Division of Environmental Services have engaged in discussions over the past year with respect to the aforementioned levee improvements and the unused culvert issues; however, as of the date of this comment letter, no formal agreements have been reached.

B. RECREATION

The IS/MND fails to identify potential significant adverse impacts to recreation as a result of the Project. As stated above, the Project presents a significant risk of levee failure. Should the RRDS levee fail, Grizzly Island Wildlife Area, a public recreation area owned and operated by DFW, is at great risk of significant adverse impacts. Currently this area is utilized by recreational hunters and is open to the public. Should levees fail at a time where public hunters are present there is a risk of significant injury, and even potential loss of human life.

C. HYDROLOGY AND WATER QUALITY

The IS/MND does not address any water quality impacts of the Project beyond construction-related water quality issues. The IS/MND needs to provide thorough documentation related to the water quality impacts (i.e., construction and non-construction related) of the Project, including the results of any reports, expert opinions, and hydrodynamic model analyses.

The Project will expose approximately 700 acres of former managed wetlands (currently under a muted-tidal regime) in the Suisun Marsh to a full-tidal regime. Based upon the geography and hydrodynamics in the vicinity of the Project site, there is the potential for the Project to alter current salinity gradients throughout the Suisun Marsh and potentially change salinities at Delta and Suisun Marsh D-1641 monitoring and compliance stations. Altering the current salinity regime in the Delta and Suisun Marsh could force operational changes at State Water Project (SWP) and Central Valley Water Project (CVP) facilities and/or require additional upstream water releases. Altering salinity gradients in Suisun Marsh could force operational changes of the Suisun Marsh Salinity Control Gates (SMSCG) and could jeopardize DWR's regulatory compliances with several Biological Opinions, the RSMPA, and D-1641.

The Project proponent's IS/MND does not address long term water quality impacts of the Project including potentially cumulative impacts from other currently planned Projects in the Suisun Marsh and within the vicinity of the Project.

DWR believes there are potentially significant impacts related to water quality associated with the Project. We request that these impacts be clearly identified within the IS/MND, that references be provided supporting your determinations and appropriate mitigation measures including collaboration with DWR be included, to reduce the impacts to less than significant.

II. THE CURRENT IS/MND DOES NOT MEET THE REQUIREMENTS OF CEQA REVIEW

A. Substantial Evidence Exists That The Project May Have A Significant Impact On The Environment And As Such An EIR Should Be Prepared

CEQA Guidelines § 15064 states that "If there is substantial evidence, in light of the whole record before a lead agency, that a Project ***may*** have a significant effect on the environment, the agency ***shall*** prepare a draft EIR" (emphasis added). Further, a mitigated negative declaration cannot be used where there is evidence that its mitigation is inadequate or deferred. As stated above, the IS/MND fails to identify several significant impacts of the Project. Additionally, without further analysis and commitment by the Project proponents it is unlikely that these impacts could be mitigated to a less than significant level.

In addition, there are two CEQA mandatory findings of significance that are applicable to the Project. First, where the Project has possible environmental effects that are cumulatively considerable and second, where the environmental effects of a Project will cause substantial adverse effects on human beings, either directly or indirectly. Although the IS/MND does not presently include the results of the limited modeling work performed on behalf of the Project proponents by RMA, the modeling that has been shared with DWR indicates an adverse impact to salinity as a result of the Project. In light of the planned and potential Projects in this vicinity the cumulative contribution of this Project may be significant. The Project also presents the possibility of substantial adverse effects on human beings as presently proposed due to the increased risk of levee failure and the adjacent properties including several privately owned duck clubs and the Grizzly Island Wildlife Area which is open the public.

B. Notwithstanding The Necessity Of Preparing An EIR, Should The Lead Agency Choose To Proceed With An MND, The Changes Would Require Recirculation

Because of the deficiencies identified above, the Draft IS/MND will need to be re-circulated prior to certifying it under CEQA, and approving the Project. Specifically, State CEQA Guidelines section 15073.5 requires that a negative declaration be re-circulated when "the document must be substantially revised after public notice of its availability has previously been given pursuant to Section 15072, but prior to its adoption." Substantial revision includes:

(1) A new, avoidable significant impact is identified and mitigation measures or Project revisions must be added in order to reduce the effect to insignificance, or

(2) The lead agency determines that the proposed mitigation measures or Project revisions will not reduce potential effects to less than significance and new measures or revisions must be required.

DWR looks forward to your responsiveness and continued coordination. As stated above and in our prior meetings we wish to continue to collaborate with you to ensure these efforts are successful and avoid adverse impacts to interested stakeholders such as DWR. If the lead agency has any questions, please do not hesitate to Erik Loboschefsky, Water Resources Engineer, at (916) 376-9751; or Cliff Feldheim, Suisun Marsh Environmental Planning and Information Branch Chief, at (916) 376-9693 with any questions. We look forward to continuing to work with you to resolve these issues.

Sincerely,



Cliff Feldheim,
Branch Chief,
Suisun Marsh Environmental Planning and Information

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY EDMUND G. BROWN JR., Governor

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

July 12, 2016

Reclamation District 2130
Dr. Terry Huffman
Huffman-Broadway Group, Inc.
828 Mission Avenue
San Rafael, California 94901

Dear Dr. Huffman:

The California Department of Water Resources (DWR) has received your conceptual design plans, submitted on behalf of Reclamation District 2130 (RD 2130), dated February 25, 2016, to support the implementation of the Mallard Farms Conservation Bank Project (MFCB) located within the Suisun Marsh. Specifically, the conceptual plans address two significant features: 1) breaching the Honker Bay levee and 2) constructing a Double Wall Impact Resistant Levee (DWIRL) with a double row of vinyl sheet piles with filling material on the Roaring River Distribution System (RRDS) embankment. DWR has performed a cursory review of the conceptual plans and has concerns that the MFCB proposal is not sufficiently substantiated in the following areas: 1) RD 2130's legal responsibility to maintain the Honker Bay levee; 2) technical concerns as to the implied impacts to the RRDS to perform as an exterior levee with proposed DWIRL constructed of vinyl sheet piles; and 3) economic concerns regarding credit values of the proposed project. DWR recognizes the potential opportunity to work with you to develop a multi-benefit project which could incorporate necessary flood control measures that protect the RRDS facility while enabling tidal marsh restoration. DWR continues to be willing to explore solutions to this project with you in the future.

RD 2130 Legal Responsibility Considerations:

The primary concern continues to be RD 2130's fundamental intent to breach the Honker Bay levee despite RD 2130's responsibility and obligations to operate and maintain the existing Honker Bay levee infrastructure as an exterior levee. This decision will have great lasting impacts to the RRDS as it is DWR's responsibility to operate and maintain the State Water Resources Development System (SWRDS) and its facilities, which includes this portion of the RRDS. It is DWR's statutory responsibility to maintain the safety, security, and integrity of the SWRDS at all times.

As part of the SWRDS, the RRDS is governed by Water Code section 12899, and the related regulations, Cal. Code Regs., Title 23 sections 600-635. Section 12899.6 and Regulation 625.6 prohibit unauthorized drainage of water, storage or distribution of water causing overflow that results in damage to the SWRDS. RD 2130 is responsible for maintaining the Honker Bay levees so that water does not reach the RRDS. If that were to occur, the RRDS embankment could be compromised and fail, resulting in flooding of numerous surrounding properties, including, but not limited to, the Grizzly Island Wildlife Area. Failure of the embankment would prevent DWR from fulfilling its flood control and water delivery obligations.

Technical Considerations:
Based upon a cursory review of the submitted conceptual plans of a DWIRL, and recognizing that the RRDS functions as an embankment, not a levee, the design as proposed does not support the RRDS to perform as an exterior levee. At minimum, DWR does not believe the proposed vinyl sheet piles are designed to be used under the proposed conditions. However, without submission of formal plans, including supportive engineering calculations, DWR is unable to make a formal determination whether the proposed DWIRL design is adequate to support tidal action against the RRDS.

In order to perform and provide a formal review, under Cal. Code Regs., Title 23, Section 610.1(b), (1) and (2), DWR requires that RD 2130 submit final plans with an original California registered professional engineer's stamp and signature before undertaking any work within DWR's right-of-way. DWR also requires submission of the engineering calculations, specifications, and detailed construction and work plans that support the final plans. This information will allow DWR to adequately determine if the improvements will be constructed to the standards required to protect the RRDS and be engineered to function in the manner proposed, thereby supporting impacts from full tidal action. As previously provided in DWR's July 15, 2014 comment letter to RD 2130, "for this location, those standards include an elevation of approximately 10.2 feet (NAVD88) with an appropriate width to allow legal vehicle access, and bank-stabilization." Furthermore, DWR's review will determine whether proposed improvements within DWR's right-of-way are in compliance with the Cal. Code Regs. Title 23, Sections 600-635. Any costs associated with long-term maintenance of the improvements should be addressed by the Project proponents in their formal proposal.

DWR recognizes that the Project proponents own the underlying fee interest. Therefore, California Water Code 12899.8 applies, requiring submittal of plans for DWR to review and comment upon before undertaking the work. Upon formal submission of stamped and signed plans, DWR will provide formal written comments. Cal. Code Regs., Title 23, Section 607.3 requires RD 2130 to comply with DWR's required changes to the project design before proceeding with the work within DWR's right-of-way. Please submit for DWR's review and comment RD 2130's formal design plans that depict and ensure that the integrity of the RRDS system will not be adversely impacted.

Economic Considerations:
The stated purpose of the proposed MFCB Project is to restore tidal marsh habitat for fish mitigation (Delta smelt, salmonids) and to sell the resulting mitigation credits. However, the habitat restoration costs, together with the substantial estimated costs required to provide adequate protection of DWR RRDS facilities could challenge the project to be economically feasible.

DWR looks forward to working with you on the issues identified above and continues to be willing to explore solutions to this project with you in the future. If you have any questions regarding this matter, please contact Ms. Alejandra Lopez, Senior Right of Way Agent, Real Estate Branch, by email at Alejandra.Lopez@water.ca.gov, or by phone directly at (916) 653-9283, or toll free at (800) 600-4397.

Sincerely,

Angelica Aguilar, Chief
Property Management and Encroachment Permit Section
Real Estate Branch

cc: James K. Openshaw, Senior Attorney
State of California
Department of Water Resources
Office of Chief Counsel, Room 1148-3
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RECLAMATION DISTRICT 2130
DR TERRY HUFFMAN
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828 MISSION AVE
SAN RAFAEL CA 94901

94901-320928

Policies in 2010 LURMP Relating to Restoration Projects

Land Use Policy (P.3): "New non-agriculturally oriented residential, recreational, commercial, habitat, restoration, or industrial development shall ensure that appropriate buffer areas are provided by those proposing new development to prevent conflicts between any proposed use and existing adjacent agricultural parcels….")

Land Use Policy (P.14): "The conversion of an agricultural parcel, parcels, and/or an agricultural island for water impoundment, including reservoirs, water conveyance or wetland development may not result in the seepage of water onto or under the adjacent parcel, parcels, and/or island. These conversions shall mitigate the risks and adverse effects associated with seepage, levee stability, subsidence, and levee erosion, and shall be consistent with the goals of this Plan."

Agriculture Policy (P.2): "Conversion of land to non-agriculturally-oriented uses should occur first where productivity and agricultural values are lowest."

Agriculture Policy (P. 6): "….Promote use of environmental mitigation in agricultural areas only when it is consistent and compatible with ongoing agricultural operations and when developed in appropriate locations designated on a countywide or Deltawide habitat management plan."

Natural Resources Policy (P.3): "Lands managed primarily for wildlife habitat should be managed to maximize ecological values…."

Natural Resources Policy (P.5): "Preserve and protect the viability of agricultural areas by including an adequate financial mechanism in any planned conversion of agricultural lands to wildlife habitat for conservation purposes. The financial mechanism shall specifically offset the loss of local government and special district revenues necessary to support public services and infrastructure."

Natural Resources Policy (P.6): "Support the implementation of appropriate buffers, management plans and/or good neighbor policies (e.g. safe harbor agreements) that among other things, limit liability for incidental take associated with adjacent agricultural and recreational activities within lands converted to wildlife habitat to ensure the ongoing agricultural and recreational operations adjacent to the converted lands are not negatively affected."

Natural Resources Policy (P.7): "Incorporate, to the maximum extent feasible, suitable and appropriate wildlife protection, restoration and enhancement on publicly-owned land as part of a Delta-wide plan for habitat management."

From: Paulus, Linus@DWR <Linus.Paulus@water.ca.gov>
Sent: Wednesday, May 1, 2019 12:47 PM
To: Osha Meserve <Osha@semlawyers.com>; Ferrero, Brian@DWR <Brian.Ferrero@water.ca.gov>; Cavanaugh, Catherine@DWR <Catherine.Cavanaugh@water.ca.gov>; Riordan, Dan@DWR <Dan.Riordan@water.ca.gov>; Chu, Ling-ru@DWR <Ling-ru.Chu@water.ca.gov>; Wheeldon, Dave@DWR <Dave.Wheeldon@water.ca.gov>; Garcia, Olivia@DWR <Olivia.Garcia@water.ca.gov>; Michael Fahn <fahn@cwo.com>
Cc: Chris Neudeck <cneudeck@ksninc.com>; fahn@cwo.com
Subject: RE: Prospect Island Restoration Meeting - Follow up Notes

Hi Osha, regarding the easements DWR was seeking from Mr. Fahn we have abandoned this effort and designed our access to the project around his ownership interests.

Linus A. Paulus, SR/WA
Chief, Acquisition and Appraisal Section
(916) 653-3947, ofc
(916) 952-5576, cell

**** DWR INTERNAL COMMUNICATION / CONFIDENTIAL. NOT FOR PUBLIC DISTRIBUTION ****

From: Osha Meserve <Osha@semlawyers.com>
Sent: Wednesday, May 1, 2019 12:02 PM
To: Ferrero, Brian@DWR <Brian.Ferrero@water.ca.gov>; Cavanaugh, Catherine@DWR <Catherine.Cavanaugh@water.ca.gov>; Paulus, Linus@DWR <Linus.Paulus@water.ca.gov>; Riordan, Dan@DWR <Dan.Riordan@water.ca.gov>; Chu, Ling-ru@DWR <Ling-ru.Chu@water.ca.gov>; Wheeldon, Dave@DWR <Dave.Wheeldon@water.ca.gov>; Garcia, Olivia@DWR <Olivia.Garcia@water.ca.gov>; Michael Fahn <fahn@cwo.com>
Cc: Chris Neudeck <cneudeck@ksninc.com>; fahn@cwo.com
Subject: RE: Prospect Island Restoration Meeting - Follow up Notes

Hi All,
Thank you for meeting with us last week. I have a few follow up items for your consideration:

Good Neighbor Program
I want to emphasize that the draft list I provided at the meeting is a working document, and we are open to sharpening and narrowing the points to address the most pressing issues. This piece was intended to begin (or continue, as the case may be) the conversation.

On the specific issue of rocking the Ryer side of Miner Slough, the issue of permitting was briefly discussed. Chris and I conferred afterward, and we believe the most expeditious path would be to include the rocking in the USACE permit already being sought by the project for work on the Prospect side (submitted in 2018). The 408 permit application will need to be modified anyway to match the project DWR approves, and a protective segment of rock on the other side of the slough can be included with the other modifications and should not pose a permitting problem.

On the issue of a claims procedure as an alternative to the typical Government (Tort) Claims Act, I had mentioned the NDWA claims procedure that is used when there are crop damages from poor water quality. I have attached that form, which was developed by DWR, as an example of what we might do for other types of damages from restoration projects. It is my understanding that this process has worked fairly well and that we could adapt something like it for a Good Neighbor Program.

Regarding the per acre cost of Prospect, I suggest that DWR categorize the Good Neighbor Program as a programmatic (rather than as a Prospect specific) expense to address neighbor impacts that may arise from various restoration activities included in the FRP. Most of the negative impacts we are concerned may occur may not need to be fully funded at the front end as long as there is a pathway to address them. These are costs that could need to be expended

Appendix G

Prospect Island Restoration Project
Air Quality Calculations

This Appendix contains the assumptions, methodology, data, and results of calculations used to estimate the air emissions associated with the construction of the Prospect Island Tidal Habitat Restoration Project. Criteria air pollutant emissions inventories are computed, and the results are then compared with the corresponding Yolo-Solano Air Quality Management District (YSAQMD) thresholds to make the significance determination of the air quality impact of the Project. Since the Project does not involve long-term operations and therefore would not generate air pollutant emissions, this appendix focuses on the emissions generated during the Project's three-year construction phase.

This assessment estimated the emissions of the following criteria pollutants:

- Carbon monoxide (CO),
- Reactive organic gases (ROG),
- Nitrogen oxides (NOx),
- Particulate matter measuring 10 micrometers or less in diameter (PM_{10}), and
- Particulate matter measuring 2.5 micrometers or less in diameter ($PM_{2.5}$)

In addition, the CO_2 emissions are also included.

The Proposed Project is a multi-year project which is planned to be carried out from April 2018 through the end of 2020. Attachment 1 contains the datasheets for the calculation of project emissions during the 2.5-year construction period. The calculations are based on the Project construction information in the "Greenhouse Gas Calculation" datasheets prepared by the Design Engineers. According to the "Greenhouse Gas Calculation" datasheet, the construction of the Project is made up of 27 tasks (or construction activities) as shown in Table 1-A "Construction Tasks" of Attachment 1, and each task involves working on certain project features. Table 1-B "Estimated Construction Implementation Timing" of Attachment 1 lists the construction time frame of these tasks. Table 2 "Timing, Equipment and Other Details of Construction Tasks" of Attachment 1 not only enumerates the number of pieces of each type of equipment and the total operation hours required to complete that task, but also provides the size of soil disturbance from activities such as clearing and grubbing, soil excavation and site grading. The Project would use off-road construction equipment such as dozers, excavators, and cranes for activities such as clearing and grubbing, excavation, transportation and grading of soil, and on-road vehicles such as cars for cars for worker commute, water trucks, service trucks, and trucks for material delivery on public roads. In addition, a helicopter would be used for spraying herbicide for aquatic species control. Tables 3-A "Construction Equipment

Descriptions" of Attachment 1 contains the list of construction equipment and the estimated horsepower values, and Table 3-B of Attachment 1 contains the information on the mobilization and demobilization of the construction equipment. The Project also involves importing various types of construction materials from off-site locations, and the Engineers proposed two delivery methods for importing rip-rap, fill and aggregate base materials from a near-by quarry: Option A is using trucks only and Option B is using barges driven by tug-boats. Table 4 of Attachment 1 contains the quantities of various types of construction materials to be imported and the two delivery options.

Air pollutant emissions from the Project construction come from these different types of sources: off-road construction equipment (construction vehicles and other diesel powered equipment such as generators), on-road vehicles (worker commute trips, haul truck trips for importing construction materials and exporting construction waste), helicopter for aerial herbicide spraying, barge/tug boats for material delivery, and fugitive dust from soil disturbance.

The emissions of the pollutants were estimated with the help of the Road Construction Emissions Model (the Roadway Model) version 7.1.5.1. The Roadway Model is developed by the Sacramento Metropolitan Air Quality Management District to perform quantitative air quality analysis for roadway projects, which uses off-road construction equipment and on-road vehicles for work commute and material hauling. The Roadway Model quantifies project construction emissions from the following sources: worker commute, material hauling, water truck, and fugitive dust and off-road equipment. The Roadway Model contains a pre-defined set of commonly-used off-road construction vehicles with their emission rates calculated based on the input construction year and the corresponding emission factors, default horsepower values and load factors from the California Air Resources Board's (CARB) OFFROAD2007 emission model. The Roadway Model also embeds the emission rates for on-road vehicles from CARB's EMFAC2011 emission model. However, the Roadway Model does not contain emission information on either the helicopter for aerial spraying or barges and tug boats for material delivery. The emission rates of these two types of equipment have to be obtained from separate sources. In addition, the Roadway Model is designed to calculate emissions from the construction of typical roadway projects which normally contain the following four phases: Grubbing /Land Clearing, Grading /Excavation, Draining/Utilities/ Sub-Grade, and Paving. The Proposed Project, which consists of 27 tasks, cannot fit into the Roadway Model; therefore, the Roadway Model cannot be used directly calculate the emissions from the Proposed Project.

On the other hand, the Roadway Model embeds CARB's OFFROAD2007 model for off-road equipment and EMFAC2011 model for on-road vehicles, so it can be used to calculate the emission rates in masses of emissions per hour for the list of off-road construction equipment and emission rates in masses of emissions per Vehicle-Mile-Travelled (VMT) for on-road vehicles for each of the construction years. It also carries the emission rates of fugitive dust from soil disturbance activities in California.

Several Roadway Model projects (see Attachment 2) have been created to calculate emission rates of different types of emission sources for the years of 2018, 2019 and 2020.

Table 5-A of Attachment 1 contains the unit Hourly Emissions of Off-Road Construction Equipment calculated by using the Road Model. The results were obtained by creating a Roadway Model project with the following data entry: on the "Data Entry" sheet, set the Construction Start Year field to 2018, the Project Construction Time field to 48 months, the Construction Period Fields for each phase to 12 month (so the four phases of the project correspond to the years of 2018, 2019, 2020, and 2021). In the Equipment Section, override the horsepower fields by the values provided by Design Engineers, override the Number of Construction Vehicle with 1 and set the Hours per Day field to 1. The Roadway Model would automatically calculate the emissions of pollutants ROG, NOx, CO, PM_{10}, $PM_{2.5}$ andCO_2 from Off-Road Equipment for each phase. The Off-Road Equipment Emissions section for the "Grubbing/Land Clearing" phase (the first phase) contains the emission rates (in pounds per hour) for one piece of each type of the construction equipment for the year 2018, the section for the "Grading /Excavation" phase (the second phase) contains the emission rates for the year 2019, the section for the "Draining/Utilities/ Sub-Grade" phase (the third phase) contains the emission rates for the year 2020, and so on.

Table 5-B of Attachment 1 contains the unit Hourly Emissions for Pickups, Water Trucks, and Service Trucks. The results were obtained similarly with the following inputs to the Roadway Model project: set the Construction Start Year field to 2018, the Project Construction Time field to 48 months, the Construction Period Fields for each phase to 12 month. Enter the estimated miles travelled in one hour of a typical workday in the Worker Commute section for light-duty trucks and enter the vehicle miles travelled in one hour of a typical workday in the water truck section for heavy-duty trucks. For example, assume a water truck would travel 80 miles on an 8-hour workday, it would travel 10 miles in one hour of

operation, so enter 10 miles in the water truck section. The model would automatically calculate the hourly emissions of ROG, NOx, CO, PM_{10}, $PM_{2.5}$ and CO_2 for one piece of these on-road vehicles.

Table 5-C of Attachment 1 contains the unit daily emissions for Worker Commute. The results were obtained similarly with the following inputs to the Roadway Model project: set the Construction Start Year field to 2018, the Project Construction Time field to 48 months, the Construction Period Fields for each phase to 12 month. Enter the miles of work commute trips (30 miles per trip) and 2 one-way trips per day for each worker. The model would automatically calculate the emissions of ROG, NOx, CO, PM_{10}, $PM_{2.5}$ and CO_2 for one worker per day.

Table 5-D of Attachment 1 contains the Daily fugitive dust in forms of Particular Matter from one acre of land disturbance. The emission rates are copied from the Fugitive Dust section of the Roadway Model.

Table 5-E of Attachment 1 contains the emission rates in pounds per hour for a helicopter for herbicide spraying. The emission factors, loader factors and other assumptions are presented in detail in Attachment 4.

Table 5-F of Attachment 1 contains the emission rates in pounds per hour for barges for material delivery. The emission factors, loader factors and other assumptions are presented in detail in Attachment 3.

Table 5-H of Attachment 1 contains the emission rates in grams per mile for the years 2018 through 2020 for heavy On-Road trucks. These emission rates are also obtained in the Roadway Model.

With the emission rates for all types of emission sources ready, the emissions for each task can be calculated using one of the methods described below:

Emissions of off-road equipment, helicopter, and barges and tugboats can be calculated using the formula below.

Daily Emissions (masses per day)
= Emissions Rate (in masses per hour) x Number of Pieces of Equipment x Operation Hours per Day (default 8 hours per day)

Emissions (quantity in mass)
= Emissions Rate (in masses per hour) x Total Operation Hours

Emissions for Pickups, Water Trucks, or Service Trucks can be calculated using the formula

Daily Emissions (masses per day)
= Emissions Rate (in masses per hour) x Number of Vehicles x Operation Hours per Day (default 8 hours per day)

Emissions (quantity in mass)
= Emissions Rate (in masses per hour) x Total Operation Hours

Work Commute emission can be calculated using the formula

Daily Emissions (masses per day)
= Emissions Rate (in masses per worker per day) x Number of Workers

Emissions (quantity in mass)
= Emissions Rate (in masses per worker per day) x Total Worker-Days

Emissions of on-road vehicles for material and equipment delivery can be calculated using the formula

Daily Emissions (masses per day)
= Emissions Rate (in masses per VMT) x Maximum VMT on one day

Emissions (quantity in mass)
= Emissions Rate (in masses per VMT) x Total Operation VMT

Fugitive dust emissions from soil disturbance activities can be calculated using the formula

Daily Emissions (masses per day)
= Emissions Rate (in masses per acre of soil disturbed) x Maximum Daily Acres Disturbed

Emissions (quantity in mass)
= Emissions Rate (in masses per acre of soil disturbed) x Average Daily Acres Disturbed x Number of Days of Soil Disturbance Operation

The total emissions and daily emissions from material deliveries for each task are calculated in Tables 6s and Tables 7s of Attachment 1. The PM emissions from soil disturbance activities are shown in Table 8 of Attachment 1. The calculations of the emissions generated by each construction task from on-road vehicles, off-road equipment, helicopter, and work commute are shown in Table 9-01 through 9-27. The total emissions for a task can be obtained by summing up the emissions from all emissions sources associated to that task (Tables 6s through 9s of Attachment 1).

The total emissions for each construction year of 2018, 2019 and 2020 can be calculated with emissions of the 27 tasks and the construction timing information in Table 1 of Attachment 1. The emissions in one construction year are obtained by summing up the emissions from all the tasks that are carried out in that year. Notice that the time windows of a few tasks span two years, so the emissions of these tasks would be allocated to the years proportional to the number of workdays in each year. For example, if a task would take 10-workdays with 3 workdays in year 1 and 7 workdays in year 2, 30 percent of the emissions would be in year 1 and 70 percent in year 2. The Project emissions in the years of 2018, 2019 and 2020 were calculated this way. The calculation procedures for Option B are shown in Tables 10-A and 10 and those for Option A are shown in Tables 11-A and 11-B of Attachment 1.

The results of annual emissions are summarized in Table G-1 below.

Table G-1. Annual Project Construction Emissions

Option A: Material Delivery Using Trucks						
2018 Emissions (tons)	0.8	4.3	8.1	1.9	0.6	1337.1
2019 Emissions (tons)	2.1	15.0	20.9	2.2	1.0	3533.6
2020 Emissions (tons)	0.5	3.4	4.6	0.5	0.2	917.2
Maximum Annual Emissions (tons)	2.1	15.0	20.9	2.2	1.0	3533.6
Total Project Emissions (tons)	3.3	22.7	33.6	4.6	1.9	5788.0
Option B: Material Delivery Using Barges						
Pollutants	ROG	CO	NOx	PM_{10}	$PM_{2.5}$	CO_2
2018 Emissions (tons)	1.2	6.5	13.2	2.1	0.8	1888.7
2019 Emissions (tons)	2.1	15.0	20.9	2.2	1.0	3533.6
2020 Emissions (tons)	0.5	3.6	5.0	0.5	0.2	962.5
Maximum Annual Emissions (tons)	2.1	15.0	20.9	2.2	1.0	3533.6
Total Project Emissions (tons)	3.8	25.0	39.1	4.7	2.1	6384.8

Similarly the maximum daily emissions for a task can be obtained by combining the daily emissions of all emission sources of the task. This approach calculates the worst case scenario by assuming all construction equipment would be in operation on the same day, so the results would be very conservative. In addition, Table 1 of Attachment 1 identifies all possible sets of tasks whose time windows would overlap. The maximum daily emissions in a time period covered by multiple tasks can be obtained by combing the maximum daily emissions of the involved tasks. The maximum daily emissions for the whole project can be obtained by taking the maximum value from the maximum daily emission values of all 27 tasks and the maximum daily emissions of the overlapping tasks. The calculation procedures for the maximum daily emissions for Option B are shown in Tables 10-A and 10-B and those for Option A are shown in Tables 11-A and 11-B of Attachment 1. The Maximum Daily Construction Emissions are summarized in Table G-2.

Table G-2. Maximum Daily Construction Emissions

Construction Emissions						
Pollutants	ROG	CO	NOx	PM_{10}	$PM_{2.5}$	CO_2
Option A: Material Delivery Using Trucks						
Maximum Daily Emissions (pounds)	76.5	229.2	429.6	74.4	24.3	90,187
Option B: Material Delivery Using Barges						
Maximum Daily Emissions (pounds)	87.5	289.4	525.2	78.5	29.6	84,083

The Project's annual and daily construction emissions, the corresponding YSAQMD threshold values and the resulting CEQA determination are summarized in Table G-3.

Table G-3. Construction Emission Summary and YSAQMD Threshold Values

	Pollutants	ROG	CO	NOx	PM_{10}	$PM_{2.5}$	CO_2
Option A: Material Delivery Using Trucks	2018 Emissions (tons)	0.8	4.3	8.1	1.9	0.6	1,337
	2019 Emissions (tons)	2.1	15.0	**20.9**	2.2	1.0	3,534
	2020 Emissions (tons)	0.5	3.4	4.6	0.5	0.2	917.2
	Maximum Annual Emissions (tons)	2.1	15.0	**20.9**	2.2	1.0	3,534
	Total Project Emissions (tons)	3.3	22.7	33.6	4.6	1.9	5,788
	YSAQMD Significance Threshold (tons)	**10**		**10**			
	YSAQMD Significance Threshold (tons)	No		**Yes**			
	Maximum Daily Emissions (pounds/day)	76.5	229.2	429.6	74.4	24.3	90,187
	YSAQMD Significance Threshold (pounds/day)				**80**		
	Significance Determination				No		
Option B: Material Delivery Using Barges	2018 Emissions (tons)	1.2	6.5	**13.2**	2.1	0.8	1,889
	2019 Emissions (tons)	2.1	15.0	**20.9**	2.2	1.0	3,534
	2020 Emissions (tons)	0.5	3.6	5.0	0.5	0.2	963
	Maximum Annual Emissions (tons)	2.1	15.0	**20.9**	2.2	1.0	3,534
	Total Project Emissions (tons)	3.8	25.0	39.1	4.7	2.1	6,385
	YSAQMD Significance Threshold (tons)	**10**		**10**			
	Significance Determination	No		**Yes**			
	Maximum Daily Emissions (pounds/day)	87.5	289.4	525.2	78.5	29.6	84,083
	YSAQMD Significance Threshold (pounds/day)				80		
	Significance Determination				No		

Table G-3 indicates that both options would have significant impacts in terms of annual NOx emissions, while the annual ROG emissions and maximum daily PM10 emissions would not exceed the threshold value and would have less than significant impacts. In addition, the annual NOx emissions are more than twice of the YSAQMD emission threshold value. Table G-3 also shows that the Option B Barges would generate more emissions than Option A Trucks.

Attachment 1

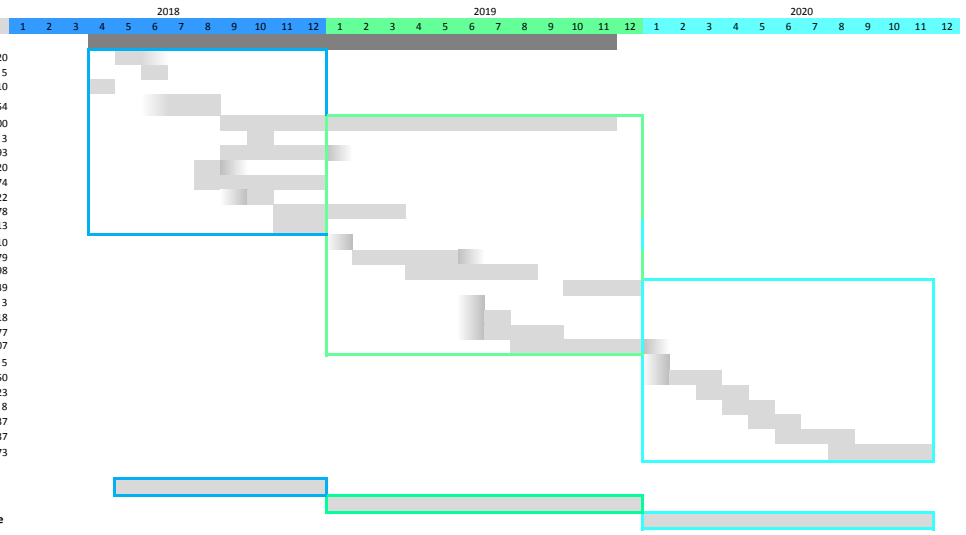
Air Pollutant Emission Calculation Datasheets

Table 1-A: Construction Tasks

	Tasks	Start Date	End Date	Construction Year
Task01	South Property Levee Repair	5/9/2019	6/5/2019	2019
Task02	Plug Existing Culvert	6/6/2019	6/12/2019	2019
Task03	Terrestrial Species control	4/10/2019	4/23/2019	2019
Task04	Initial Dewatering (Surface Water)	6/13/2019	8/27/2019	2019
Task05	Maintenance Dewatering (Groundwater)	9/11/2019	11/4/2020	2019-2020
Task06	Aquatic Species control	10/1/2019	10/3/2019	2019
Task07	Clearing and Grubbing	9/11/2019	1/17/2020	2019-2020
Task08	Construct Ramps	8/28/2019	9/24/2019	2019
Task09	Construct Access Roads	8/28/2019	12/7/2019	2019
Task10	Interior Staging Area Construction	9/25/2019	10/24/2019	2019
Task11	Old infrastructure removal	11/20/2019	3/7/2020	2019-2020
Task12	Remove Pump Stations (6)	11/20/2019	12/6/2019	2019
Task13	Breach (Cross Levee)	1/18/2020	1/31/2020	2020
Task14	Interior Channel Network	2/15/2020	6/5/2020	2020
Task15	Dry Excavated Material	3/29/2020	8/13/2020	2020
Task16	Remove existing Pump (Southeast corner)	10/1/2020	12/6/2020	2020
Task17	Fill Agricultural Ditches	6/6/2020	6/10/2020	2020
Task18	Construct Interior Mounds	6/11/2020	7/4/2020	2020
Task19	Construct Eastern Toe Berm	6/6/2020	9/20/2020	2020
Task20	Construct Intertidal Bench	8/14/2020	1/9/2021	2020-2021
Task21	Fill borrow ditch	1/20/2021	1/24/2021	2021
Task22	Dredge Miner Slough	1/10/2021	3/19/2021	2021
Task23	Remove Access Roads	3/20/2021	4/21/2021	2021
Task24	Remove Ramps	4/22/2021	5/1/2021	2021
Task25	Breach (Northern Breach)	5/4/2021	6/23/2021	2021
Task26	Breach (Southern Breach)	6/24/2021	8/13/2021	2021
Task27	Planting and revegetation	8/14/2021	11/24/2021	2021

Table 1-B Estimated Construction Implementation Timing (Table 2.2-6. of the DEIR)

	Proposed Project	Start Date	End Date	notes	num of workdays
Construction Tasks		**5/9/2019**	**11/4/2020**		
Task01	South Property Levee Repair	5/9/2019	6/5/2019		20
Task02	Plug Existing Culvert	6/6/2019	6/12/2019		5
Task03	Terrestrial Species control	4/10/2019	4/23/2019		10
Task04	Initial Dewatering (Surface Water)	6/13/2019	8/27/2019		54
Task05	Maintenance Dewatering (Groundwater)	9/11/2019	11/4/2020		300
Task06	Aquatic Species control	10/1/2019	10/3/2019		3
Task07	Clearing and Grubbing	9/11/2019	1/17/2020		93
Task08	Construct Ramps	8/28/2019	9/24/2019		20
Task09	Construct Access Roads	8/28/2019	12/7/2019		74
Task10	Interior Staging Area Construction	9/25/2019	10/24/2019		22
Task11	Old infrastructure removal	11/20/2019	3/7/2020		78
Task12	Remove Pump Stations (6)	11/20/2019	12/6/2019		13
Task13	Breach (Cross Levee)	1/18/2020	1/31/2020		10
Task14	Interior Channel Network	2/15/2020	6/5/2020		79
Task15	Dry Excavated Material	3/29/2020	8/13/2020		98
Task16	Remove existing Pump (Southeast corner)	10/1/2020	12/6/2020		49
Task17	Fill Agricultural Ditches	6/6/2020	6/10/2020		3
Task18	Construct Interior Mounds	6/11/2020	7/4/2020		18
Task19	Construct Eastern Toe Berm	6/6/2020	9/20/2020		77
Task20	Construct Intertidal Bench	8/14/2020	1/9/2021		107
Task21	Fill borrow ditch	1/20/2021	1/24/2021		5
Task22	Dredge Miner Slough	1/10/2021	3/19/2021		50
Task23	Remove Access Roads	3/20/2021	4/21/2021		23
Task24	Remove Ramps	4/22/2021	5/1/2021		8
Task25	Breach (Northern Breach)	5/4/2021	6/23/2021		37
Task26	Breach (Southern Breach)	6/24/2021	8/13/2021		37
Task27	Planting and revegetation	8/14/2021	11/24/2021		73



Construction Phases for Air Quality Calculation

2018 Construction
2019 Construction
2020 Construction Phase

Overlapping Tasks

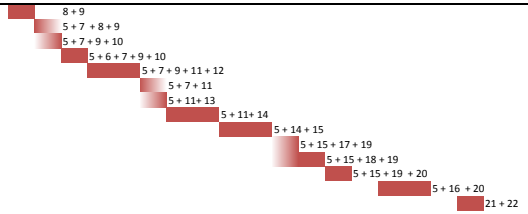


Table 2 Timing, Equipment and Other Details of Construction Tasks

Index Number	Task	Quantities	Current PD Table 2.2-2	Units	Acreage	Start Date	End Date	Production Rate	Description/Notes/Assumptions	Days	Equipment List and hours																																					
											815F Sheepfoot Compactor		RT Sheepfoot 60"		Barge Mounted Dredge		D-6H Dozer		LGP 325L Excavator		LGP 375L Excavator		Telescopic Handler (Forklift)		950G Rubber Tire Loader		140H Motor Grader		Cat. 740C Offroad Dump Tru		10 Wheel Dump 10 TON		Semi End Dump 20 TON		Water Truck 3600 gallon		Foreman Op PU 4x2 TON		Service Truck		Pickup 4x4 3/4 TON		Flatbed 2 TON		RT Crane 30 Ton		RT Crane 60 Ton		Small Generator (5 kW?)		Large Generator (25kW?)		Concrete Crane Pump Truck		Helicopter		Drill Rig		Tub Grinder	
											QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]	QTY	HRS[1]
1	**South Property Levee Repair**					5/9/2018	6/5/2018			**15**																							1	60																		
	- Fill Placement	4,500	3000	CY	0.6	5/22/2018	5/28/2018		50% increase for imported material	15	2	240					2	240									2	240							1	60					1	120												
	- Sheet Piles	200	200	LF		5/11/2018	5/21/2018	30 LF/day	Unrealistic increase is needed. % increase not incorporated	7													1	21															1	14							1	56			1	56				
	- Geotextile	10,000	10,000	SQ FT		5/29/2018	5/29/2018			2													1	16																	1	8			1	16						
	- Stone Armoring (Rip Rap)	400	200	TONS		5/30/2018	6/5/2018		100% increase for imported material	5											1	40																					1	20										
2	**Plug Existing Culvert**					5/9/2018	5/11/2018			**3**																							1	12																		
	- Remove Gangway and Gate	NA								1																											1	8					1	8			1	8				
	- Seal end of pipe	NA							Pipe est. 4' Dia x 80' long	1																													1	8							1	8				
	- Fill pipe with Concrete/CLSM	40		CY				8 CY/truck	est. 37 CY (round up to 40 CY)	1																																								1	4		
3	**Terrestrial Species control**					4/10/2018	4/23/2018			**27**																							1	108																		
	- Spot Treatment	6.4	6.4	ACRE						27																													1	160												
4	**Initial Dewatering (Surface Water)**					6/13/2018	8/27/2018		Assume discharge from North to South & South to North to avoid the need for settling ponds	**76**																									1	152																		
	- Sheet Piles	660	660	LF		6/15/2018	6/22/2018	30 LF/day		22													2	132															1	44							2	352			2	352				
	- Place & Compact Fill for Pump Platforms	1,560	1560	CY		6/22/2018	6/28/2018			7			2	56							2	112			1	28													1	28												
	- Excavate Sumps	(500)	6	CY		6/29/2018	6/29/2018		Assume excavate 50'x10'x5' w/ 2:1 sloped sump pit	1											2	16										8	64									1	4												
	- Setup/Install Temporary Pumps & Pipes	Job	6	Job		7/2/2018	7/6/2018		6 pumpstations & discharge pipe	10													1	80															1	20					1	80			1	20				
	- Clear Existing Agricultural Ditches & Move trapped water to pumps	21	21	AC	62	7/9/2018	7/30/2018			16							1	16			3	384										9	1152									1	32										
	- Pumping	20	NA	Days		7/31/2018	8/27/2018		Assumptions: 1 generator for each pump platform (6 total). 24/7 pumping.	20																											1	480											6	2880				
5	**Maintenance Dewatering (Groundwater)**					9/11/2018	11/4/2019			**300**																																									
	- drill wells	10	NA	EA					Qty estimated. Not clear what is needed for dewatering	30																											1	60							1	60							1	240		
	- Excavate Sumps	6	NA	EA					Qty estimated. Not clear what is needed for dewatering	10											1	80										2	160									1	40												
	- Setup/Install Temporary Pumps & Pipes	Job		Job					Equals -> # pumps x 3-days	120													1	960															1	240			1	960			1	240				
	- Pumping	140	NA	Days					Assume 10 day/month (8 hrs/day) for 14 months following surface dewatering. Assume half the pumps are operational at any one time (2 pumps per generator)	140																											1	1120											8	8960				
6	**Aquatic Species control**					10/1/2018	10/31/2018			**1**																									1	32																
	- Aquatic aerial spraying	411	1256	ACRE	411			250 Ac/Hr	Time inlcudes travel to and from site. Production rate based off of info received from Gina.	1																																											1	8		
7	**Clearing**					9/11/2018	1/17/2019			**93**																									1	372																
	- Clear and Grub	156	1256	ACRE	156				Trucks for removal are in "Deliveries"	93							6	4464	2	744					1	744			2	744					2	1488					1	186												
	- Clear and Disk	504			504																																													1	290
8	**Construct Ramps**					8/28/2018	9/24/2018		12 ramps	**16**																									1	32																
	- Grade/Prep subbase	NA	8000							6			1	24			1	48							1	48																								
	- Place and Compact Fill	7,500		CY	1					8			2	128			2	128									2	128							2	64					1	16						
	- Place and Compact AB	500		CY	1					2			2	32			2	32									2	32							2	16					1	4						
9	**Construct Access Roads**					8/28/2018	12/7/2018		If site cannot be dewatered	**64**																									1	128																
	- Grade subbase	NA	NA							18			1	72			1	144							1	144																								
	- Geotextile	10,000	10,000	SQ FT						2													1	16																	1	8			1	16						
	- Place and Compact Fill	39,000	26000	CY	16.1				50% increase for imported material	38			2	608			2	608									2	608							2	304					1	76												
	- Place and Compact AB	3500	NA	CY						6			2	96			2	96									2	96							2	48					1	12						
10	**Temporary Staging Areas**					9/25/2018	10/24/2018			18																									1	36																
	- Place and Compact AB	30000	20000	CY	31.8				50% increase for imported material	18			2	288			2	288									2	288							2	144																
11	**Old infrastructure removal**					11/20/2018	3/7/2019			**5**																									1	10																
	- Remove Abandoned structures	2	NA	EA					Trucks for removal are in "Deliveries"	5							1	40			1	40																			1	20												
12	**Remove Pump Stations (6)**					11/20/2018	12/6/2018			**13**																									1	52																
	- Remove Pumps and Piping	Job		Job						5													1	40													1	10					1	40			1	10				
	- Excavate Fill for Pump Platforms	(1,560)		CY	0.25					3											1	24									3	72	1	24					1	12										
	- Remove Sheetpiles	(660)		LF				150 LF/day		5													1	15													1	10							1	40			1	40		
13	**Excavate (Cross Levee)**					1/18/2019	1/31/2019			**20**																									1	80																
	- construct breach	(20,000)	20000	CY	2					20											2	320									6	960	1	160					1	80												
14	**Interior Channel Network**					2/15/2019	6/5/2019			**79**																									1	316																
	- Excavate Interior Tapered Connections	(61,000)	61,000	CY	59.4					56											3	1344									9	4032	1	448					1	224												
	- Excavate Interior Channel Network	(335,200)	335,200	CY					includes transport within island	79											6	3792									18	11376	2	1264					1	316												
15	**Dry Excavated Material**		NA			3/29/2019	8/13/2019			**98**																																									
	- Transport/Spread material for drying	396,200		CY	0					98							3	2352							3	2352							1	392					1	784												

| | | |

Table 3-A Construction Equipment Descriptions

	Type of Equipment	HorsePower	Source
1	815F Sheepfoot Compactor	253	http://www.ritchiespecs.com/specification?type=&category=Compactor&make=Caterpillar&model=815F&modelid=93380
2	RT Sheepfoot 60"	148	http://www.constructionequipment.com/volvo-sd75b-sd115b-gives-operator-control
3	Barge Mounted Dredge	Based one excavator	
4	D-6H Dozer	165	http://www.ritchiespecs.com/specification?type=Con&category=Crawler+Tractor&make=Caterpillar&model=D6H+LGP&modelid=103768
5	LGP 325L Excavator	168	http://www.ritchiespecs.com/specification?type=Construction+Equipment&category=Hydraulic+Excavator&make=Caterpillar&model=325B+L&modelid=104006
6	LGP 375L Excavator	428	http://www.ritchiespecs.com/specification?type=&category=Hydraulic+Excavator&make=Caterpillar&model=375&modelid=92911
7	Telescopic Handler (Forklift)	135	http://www.ritchiespecs.com/specification?type=&category=Telescopic+Forklift&make=Caterpillar&model=TL1255&modelid=94392
8	950G Rubber Tire Loader	130	http://www.ritchiespecs.com/specification?type=Con&category=Wheel+Loader&make=Caterpillar&model=950&modelid=91545
9	140H Motor Grader	185	http://www.ritchiespecs.com/specification?type=&category=Motor+Grader&make=Caterpillar&model=140H&modelid=91709
10	10 Wheel Dump 10 TON	290	http://www.ritchiewiki.com/wiki/index.php/Dump_Truck
11	Semi End Dump 20 TON	445	http://www.ritchiespecs.com/specification?category=Articulated+Dump+Truck&make=CATERPILLAR&model=740&modelid=91910
12	Water Truck 3600 gallon	275	http://www.truckpaper.com/list/list.aspx?catid=240&Manu=KENWORTH&bcatid=27
13	Foreman Op PU 4x2 TON	75	https://books.google.com/books?id=ovglY5i7R3YC&pg=SA2-PA188&lpg=SA2-PA188&dq=Pickup+4x2+Ton+hp&source=bl&ots=OS98VoVo3K&sig=Wq_AuZvKfQm8qupitBJG689pbvk&hl=en&sa=X&ved=0CB4Q6AEwAGoVChMIs-bGkczvxgIVDaWICh0CPACz#v=onepage&q=Pickup%204x2%20Ton%20hp&f=false
14	Service Truck	300	http://www.truckpaper.com/list/list.aspx?catid=267&Manu=ISUZU&bcatid=27
15	Pickup 4x4 3/4 TON	130	https://books.google.com/books?id=ovglY5i7R3YC&pg=SA2-PA188&lpg=SA2-PA188&dq=Pickup+4x4+3/4+Ton+hp&source=bl&ots=OS98VoVp7P&sig=q2o3Dv6CrwJoXadEYuHiDBnNahE&hl=en&sa=X&ved=0CD8Q6AEwBWoVChMIopGA18zvxgIVDJyICh06BwKL#v=onepage&q=Pickup%204x4%203%2F4%20Ton%20hp&f=false
16	Flatbed 2 TON	275	http://www.commercialtrucktrader.com/Chevrolet-Flatbed-Dump-Trucks-For-Sale/search-results?category=flatbed%20dump%7C2011212&make=CHEVROLET%7C2309502
17	RT Crane 30 Ton	152	http://www.kellytractor.com/eng/images/pdf/cranes/rt8030f.pdf
18	RT Crane 60 Ton	270	http://www.linkbelt.com/lit/pdf/rtc/8065ii/rt8065iit.pdf
19	Small Generator (5 kW?)	6.7	Calculated directly
20	Large Generator (25kW?)	33.5	Calculated directly
21	Concrete Crane Pump Truck	330	http://www.constructionequipment.com/concrete-pumps
22	Helicopter	317	https://en.wikipedia.org/wiki/Bell_206
23	Drill Rig	Hydraulic 200 hp, truck 213 hp	http://www.mobiledrill.net/new-drill-rigs/MS1000
24	Tub Grinder	350	http://www.urcrecycle.com/category/tub-grinder/

Table 3-B Equipment Mobilization and Demobilization

Mobilization & Demobilization

Type of Equipment	Max # Equipment Required	Delivery Equipment	Roundtrip Distance to manufacturer (miles)	Assumed source	Mobilization Miles Travelled[2]	Demobilization Miles Travelled[2]	Total Miles Travelled[2]
815F Sheepfoot Compactor	6	Lowboy truck/trailer	30	From Dutra in Rio Vista	180	180	360
RT Sheepfoot 60"	2	Lowboy truck/trailer	30	From Dutra in Rio Vista	60	60	120
D-6H Dozer	6	Lowboy truck/trailer	30	From Dutra in Rio Vista	180	180	360
325L Excavator	2	Lowboy truck/trailer	30	From Dutra in Rio Vista	60	60	120
375L Excavator	6	Lowboy truck/trailer	30	From Dutra in Rio Vista	180	180	360
Telescopic Handler	2	Lowboy truck/trailer	30	From Dutra in Rio Vista	60	60	120
950G Rubber Tire Loader	2	Lowboy truck/trailer	30	From Dutra in Rio Vista	60	60	120
140H Motor Grader	6	Lowboy truck/trailer	30	From Dutra in Rio Vista	180	180	360
10 Wheel Dump 10 TON	8	Self delivered	30	From Dutra in Rio Vista	240	240	480
Semi End Dump 20 TON	18	Self delivered	30	From Dutra in Rio Vista	540	540	1080
Water Truck 3600 gallon	3	Self delivered	30	From Dutra in Rio Vista	90	90	180
4 Man Op PU 4x2 TON	1	Self delivered	30	From Dutra in Rio Vista	30	30	60
Pickup 4x2 1 TON	1	Self delivered	30	From Dutra in Rio Vista	30	30	60
Pickup Flatbed 4x4 3/4 TON	2	Self delivered	30	From Dutra in Rio Vista	60	60	120
Flatbed 2 TON	1	Self delivered	30	From Dutra in Rio Vista	30	30	60
RT Crane 60 Ton	2	Self delivered	60	med from vendor in Sacram	120	120	240
Generator	8	Pickup truck/1 each	60	Rent Construction Yard Sacra	480	480	960
Well Augur Rig	1	Lowboy truck/trailer	60	Rent Construction Yard Sacra	60	60	120
Helicopter	1	Self delivered	60	Sacramento	60	60	120
Total # Trips	156	**Avg Distance**	36.31578947			**Total Miles**	5400

[1] Total Miles = Qty x Roundtrip Distance

[2] Total Miles = # Equipment x Roundtrip Distance

Table 4 Material Deliveries

Material Transportation

Type of material	Quantity	Current PD Table 2.2-2	Unit	Method of Transportation	Capacity per trip (unit/trip)	Roundtrip Distance to manufacturer (miles)	Assumed Source/Destination	Total Miles Travelled[1]	
Geotextile	20,000	20,000	SF	Flatbed	10,000	60	From stockpiles in Sacramento	120	
Sheet Piles	860	2520	LF	FLATBED	5 pile pairs/truck	166	From LB Foster Piling vendor in Union City	4759	6 LF = 1 pile pair
Concrete	62		CY	Concrete Truck	8	60	From Sacramento	465	
Plants	50		trips	Truck		60	From Sacramento	3000	~49 Acres of plantings & hydro-seed per Stillwater (assume 1 trip per acre)
Fuel	45		trips	Refueling Truck		60	From Sacramento	2700	Assume refueling trip every-other day during Surface Dewatering. Trip every 4 days during Maintenance De

Import Fill Material - By Barge

Type of material	Quantity	Current PD Table 2.2-2	Transport method	Unit	Capacity per trip (Unit/trip)	Conversion (Ton/CY)	# of Trips	Roundtrip Distance to manufacturer (miles)	Operation Speed (MPH)	Assumed Source/Destination	Total Hours of Operation	Total Miles Travelled	
Import Fill	59160	117120	Truck	CY	10	Already in CY/trip	5916	1		from source to barge		5916	assume 10 CY end-dum
			Barge		4000	1.3	20	14	4	Fill from Dutra in Rio Vista	70		
			Truck		10	Already in CY/trip	5916	3		Barge to Placement Location		17748	assume 10 CY end-dum

Rip Rap Material - By Barge

Type of material	Quantity	Current PD Table 2.2-2	Transport method	Unit	Capacity per trip (Unit/trip)	Conversion (Ton/CY)	# of Trips	Roundtrip Distance to manufacturer (miles)	Operation Speed (MPH)	Assumed Source/Destination	Total Hours of Operation	Total Miles Travelled	
Rip Rap	1,640	1640	Truck	Ton	22	Already in Ton/trip	75	1		from source to barge		75	assume 22 Ton capacit
			Barge		4000	Already in Ton/trip	1	14	4	Fill from Dutra in Rio Vista	4		
			Truck		22	Already in Ton/trip	75	3		Barge to Placement Location		225	assume 22 Ton capacit

Aggregate Base Material - By Barge

Type of material	Quantity	Current PD Table 2.2-2	Transport method	Unit	Capacity per trip (Unit/trip)	Conversion (Ton/CY)	# of Trips	Roundtrip Distance to manufacturer (miles)	Operation Speed (MPH)	Assumed Source/Destination	Total Hours of Operation	Total Miles Travelled	
Agg. Base	34000	NA	Truck	CY	10	Already in CY/trip	3400	1		from source to barge		3400	assume 10 CY end-dum
			Barge	CY	4000	1.3	12	14	4	Fill from Dutra in Rio Vista	42		
			Truck	CY	10	Already in CY/trip	3400	3		Barge to Placement Location		10200	assume 10 CY end-dum

Import Material - By Truck

Type of material	Quantity	Current PD Table 2.2-2	Unit	Method of Transportation	Capacity per trip (unit/trip)	Roundtrip Distance to manufacturer (miles)	Assumed Source/Destination	Total Miles Travelled[1]	
Import Fill	59160	117120	CY	18 Wheel Truck	20	60	Fill from Dutra in Rio Vista	177480	assume 20 CY capacity transfer-truck
Rip Rap	1,640	1640	Tons	18 Wheel Truck	22	60	Assuming taken from Rio Vista stockpiles	4473	assume 22 Ton capacity end-dump truck
AB	34000	NA	CY	18 Wheel Truck	20	60	From Dutra in Rio Vista	102000	assume 20 CY capacity transfer-truck
	94,800								

Table 5-A Off-Road Construction Equipment Hourly Emissions from Road Construction Emissions Mode

Emission rates are from Road Construction Emissions Model, Version 7.1.5.1

Each phase is set to 12 months, so Grubbing/Land Clearing phase is for year 2018, Grading/Excavation phase is for year 2019, Drainage/Utilities/Sub-Grade phase is for year 2020 and paving phase is for year 2021

	for Equipment Set A						
	for Equipment Set B	0.094386888	0.827737072	1.07404558	0.04067996	0.037425564	158.7796329

	Road Construction Emissions Model Assumptions	2018 Emissions (pounds per hour)						2019 Emissions (pounds per hour)						2020 Emissions (pounds per hour)					
		ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
815F Sheepfoot Compactor	Roller, 253 horsepower	0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	0.051235	0.599447	0.608108	0.023191	0.021336	111.030330	0.051429	0.599446	0.591347	0.022878	0.021047	111.030255
RT Sheepfoot 60"	Roller, 148 horsepower	0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	0.029554	0.345280	0.330170	0.015159	0.013946	63.953141	0.027551	0.345245	0.299880	0.013775	0.012673	63.946723
Barge Mounted Dredge	Crane, 270 horsepower	0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	0.057492	0.447929	0.661777	0.026526	0.024404	89.699404
Dozer (D-6H Dozer)	Crawler Tractors, 165 horsepower	0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	0.084311	0.440765	0.838724	0.046690	0.042955	81.344350	0.077651	0.440637	0.759299	0.042419	0.039025	81.320666
LGP 325L Excavator	Excavator, 168 horsepower	0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	0.036417	0.359917	0.357912	0.017261	0.015880	73.927125	0.034218	0.359992	0.321981	0.015596	0.014349	73.942541
LGP 375L Excavator	Excavator, 428 horsepower	0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	0.061076	0.914181	0.640802	0.020808	0.019143	187.773277	0.057797	0.913251	0.565964	0.018647	0.017155	187.582279
Telescopic Handler (Forklift)	Forklift, 142 horsepower	0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	0.025155	0.179179	0.242958	0.013213	0.012156	32.881502	0.022246	0.179179	0.208696	0.011297	0.010393	32.881502
950G Rubber Tire Loader	Rubber Tire Load, 225 horsepower	0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	0.058060	0.438594	0.671416	0.022512	0.020711	93.296359	0.054465	0.438454	0.613435	0.020364	0.018735	93.266561
140H Motor Grader	Grader, 185 horsepower	0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	0.062738	0.455483	0.810345	0.026007	0.023927	87.778585	0.061334	0.455049	0.779056	0.024906	0.022913	87.695050
RT Crane 30 Ton	Crane, 152 horsepower	0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	0.057305	0.253275	0.573777	0.030647	0.028195	50.719322	0.054200	0.253254	0.537233	0.028727	0.026429	50.715012
RT Crane 60 Ton	Crane, 270 horsepower	0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	0.057492	0.447929	0.661777	0.026526	0.024404	89.699404
Small Generator	Generate Set, 10 horsepower	0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	0.010929	0.058221	0.076170	0.003800	0.003496	9.263039	0.010670	0.057976	0.074537	0.003611	0.003322	9.263038
Large Generator	Generate Set, 33.5 horsepower	0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	0.046855	0.230547	0.240499	0.013700	0.012604	31.031175	0.042379	0.227131	0.234202	0.012340	0.011352	31.031175
Concrete Crane Pump Truck	Other material handling equipment, 330 horsepower	0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	0.087493	0.780438	0.968534	0.036707	0.033770	149.706511	0.084951	0.780438	0.922264	0.034414	0.031661	149.706511
Tub Grinder	Other material handling equipment, 350 horsepower	0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	0.092796	0.827737	1.027233	0.038932	0.035817	158.779633	0.090100	0.827737	0.978159	0.036500	0.033580	158.779633
Drill Rig	Drill Rig, 206 horsepower default value	0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	0.034211	0.472337	0.431914	0.012249	0.011269	117.571065	0.033980	0.473745	0.412080	0.011873	0.010923	117.921634
10 Wheel Dump 10 TON	Off-Highway Trucks, 290 horsepower	0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	0.067273	0.388525	0.650970	0.023672	0.021779	128.325967	0.062838	0.388319	0.572483	0.020858	0.019189	128.257698
Semi End Dump 20 TON	Off-Highway Trucks, 490 horsepower	0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	0.113668	0.656474	1.099915	0.039998	0.036798	216.826634	0.106175	0.656125	0.967299	0.035242	0.032423	216.711283

Table 5-B Hourly Emissions for Pickup Trucks, Water Trucks, Service Trucks from Road Construction Emissions Model

Equipment	Road Construction Emissions Model Assumptions	2018 Hourly Emissions for Each Vehicle(pounds per hour)						2019 Hourly Emissions for Each Vehicle(pounds per hour)						2020 Hourly Emissions for Each Vehicle(pounds per hour)					
		ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
Foreman Op PU 4x2 TON	Road Construction Emissions Model, light duty truck, assume 100 miles per day	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047
Pickup 4x4 3/4 TON	Road Construction Emissions Model, light duty truck, assume 100 miles per day	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047
Water Truck	Road Construction Emissions Model (assume 40 miles per day)	0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	0.001682	0.007622	0.064722	0.001717	0.000979	17.582528	0.001726	0.007867	0.051457	0.001710	0.000974	17.165125
Service Truck	Road Construction Emissions Model, use water truck (heavy-duty truck assume 100 miles per day)	0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	0.004316	0.019668	0.128643	0.004276	0.002434	42.912812
Flatbed 2 TON	Road Construction Emissions Model, use water truck (heavy-duty truck assume 100 miles per day)	0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	0.004316	0.019668	0.128643	0.004276	0.002434	42.912812

Table 5-C Daily Worker Commute Emissions from Road Construction Emissions Model

	Road Construction Emissions Model Assumptions	2018 Daily Emissions for Each Worker (pounds per day)						2019 Daily Emissions for Each Worker (pounds per day)						2020 Daily Emissions for Each Worker (pounds per day)					
		ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
Worker Commute	Road Construction Emissions Model, work commute emissions (30 miles one way, one round-trip per day	0.0177	0.1999	0.0215	0.0062	0.0026	59.0842	0.0165	0.1843	0.0195	0.0062	0.0026	58.8018	0.0155	0.1704	0.0179	0.0062	0.0026	58.8177

Table 5-D Daily PM Emissions for Each Acre of Land Disturbance from Road Construction Emissions Model

	Road Construction Emissions Model Assumptions	Daily PM Emissions for Each Acre of Land (pounds per day)					
		ROG	CO	NOx	PM10	PM2.5	CO2
Land Disturbed					10.0000	2.0800	

Table 5-E Hourly Emissions for Helicopter

	Assumptions	Emissions (pounds per hour)					
		ROG	CO	NOx	PM10	PM2.5	CO2
Helicopter	See Appendix 2: Helicoptor Emission	6.11248	7.76420	3.92819	0.12203	0.12203	1993.01329

Table 5-F Hourly for Barge and Tug boat

	Assumptions	Emissions (pounds per hour)					
		ROG	CO	NOx	PM10	PM2.5	CO2
Barge and Tug Boat	See Appendix 1: Emissions from Barges and Tug Boat	1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034

Table 5-G Emissions Per Vehicle-Miles-Travelled for On-road Trucks

	Road Construction Emissions Model Assumptions	2018 Emissions Rates (grams per mile)						2019 Daily Emissions for Each Worker (pounds per day)						2020 Daily Emissions for Each Worker (pounds per day)					
		ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
Heavy On-Road Trucks	from the water truck section of the Roadway Model	0.14913143	0.673237769	6.662928787	0.155946827	0.089010566	1624.614821	0.152689658	0.692092622	5.876773556	0.155859671	0.088930381	1596.493543	0.156764041	0.714336426	4.672320593	0.155299655	0.088415167	1558.593331

Materials Deliveries Part I: Geotextile, Sheet Piles, Concrete, and Fuel etc

Table 6-1: emissions from importing geotextile, sheet piles, concrete and fuel

Task #	Tasks	Start	End	Year	Materials	Quantity	Unit	Method	Capacity per trip (unit/trip	Trips	Miles per Trip	Vehicle Miles	Emission rate (grams/mile) ROG	CO	NOx	PM10	PM2.5	CO2	Total Emissions (pounds) ROG	CO	NOx	PM10	PM2.5	CO2
T-01	South Property Levee Repair	5/9/2018	6/5/2018	2018	Geotextile	10000	SQ FT	trucks	10000	1	60	60	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.01973	0.08905	0.88136	0.02063	0.01177	214.90088
					Sheet Piles	200	LF	trucks	30	7	166	1162	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.38204	1.72469	17.06899	0.39958	0.22803	4161.91967
T-02	Plug existing culvert	6/6/2018	6/12/2018	2018	Concrete	40	CY	trucks	8	5	60	300	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.05863	0.44527	4.40680	0.10314	0.05887	1074.50439
T-04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	Sheet Piles	660	LF	trucks	30	22	166	3652	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	1.20071	5.42046	53.64540	1.25558	0.71665	13080.30017
					Pump Fuel	10	trips	trucks	1	10	60	600	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.19727	0.89055	8.81359	0.20628	0.11774	2149.00878
T-05	Maintenance Dewatering (Groundwater)	9/11/2018	11/4/2019	2018-2019	Pump Fuel	35	trips	trucks	1	35	60	2100	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.69044	3.11691	30.84757	0.72199	0.41210	7521.53073
T-09	Construct Access Roads	8/28/2018	12/7/2018	2018	Geotextile	10000	SQ FT	trucks	10000	1	60	60	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.01973	0.08905	0.88136	0.02063	0.01177	214.90088
T-16	Remove existing Pump (Southeast corner)	10/27/2019	12/6/2019	2019	Concrete	22	CY	trucks	8	3	60	180	0.15269	0.69209	5.87677	0.15586	0.08893	1596.49354	0.06059	0.27465	2.33210	0.06183	0.03529	633.54315
T-27	Planting and revegetation	8/14/2020	11/24/2020	2020	Plants	50	trips	trucks	1	50	60	3000	0.15676	0.71434	4.67232	0.15530	0.08842	1558.59333	1.03682	4.72455	30.90227	1.02714	0.58477	10308.38421

Materials Deliveries Part II : Rip Rap, Fill Material and Aggregate Base

Option A: Imported by trucks

Table 6-2-A Option A Emissions (emissions from trucks)

Task #	Tasks	Start	End	Year	Materials	Quantity	Unit	Method	Capacity per trip (unit/trip	Trips	Miles per Trip	Vehicle Miles	Emission rate (grams/mile) ROG	CO	NOx	PM10	PM2.5	CO2	Total Emissions (pounds) ROG	CO	NOx	PM10	PM2.5	CO2
T-01	South Property Levee Repair	5/9/2018	6/5/2018	2018	Rip Rap	400	tons	trucks	22	19	60	1140	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.37	1.65	16.75	0.38	0.22	4083.12
					Fill Material	4500	cy	trucks	20	225	60	13500	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	4.44	20.04	198.31	4.64	2.65	48352.70
T-04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	Fill Material	1560	cy	trucks	20	78	60	4680	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	1.54	6.95	68.75	1.61	0.92	16762.27
T-08	Construct Ramps	8/28/2018	9/24/2018	2018	Fill Material	7500	cy	trucks	20	375	60	22500	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	7.40	33.40	330.51	7.74	4.42	80587.83
					Aggregate Base	500	cy	trucks	20	25	60	1500	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.49	2.23	22.03	0.52	0.29	5372.52
					Rip Rap	1000	tons	trucks	22	46	60	2760	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.91	4.10	40.54	0.95	0.54	9885.44
T-09	Construct Access Roads	8/28/2018	12/7/2018	2018	Fill Material	39000	cy	trucks	20	1950	60	117000	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	38.47	173.66	1718.63	40.23	22.96	419056.71
					Aggregate Base	3500	cy	trucks	20	175	60	10500	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	3.45	15.58	154.24	3.61	2.06	37607.65
T-10	Interior Staging Area Construction	9/25/2018	10/24/2018	2018	Aggregate Base	30000	cy	trucks	20	1500	60	90000	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	29.59	133.58	1322.04	30.94	17.66	322351.32
T-22	Dredge Miner Slough	1/10/2020	1/19/2020	2020	Fill Material	6600	cy	trucks	20	330	60	19800	0.15676	0.71434	4.67232	0.15530	0.08842	1558.59333	6.84	31.18	203.95	6.78	3.86	68035.34
T-24	Breach (Northern Breach)	5/4/2020	6/23/2020	2020	Rip Rap	120	tons	trucks	22	6	60	360	0.15676	0.71434	4.67232	0.15530	0.08842	1558.59333	0.12	0.57	3.71	0.12	0.07	1237.01
T-25	Breach (Southern Breach)	6/24/2020	8/13/2020	2020	Rip Rap	120	tons	trucks	22	6	60	360	0.15676	0.71434	4.67232	0.15530	0.08842	1558.59333	0.12	0.57	3.71	0.12	0.07	1237.01

Option B: Imported by barges and loaded/unloaded by dump-trucks at Project site and Quarry site

Table 6-2-B1 Option B Emissions Part 1 - from dump trucks at the quarry and project site

Emissions from dump trucks

Task #	Tasks	Start	End	Year	Materials	Quantity (in CY)	Unit	Method	Capacity per trip (tons/trip	Trips	Hours Per Trip	Operation Hours	Emission Rate (pounds/hour) ROG	CO	NOx	PM10	PM2.5	CO2	Total Emissions from Dump Trucks (pounds) ROG	CO	NOx	PM10	PM2.5	CO2
T-01	South Property Levee Repair	5/9/2018	6/5/2018	2018	Rip Rap	1640	tons	Dump Truck	22	75	1	75	0.12382	0.65675	1.27362	0.04649	0.04277	216.91846	9.29	49.26	95.52	3.49	3.21	16268.88
					Fill Material	4500	cy	Dump Truck	10	450	1	450	0.07328	0.38869	0.75378	0.02751	0.02531	128.38031	32.98	174.91	339.20	12.38	11.39	57771.14
T-04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	Fill Material	1560	cy	Dump Truck	10	156	1	156	0.07328	0.38869	0.75378	0.02751	0.02531	128.38031	11.43	60.64	117.59	4.29	3.95	20027.33
T-08	Construct Ramps	8/28/2018	9/24/2018	2018	Fill Material	7500	cy	Dump Truck	10	750	1	750	0.07328	0.38869	0.75378	0.02751	0.02531	128.38031	54.96	291.52	565.33	20.63	18.98	96285.24
					Aggregate Base	500	cy	Dump Truck	10	50	1	50	0.07328	0.38869	0.75378	0.02751	0.02531	128.38031	3.66	19.43	37.69	1.38	1.27	6419.02
					Rip Rap																			
T-09	Construct Access Roads	8/28/2018	12/7/2018	2018	Fill Material	39000	cy	Dump Truck	10	3900	1	3900	0.07328	0.38869	0.75378	0.02751	0.02531	128.38031	285.80	1515.89	2939.73	107.30	98.71	500683.22
					Aggregate Base	3500	cy	Dump Truck	10	350	1	350	0.07328	0.38869	0.75378	0.02751	0.02531	128.38031	25.65	136.04	263.82	9.63	8.86	44933.13
T-10	Interior Staging Area Construction	9/25/2018	10/24/2018	2018	Aggregate Base	30000	cy	Dump Truck	10	3000	1	3000	0.07328	0.38869	0.75378	0.02751	0.02531	128.38031	219.85	1166.07	2261.31	82.54	75.93	385140.94
T-22	Dredge Miner Slough	1/10/2020	1/19/2020	2020	Fill Material	6600	cy	Dump Truck	10	660	1	660	0.07328	0.38869	0.75378	0.02751	0.02531	128.38031	48.37	256.54	497.49	18.16	16.71	84731.03
T-25	Breach (Northern Breach)	5/4/2020	6/23/2020	2020	Rip Rap																			
T-26	Breach (Southern Breach)	6/24/2020	8/13/2020	2020	Rip Rap																			
					Rip Rap	1,640																		
					Imported Fill	59,160																		
					Imported AB	34,000																		

Table 6-2-B2 Option B Emissions Part 2 - from barges and tug boats

Task #	Tasks	Start	End	Year	Materials	Quantity (in CY)	Unit	Method	Capacity per trip (tons/trip	Trips	Miles per Trip	Operation Hours	Emission rate (pounds/hour) ROG	CO	NOx	PM10	PM2.5	CO2	Total Emissions from Barges (pounds) ROG	CO	NOx	PM10	PM2.5	CO2
T-01	South Property Levee Repair	5/9/2018	6/5/2018	2018	Rip Rap	1640	tons	Barges	4000	1	16	4	1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034	4.45	23.00	101.37	2.61	2.61	12228.24
					Fill Material	4500	cy	Barges	4000	1	16	28	1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034	31.14	160.98	709.56	18.30	18.30	85597.69
T-04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	Fill Material	1560	cy	Barges	4000	1	16	14	1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034	15.57	80.49	354.78	9.15	9.15	42798.84
T-08	Construct Ramps	8/28/2018	9/24/2018	2018	Fill Material	7500	cy	Barges	4000	1	16	28	1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034	31.14	160.98	709.56	18.30	18.30	85597.69
					Aggregate Base	500	cy	Barges	4000	1	16	14	1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034	15.57	80.49	354.78	9.15	9.15	42798.84
					Rip Rap																			
T-09	Construct Access Roads	8/28/2018	12/7/2018	2018	Fill Material	39000	cy	Barges	4000	10	16	140	1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034	155.70	804.92	3547.79	91.49	91.49	427988.45
					Aggregate Base	3500	cy	Barges	4000	1	16	14	1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034	15.57	80.49	354.78	9.15	9.15	42798.84
T-10	Interior Staging Area Construction	9/25/2018	10/24/2018	2018	Aggregate Base	30000	cy	Barges	4000	8	16	112	1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034	124.56	643.94	2838.23	73.20	73.20	342390.76
T-22	Dredge Miner Slough	1/10/2020	1/19/2020	2020	Fill Material	6600	cy	Barges	4000	1	16	28	1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034	31.14	160.98	709.56	18.30	18.30	85597.69
T-25	Breach (Northern Breach)	5/4/2020	6/23/2020	2020																				
T-26	Breach (Southern Breach)	6/24/2020	8/13/2020	2020																				

Table 6-2-B Emission Comparison for Two Options of Importing Rip-rap, Fill and Aggregate Base

Task #	Tasks	Start	End	Year	Materials	Emissions from Option A: Imported by Trucks (pounds) ROG	CO	NOx	PM10	PM2.5	CO2	Emissions from Option B: Barges + Dump Trucks (pounds) ROG	CO	NOx	PM10	PM2.5	CO2	Emissions from Dump Trucks (pounds) ROG	CO	NOx	PM10	PM2.5	CO2	Emissions from Barges (pounds) ROG	CO	NOx	PM10	PM2.5	CO2
T-01	South Property Levee Repair	5/9/2018	6/5/2018	2018	Rip Rap	0.37	1.65	16.75	0.38	0.22	4083.12	13.74	72.25	196.89	6.10	5.82	28497.33	9.29	49.26	95.52	3.49	3.21	16268.88	4.45	23.00	101.37	2.61	2.61	12228.24
					Fill Material	4.44	20.04	198.31	4.64	2.65	48352.70	64.12	335.30	1048.76	30.68	29.69	143368.83	32.98	174.91	339.20	12.38	11.39	57771.14	31.14	160.98	709.56	18.30	18.30	85597.69
T-04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	Fill Material	1.54	6.95	68.75	1.61	0.92	16762.27	27.00	141.13	472.37	13.44	13.10	62826.17	11.43	60.64	117.59	4.29	3.95	20027.33	15.57	80.49	354.78	9.15	9.15	42798.84
T-08	Construct Ramps	8/28/2018	9/24/2018	2018	Fill Material	7.40	33.40	330.51	7.74	4.42	80587.83	86.16	452.50	1274.89	38.93	37.28	181882.92	54.96	291.52	565.33	20.63	18.98	96285.24	31.14	160.98	709.56	18.30	18.30	85597.69
					Aggregate Base	0.49	2.23	22.03	0.52	0.29	5372.52	19.23	99.93	392.47	10.53	10.41	49217.86	3.66	19.43	37.69	1.38	1.27	6419.02	15.57	80.49	354.78	9.15	9.15	42798.84
					Rip Rap	0.91	4.10	40.54	0.95	0.54	9885.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T-09	Construct Access Roads	8/28/2018	12/7/2018	2018	Fill Material	38.47	173.66	1718.63	40.23	22.96	419056.71	441.50	2320.80	6487.52	198.79	190.21	928671.67	285.80	1515.89	2939.73	107.30	98.71	500683.22	155.70	804.92	3547.79	91.49	91.49	427988.45
					Aggregate Base	3.45	15.58	154.24	3.61	2.06	37607.65	41.22	216.53	618.60	18.78	18.01	87731.95	25.65	136.04	263.82	9.63	8.86	44933.13	15.57	80.49	354.78	9.15	9.15	42798.84
T-10	Interior Staging Area Construction	9/25/2018	10/24/2018	2018	Aggregate Base	29.59	133.58	1322.04	30.94	17.66	322351.32	344.40	1810.01	5099.56	155.73	149.13	727531.70	219.85	1166.07	2261.31	82.54	75.93	385140.94	124.56	643.94	2838.23	73.20	73.20	342390.76
T-22	Dredge Miner Slough	1/10/2020	1/19/2020	2020	Fill Material	6.84	31.18	203.95	6.78	3.86	68035.34	79.51	417.52	1207.05	36.46	35.00	170328.70	48.37	256.54	497.49	18.16	16.71	84731.03	31.14	160.98	709.56	18.30	18.30	85597.69
T-25	Breach (Northern Breach)	5/4/2020	6/23/2020	2020	Rip Rap	0.12	0.57	3.71	0.12	0.07	1237.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T-26	Breach (Southern Breach)	6/24/2020	8/13/2020	2020	Rip Rap	0.12	0.57	3.71	0.12	0.07	1237.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6-3: Emissions for Deliveries of All Materials (combine the emissions from tables above)

Task #	Tasks	Start	End	Year	Materials	Total Emissions (pounds) for Option A (import riprap etc by trucks) ROG	CO	NOx	PM10	PM2.5	CO2	Total Emissions (pounds) for Option B (import riprap etc by barges and trucks) ROG	CO	NOx	PM10	PM2.5	CO2
					Geotextile	0.02	0.09	0.88	0.02	0.01	214.90	0.02	0.09	0.88	0.02	0.01	214.90
					Sheet Piles	0.38	1.72	17.07	0.40	0.23	4161.91	0.38	1.72	17.07	0.40	0.23	4161.91
T-01	South Property Levee Repair	5/9/2018	6/5/2018	2018	Rip Rap	0.37	1.65	16.75	0.38	0.22	4083.12	13.74	72.25	196.89	6.10	5.82	28497.33						
					Fill Material	4.44	20.04	198.31	4.64	2.65	48352.70	64.12	335.30	1048.76	30.68	29.69	143368.83						
					Total	**5.22**	**23.54**	**233.00**	**5.45**	**3.11**	**56812.63**	**78.25**	**409.96**	**1263.60**	**37.20**	**35.75**	**176242.77**						
T-02	Plug existing culvert	5/9/2018	5/11/2018	2018	Concrete	0.38	1.72	17.07	0.40	0.23	4161.91	0.38	1.72	17.07	0.40	0.23	4161.91						
					Total	**0.38**	**1.72**	**17.07**	**0.40**	**0.23**	**4161.91**	**0.38**	**1.72**	**17.07**	**0.40**	**0.23**	**4161.91**						
					Sheet Piles	1.20	5.42	53.65	1.26	0.72	13080.30	1.20	5.42	53.65	1.26	0.72	13080.30						
T-04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	Pump Fuel	0.20	0.89	8.81	0.21	0.12	2149.01	0.20	0.89	8.81	0.21	0.12	2149.01						
					Fill Material	1.54	6.95	68.75	1.61	0.92	16762.27	27.00	141.13	472.37	13.44	13.10	62826.17						
					Total	**2.94**	**13.26**	**131.21**	**3.07**	**1.75**	**31991.58**	**28.40**	**147.44**	**534.83**	**14.90**	**13.93**	**78055.48**						
T-05	Maintenance Dewatering (Groundwater)	9/11/2018	11/4/2019	2018-2019	Pump Fuel	0.69	3.12	30.85	0.72	0.41	7521.53	0.69	3.12	30.85	0.72	0.41	7521.53						
					Total	**0.69**	**3.12**	**30.85**	**0.72**	**0.41**	**7521.53**	**0.69**	**3.12**	**30.85**	**0.72**	**0.41**	**7521.53**						
T-08	Construct Ramps	8/28/2018	9/24/2018	2018	Fill Material	7.40	33.40	330.51	7.74	4.42	80587.83	86.16	452.50	1274.89	38.93	37.28	181882.92						
					Aggregate Base	0.49	2.23	22.03	0.52	0.29	5372.52	19.23	99.93	392.47	10.53	10.41	49217.86						
					Total	**7.89**	**35.62**	**352.54**	**8.25**	**4.71**	**85960.35**	**105.33**	**552.43**	**1667.36**	**49.46**	**47.70**	**231100.79**						
					Geotextile	0.02	0.09	0.88	0.02	0.01	214.90	0.02	0.09	0.88	0.02	0.01	214.90						
					Rip Rap	0.91	4.10	40.54	0.95	0.54	9885.44	0.00	0.00	0.00	0.00	0.00	0.00						
T-09	Construct Access Roads	8/28/2018	12/7/2018	2018	Fill Material	38.47	173.66	1718.63	40.23	22.96	419056.71	441.50	2320.80	6487.52	198.79	190.21	928671.67						
					Aggregate Base	3.45	15.58	154.24	3.61	2.06	37607.65	41.22	216.53	618.60	18.78	18.01	87731.95						
					Total	**39.39**	**177.84**	**1760.07**	**41.19**	**23.51**	**429157.05**	**441.52**	**2320.90**	**6488.40**	**198.81**	**190.22**	**928886.57**						
T-10	Interior Staging Area Construction	9/25/2018	10/24/2018	2018	Aggregate Base	29.59	133.58	1322.04	30.94	17.66	322351.32	344.40	1810.01	5099.56	155.73	149.13	727531.70						
					Total	**29.59**	**133.58**	**1322.04**	**30.94**	**17.66**	**322351.32**	**344.40**	**1810.01**	**5099.56**	**155.73**	**149.13**	**727531.70**						
					Concrete	**0.06**	**0.27**	**2.33**	**0.06**	**0.04**	**633.54**	**0.06**	**0.27**	**2.33**	**0.06**	**0.04**	**633.54**						
T-16	Remove existing Pump (Southeast corner)	10/27/2020	11/24/2020	2019	**Total**	**0.06**	**0.27**	**2.33**	**0.06**	**0.04**	**633.54**	**0.06**	**0.27**	**2.33**	**0.06**	**0.04**	**633.54**						
					Aggregate Base	6.84	31.18	203.95	6.78	3.86	68035.34	79.51	417.52	1207.05	36.46	35.00	170328.70						
T-22	Dredge Miner Slough	1/10/2020	1/19/2020	2020	**Total**	**6.84**	**31.18**	**203.95**	**6.78**	**3.86**	**68035.34**	**79.51**	**417.52**	**1207.05**	**36.46**	**35.00**	**170328.70**						
					Rip Rap	0.12	0.57	3.71	0.12	0.07	1237.01	0.00	0.00	0.00	0.00	0.00	0.00						
					Total	**0.12**	**0.57**	**3.71**	**0.12**	**0.07**	**1237.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**						
					Rip Rap	0.12	0.57	3.71	0.12	0.07	1237.01	0.00	0.00	0.00	0.00	0.00	0.00						
					Total	**0.12**	**0.57**	**3.71**	**0.12**	**0.07**	**1237.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**						
T-27	Planting and revegetation	7/2/2020	9/23/2020	2020	**Plants**	**1.04**	**4.72**	**30.90**	**1.03**	**0.58**	**10308.38**	**1.04**	**4.72**	**30.90**	**1.03**	**0.58**	**10308.38**						

Table 6-4: Summary of Emissions from Material Deliveries for Each Task

Task #	Tasks	Total Emissions (pounds) for Option A (import riprap etc by trucks) ROG	CO	NOx	PM10	PM2.5	CO2	Total Emissions (pounds) for Option B (import riprap etc by barges and trucks) ROG	CO	NOx	PM10	PM2.5	CO2
T-01	South Property Levee Repair	5.22	23.54	233.00	5.45	3.11	56812.63	78.25	409.96	1263.60	37.20	35.75	176242.77
T-02	Plug existing culvert	0.38	1.72	17.07	0.40	0.23	4161.91	0.38	1.72	17.07	0.40	0.23	4161.91
T-04	Initial Dewatering (Surface Water)	2.94	13.26	131.21	3.07	1.75	31991.58	28.40	147.44	534.83	14.90	13.93	78055.48
T-05	Maintenance Dewatering (Groundwater)	0.69	3.12	30.85	0.72	0.41	7521.53	0.69	3.12	30.85	0.72	0.41	7521.53
T-08	Construct Ramps	7.89	35.62	352.54	8.25	4.71	85960.35	105.33	552.43	1667.36	49.46	47.70	231100.79
T-09	Construct Access Roads	39.39	177.84	1760.07	41.19	23.51	429157.05	441.52	2320.90	6488.40	198.81	190.22	928886.57
T-10	Interior Staging Area Construction	29.59	133.58	1322.04	30.94	17.66	322351.32	344.40	1810.01	5099.56	155.73	149.13	727531.70
T-16	Remove existing Pump (Southeast corner)	0.06	0.27	2.33	0.06	0.04	633.54	0.06	0.27	2.33	0.06	0.04	633.54
T-22	Dredge Miner Slough	6.84	31.18	203.95	6.78	3.86	68035.34	79.51	417.52	1207.05	36.46	35.00	170328.70
T-25	Breach (Northern Breach)	0.12	0.57	3.71	0.12	0.07	1237.01	0.00	0.00	0.00	0.00	0.00	0.00
T-26	Breach (Southern Breach)	0.12	0.57	3.71	0.12	0.07	1237.01	0.00	0.00	0.00	0.00	0.00	0.00
T-27	Planting and revegetation	1.04	4.72	30.90	1.03	0.58	10308.38	1.04	4.72	30.90	1.03	0.58	10308.38

Materials Deliveries Part I: Geotextile, Sheet Piles, Concrete, and Fuel etc

Table 7-1: emissions from importing geotextile, sheet piles, concrete and fuel

											Emission rate (grams/mile)						Maximum Daily Emissions (pounds)					
Task #	Tasks	Materials	Quantity	Unit	Method	Capacity per trip (unit	Total Trips	Max Daily Trips	Miles per Trip	Total Vehicle Mile	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
T-01	South Property Levee Repair	Geotextile	10000	SQ FT	trucks	10000	1	1	60	60	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.02	0.09	0.88	0.02	0.01	214.90
		Sheet Piles	200	LF	trucks	30	7	7	166	1162	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.38	1.72	17.07	0.40	0.23	4161.91
T-02	Plug existing culvert	Concrete	40	CY	trucks	8	5	5	60	300	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.10	0.45	4.41	0.10	0.06	1074.50
T-04	Initial Dewatering (Surface Water)	Sheet Piles	660	LF	trucks	30	22	6	166	996	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.33	1.48	14.63	0.34	0.20	3567.35
		Pump Fuel	10	trips	trucks	1	10	1	60	60	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.02	0.09	0.88	0.02	0.01	214.90
T-05	Maintenance Dewatering (Groundwater)	Pump Fuel	35	trips	trucks	1	35	1	60	60	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.02	0.09	0.88	0.02	0.01	214.90
T-09	Construct Access Roads	Geotextile	10000	SQ FT	trucks	10000	1	1	60	60	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.02	0.09	0.88	0.02	0.01	214.90
T-16	Remove existing Pump (Southeast corner)	Concrete	22	CY	trucks	8	3	3	60	180	0.15269	0.69209	5.87677	0.15586	0.08893	1596.49354	0.06	0.27	2.33	0.06	0.04	633.54
T-27	Planting and revegetation	Plants	50	trips	trucks	1	50	5	60	300	0.15676	0.71434	4.67232	0.15530	0.08842	1558.59333	0.10	0.47	3.09	0.10	0.06	1030.84

Materials Deliveries Part II : Rip Rap, Fill Material and Aggregate Base

Option A: Imported by trucks

Table 7-2-A Option A Emissions (emissions from trucks)

												Emission rate (grams/mile)						Maximum Daily Emissions (pounds)					
Task #	Tasks	Materials	Quantity	Unit	Method	Capacity per trip (unit	Trips	Work Days	Max Daily Trips	Miles per Trip	Vehicle Miles	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
T-01	South Property Levee Repair	Rip Rap	400	tons	trucks	22	19	5	7	60	420	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.14	0.62	6.17	0.14	0.08	1504.31
		Fill Material	4500	cy	trucks	20	225	15	20	60	1200	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	**0.39**	**1.78**	**17.63**	**0.41**	**0.24**	**4298.02**
T-04	Initial Dewatering (Surface Water)	Fill Material	1560	cy	trucks	20	78	7	12	60	720	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	**0.24**	**1.07**	**10.58**	**0.25**	**0.14**	**2578.81**
T-08	Construct Ramps	Fill Material	7500	cy	trucks	20	375	8	50	60	3000	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	**0.99**	**4.45**	**44.07**	**1.03**	**0.59**	**10745.04**
		Aggregate Base	500	cy	trucks	20	25	2	13	60	780	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.26	1.16	11.46	0.27	0.15	2793.71
T-09	Construct Access Roads	Rip Rap	1300	tons	trucks	22	46	5	25	60	1500	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	0.49	2.23	22.03	0.52	0.29	5372.52
		Fill Material	39000	cy	trucks	20	1950	38	75	60	4500	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	**1.48**	**6.68**	**66.10**	**1.55**	**0.88**	**16117.57**
		Aggregate Base	3500	cy	trucks	20	175	6	75	60	4500	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	1.48	6.68	66.10	1.55	0.88	16117.57
T-10	Interior Staging Area Construction	Aggregate Base	30000	cy	trucks	20	1500	18	90	60	5400	0.14913	0.67324	6.66293	0.15595	0.08901	1624.61482	**1.78**	**8.01**	**79.32**	**1.86**	**1.06**	**19341.08**
T-22	Dredge Miner Slough	Fill Material	6600	cy	trucks	20	330	20	20	60	1200	0.15676	0.71434	4.67232	0.15530	0.08842	1558.59333	**0.41**	**1.89**	**12.36**	**0.41**	**0.23**	**4123.35**
T-25	Breach (Northern Breach)	Rip Rap	120	tons	trucks	22	6		9	60	540	0.15676	0.71434	4.67232	0.15530	0.08842	1558.59333	**0.19**	**0.85**	**5.56**	**0.18**	**0.11**	**1855.51**
T-26	Breach (Southern Breach)	Rip Rap	120	tons	trucks	22	6		9	60	540	0.15676	0.71434	4.67232	0.15530	0.08842	1558.59333	**0.19**	**0.85**	**5.56**	**0.18**	**0.11**	**1855.51**

Option B: Imported by barges and loaded/unloaded by dump-trucks at Project site and Quarry site

Table 7-2-B Option B Emissions Part 1 - from dump trucks at the quarry and project site

Assumption: 1 barge is used, and 1 trip per day to transport a full load (4000 tons) materials from the quarry to the Project site, 4 hours of barge operation, and the remaining hours is for dump trucks to load and unload

Emissions from dump trucks				Emission Rate (pounds/hour)						Maximum Daily Emissions Barge and Trucks combined (pounds)					
Task #	Method	Operation Hours		ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
T-01,04,08,09,10, and 22	Barge	4		1.11211	5.74945	25.34137	0.65353	0.65353	3057.06034	4.45	23.00	101.37	2.61	2.61	12228.24
	Dump Trucks	40		0.07328	0.38869	0.75378	0.02751	0.02531	128.38031	2.93	15.55	30.15	1.10	1.01	5135.21
	Maximum Daily Emissions from Barge + Trucks									7.38	38.55	131.52	3.71	3.63	17363.45
T-25 and 26	Dump Trucks	40		0.07328	0.38869	0.75378	0.02751	0.02531	128.38031	2.93	15.55	30.15	1.10	1.01	5135.21
	Emissions from Dum Trucks only (rip rap has been imported in the first year									2.93	15.55	30.15	1.10	1.01	5135.21

Table 7-3: Emissions for Deliveries of All Materials (combine the emissions from tables above)

						Total Emissions (pounds) for Option A (import riprap etc by trucks)							Total Emissions (pounds) for Option B (import riprap etc by barges and trucks)						
Task #	Tasks	Start	End	Year	Materials	ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	
T-01	South Property Levee Repair	5/9/2018	6/5/2018	2018	Geotextile	0.02	0.09	0.88	0.02	0.01	214.90		0.02	0.09	0.88	0.02	0.01	214.90	
					Sheet Piles	0.38	1.72	17.07	0.40	0.23	4161.91		0.38	1.72	17.07	0.40	0.23	4161.91	
					Rip Rap	0.14	0.62	6.17	0.14	0.08	1504.31		7.38	38.55	131.52	3.71	3.63	17363.45	
					Fill Material	0.39	1.78	17.63	0.41	0.24	4298.02								
					Max Daily	**0.93**	**4.22**	**41.75**	**0.98**	**0.56**	**10179.14**		**7.78**	**40.36**	**149.47**	**4.13**	**3.87**	**21740.27**	
T-02	Plug existing culvert	5/9/2018	5/11/2018	2018	Concrete	0.10	0.45	4.41	0.10	0.06	1074.50		0.10	0.45	4.41	0.10	0.06	1074.50	
					Max Daily	**0.10**	**0.45**	**4.41**	**0.10**	**0.06**	**1074.50**		**0.10**	**0.45**	**4.41**	**0.10**	**0.06**	**1074.50**	
T-04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	Sheet Piles	0.33	1.48	14.63	0.34	0.20	3567.35		0.33	1.48	14.63	0.34	0.20	3567.35	
					Pump Fuel	0.02	0.09	0.88	0.02	0.01	214.90		0.02	0.09	0.88	0.02	0.01	214.90	
					Fill Material	0.24	1.07	10.58	0.25	0.14	2578.81		7.38	38.55	131.52	3.71	3.63	17363.45	
					Max Daily	**0.58**	**2.64**	**26.09**	**0.61**	**0.35**	**6361.07**		**7.73**	**40.11**	**147.03**	**4.08**	**3.83**	**21145.71**	
T-05	Maintenance Dewatering (Groundwater)	9/11/2018	11/4/2019	2018-2019	Pump Fuel	0.02	0.09	0.88	0.02	0.01	214.90		0.02	0.09	0.88	0.02	0.01	214.90	
					Total	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**		**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	
T-08	Construct Ramps	8/28/2018	9/24/2018	2018	Fill Material	0.99	4.45	44.07	1.03	0.59	10745.04		7.38	38.55	131.52	3.71	3.63	17363.45	
					Aggregate Base	0.26	1.16	11.46	0.27	0.15	2793.71								
					Max Daily	**1.24**	**5.61**	**55.53**	**1.30**	**0.74**	**13538.76**		**7.38**	**38.55**	**131.52**	**3.71**	**3.63**	**17363.45**	
T-09	Construct Access Roads	8/28/2018	12/7/2018	2018	Geotextile	0.02	0.09	0.88	0.02	0.01	214.90		0.02	0.09	0.88	0.02	0.01	214.90	
					Rip Rap	0.49	2.23	22.03	0.52	0.29	5372.52		7.38	38.55	131.52	3.71	3.63	17363.45	
					Fill Material	1.48	6.68	66.10	1.55	0.88	16117.57								
					Aggregate Base	1.48	6.68	66.10	1.55	0.88	16117.57								
					Max Daily	**1.99**	**8.99**	**89.02**	**2.08**	**1.19**	**21704.99**		**7.40**	**38.63**	**132.40**	**3.74**	**3.64**	**17578.35**	
T-10	Interior Staging Area Construction	9/25/2018	10/24/2018	2018	Aggregate Base	1.78	8.01	79.32	1.86	1.06	19341.08		7.38	38.55	131.52	3.71	3.63	17363.45	
					Max Daily	**1.78**	**8.01**	**79.32**	**1.86**	**1.06**	**19341.08**		**7.38**	**38.55**	**131.52**	**3.71**	**3.63**	**17363.45**	
T-16	Remove existing Pump (Southeast corner)	10/27/2020	11/24/2020	2019	Concrete	**0.06**	**0.27**	**2.33**	**0.06**	**0.04**	**633.54**		**0.06**	**0.27**	**2.33**	**0.06**	**0.04**	**633.54**	
					Max Daily	**0.06**	**0.27**	**2.33**	**0.06**	**0.04**	**633.54**		**0.06**	**0.27**	**2.33**	**0.06**	**0.04**	**633.54**	
T-22	Dredge Miner Slough	1/10/2020	3/19/2020	2020	Aggregate Base	0.41	1.89	12.36	0.41	0.23	4123.35		7.38	38.55	131.52	3.71	3.63	17363.45	
					Max Daily	**0.41**	**1.89**	**12.36**	**0.41**	**0.23**	**4123.35**		**7.38**	**38.55**	**131.52**	**3.71**	**3.63**	**17363.45**	
					Rip Rap	0.19	0.85	5.56	0.18	0.11	1855.51		2.93	15.55	30.15	1.10	1.01	5135.21	
					Max Daily	**0.19**	**0.85**	**5.56**	**0.18**	**0.11**	**1855.51**		**2.93**	**15.55**	**30.15**	**1.10**	**1.01**	**5135.21**	
					Rip Rap	0.19	0.85	5.56	0.18	0.11	1855.51		2.93	15.55	30.15	1.10	1.01	5135.21	
					Max Daily	**0.19**	**0.85**	**5.56**	**0.18**	**0.11**	**1855.51**		**2.93**	**15.55**	**30.15**	**1.10**	**1.01**	**5135.21**	
T-27	Planting and revegetation	7/2/2020	9/23/2020	2020	Plants	0.10	0.47	3.09	0.10	0.06	1030.84		0.10	0.47	3.09	0.10	0.06	1030.84	
					Max Daily	**0.10**	**0.47**	**3.09**	**0.10**	**0.06**	**1030.84**		**0.10**	**0.47**	**3.09**	**0.10**	**0.06**	**1030.84**	

Table 7-4: Summary of Maximum Daily Emissions from Material Deliveries for Each Task

		Total Emissions (pounds) for Option A (import riprap etc by trucks)						Total Emissions (pounds) for Option B (import riprap etc by barges and trucks)					
Task #	Task	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
T-01	South Property Levee Repair	0.93	4.22	41.75	0.98	0.56	10179.14	7.78	40.36	149.47	4.13	3.87	21740.27
T-02	Plug existing culvert	0.10	0.45	4.41	0.10	0.06	1074.50	0.10	0.45	4.41	0.10	0.06	1074.50
T-04	Initial Dewatering (Surface Water)	0.58	2.64	26.09	0.61	0.35	6361.07	7.73	40.11	147.03	4.08	3.83	21145.71
T-05	Maintenance Dewatering (Groundwater)	0.02	0.09	0.88	0.02	0.01	214.90	0.02	0.09	0.88	0.02	0.01	214.90
T-08	Construct Ramps	1.24	5.61	55.53	1.30	0.74	13538.76	7.38	38.55	131.52	3.71	3.63	17363.45
T-09	Construct Access Roads	1.99	8.99	89.02	2.08	1.19	21704.99	7.40	38.63	132.40	3.74	3.64	17578.35
T-10	Interior Staging Area Construction	1.78	8.01	79.32	1.86	1.06	19341.08	7.38	38.55	131.52	3.71	3.63	17363.45
T-16	Remove existing Pump (Southeast corner)	0.06	0.27	2.33	0.06	0.04	633.54	0.06	0.27	2.33	0.06	0.04	633.54
T-22	Dredge Miner Slough	0.41	1.89	12.36	0.41	0.23	4123.35	7.38	38.55	131.52	3.71	3.63	17363.45
T-25	Breach (Northern Breach)	0.19	0.85	5.56	0.18	0.11	1855.51	2.93	15.55	30.15	1.10	1.01	5135.21
T-26	Breach (Southern Breach)	0.19	0.85	5.56	0.18	0.11	1855.51	2.93	15.55	30.15	1.10	1.01	5135.21
T-27	Planting and revegetation	0.10	0.47	3.09	0.10	0.06	1030.84	0.10	0.47	3.09	0.10	0.06	1030.84

Table 8 Fugitive Dust Emissions

	Tasks	Total Acres	Num Work Days	Total Acres/Num Workdays	Average Daily Acres	Max Daily Acres	Emissions Factor (pounds/acre-day)		Maximum Daily Emissions (pounds/day)		Emissions for the Task (pound)	
							PM10	PM2.5	PM10	PM2.5	PM10	PM2.5
T-01	South Property Levee Repair	0.6	15	0.04	0.10	0.1	10.00	2.08	1.00	0.21	15.00	3.12
T-02	Plug Existing Culvert						10.00	2.08	0.00	0.00	0.00	0.00
T-03	Terrestrial Species control						10.00	2.08	0.00	0.00	0.00	0.00
T-04	Initial Dewatering (Surface Water)	62	16	3.88	4.00	5.0	5.00	1.04	25.00	5.20	320.00	66.56
T-05	Maintenance Dewatering (Groundwater)						10.00	2.08	0.00	0.00	0.00	0.00
T-06	Aquatic Species control						10.00	2.08	0.00	0.00	0.00	0.00
T-07	Clearing and Grubbing						10.00	2.08	40.00	8.32	3255.00	677.04
T-08	Construct Ramps	2	10	0.20	0.50	1.0	10.00	2.08	10.00	2.08	50.00	10.40
T-09	Construct Access Roads	16.1	44	0.37	0.50	1.0	10.00	2.08	10.00	2.08	220.00	45.76
T-10	Interior Staging Area Construction						10.00	2.08	0.00	0.00	0.00	0.00
T-11	Old infrastructure removal						10.00	2.08	0.00	0.00	0.00	0.00
T-12	Remove Pump Stations (6)	0.25	3	0.08	0.25	0.25	10.00	2.08	2.50	0.52	7.50	1.56
T-13	Breach (Cross Levee)	2	20	0.10	0.50	1.0	10.00	2.08	10.00	2.08	100.00	20.80
T-14	Interior Channel Network	59.4	79	0.75	1.00	2.0	10.00	2.08	20.00	4.16	790.00	164.32
T-15	Dry Excavated Material						10.00	2.08	0.00	0.00	0.00	0.00
T-16	Remove existing Pump (Southeast corner)						10.00	2.08	0.00	0.00	0.00	0.00
T-17	Fill Agricultural Ditches	2	4	0.50	1.00	1.0	10.00	2.08	10.00	2.08	40.00	8.32
T-18	Construct Interior Mounds	3	18	0.17	0.50	1.0	10.00	2.08	10.00	2.08	90.00	18.72
T-19	Construct Eastern Toe Berm	18.5	77	0.24	0.50	1.0	10.00	2.08	10.00	2.08	385.00	80.08
T-20	Construct Intertidal Bench	66.5	107	0.62	1.00	2.0	10.00	2.08	20.00	4.16	1070.00	222.56
T-21	Fill borrow ditch	3	3	1.00	1.50	2.0	10.00	2.08	20.00	4.16	45.00	9.36
T-22	Dredge Miner Slough	18	30	0.60	1.00	2.0	10.00	2.08	20.00	4.16	300.00	62.40
T-23	Remove Access Roads	0.3	23	0.01	0.30	0.30	10.00	2.08	3.00	0.62	69.00	14.35
T-24	Remove Ramps	0.3	8	0.04	0.30	0.30	10.00	2.08	3.00	0.62	24.00	4.99
T-25	Breach (Northern Breach)	1.5	22	0.07	0.50	1.5	10.00	2.08	15.00	3.12	110.00	22.88
T-26	Breach (Southern Breach)	1.5	22	0.07	0.50	1.5	10.00	2.08	15.00	3.12	110.00	22.88
T-27	Planting and revegetation			0.00			10.00	2.08	0.00	0.00	0.00	0.00
T-07	Clearing and Grubbing	156	93	1.68	2.00	2.5	10.00	2.08	25.00	5.20	1860.00	386.88
	Clearing and Disking	504	93	5.42	6.00	6.0	2.50	0.52	15.00	3.12	1395.00	290.16
	Total								40.00	8.32	3255.00	677.04

Notes
1. Column D is the total acres disturbed
2. Column E is the number of workdays for the soil disturbance operation
3. Column F is the total acres devided by Column E.
4. Column G is the average number of acres disturbed each day. The values in this column are determined on the case by case basis depending on the type of operation.
5. Column H is the maximum of number of acres disturbed on a single day based on the worst case senario. It is estimated on the case by case basis.
For site prepration operations, the areas only need to be disturbed one or two pass, so the values in Column G and H would be smaller; For construction activities, construction equipment would disturb the areas multiple times, so more acres would be disturbed on daily basis.
6. Comumns I and J are emissions factors for fugitive dust, which are taken from the Roadway Construction Model, Version 7.1.5.1.The emission factor values are accepted by the California Air Resources Board for project with dewatering.
(http://www.arb.ca.gov/ei/areasrc/fullpdf/full7-7.pdf). It is also used by URBEMIS2007 model.
Clearing and disking operation in T-07 involves the remove and disk trees which not occupy the whole area, so a 75% reduction of emission factors is used.
Clearing existing ditches in T-04 involve working on wet surfaces, and a 50% reduction to the emission factors is used.
7. Columns K and L are the maximum daily emissions. K = G * H and L = J x H.
8. Columns M and N are the total emissions for the task. M = G x E x I; N = G x E x I.

Table 9-01 through 9-27 Task Emissions (Off-road Equipment, On-road Vehicles, Worker Commute and Helicopter etc)

Table 9 -01 Emissions from Task 02- South Property Levee Repair

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor	2	0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.86	9.59	10.36	0.40	0.37	1776.59	240	12.86	143.88	155.47	5.97	5.50	26648.89
	RT Sheepfoot 60"		0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	2	0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	1.45	7.06	14.61	0.81	0.75	1302.91	240	21.72	105.90	219.13	12.17	11.20	19543.60
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	1	0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.53	7.31	5.91	0.19	0.18	1502.25	40	2.63	36.57	29.53	0.96	0.88	7511.24
	Telescopic Handler (Forklift)	1	0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.22	1.43	2.23	0.12	0.11	263.05	37	1.04	6.63	10.30	0.56	0.52	1216.62
	950G Rubber Tire Loader		0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader	2	0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	1.07	7.31	14.05	0.46	0.42	1407.79	240	16.08	109.58	210.68	6.85	6.30	21116.85
	RT Crane 30 Ton		0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton	1	0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.53	3.58	6.35	0.26	0.24	717.53	72	4.77	32.25	57.17	2.31	2.12	6457.78
	Small Generator		0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator	1	0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	0.42	1.88	1.98	0.12	0.11	248.25	56	2.95	13.16	13.83	0.85	0.78	1737.75
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.123822	0.656752	1.273623	0.046487	0.042768	216.918461														
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	60	0.21	2.37	0.26	0.08	0.03	734.86
	Pickup 4x4 3/4 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	148	0.51	5.84	0.64	0.19	0.08	1812.66
	Water Truck	1	0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.01	0.06	0.59	0.01	0.01	143.14	60	0.10	0.44	4.40	0.10	0.06	1073.53
	Service Truck		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00	14	0.06	0.26	2.57	0.06	0.03	626.23
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
										0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions (note 2)		13	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.23	2.60	0.28	0.08	0.03	768.09	151	2.67	30.16	3.25	0.94	0.39	8914.33
Sub Total										5.38	41.46	56.42	2.47	2.22	8325.57		65.59	487.02	707.23	31.04	27.90	97394.34

Table 9 -02 Emissions from Task 02- Plug Existing Culvert

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader		0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton	1	0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.50	2.03	5.06	0.27	0.25	405.72	8	0.50	2.03	5.06	0.27	0.25	405.72
	RT Crane 60 Ton		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator	1	0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.09	0.47	0.62	0.03	0.03	74.10	16	0.18	0.94	1.25	0.06	0.06	148.21
	Large Generator		0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck	1	0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.71	6.24	8.10	0.31	0.28	1197.65	4	0.36	3.12	4.05	0.15	0.14	598.83
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON	1	0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	0.59	3.11	6.03	0.22	0.20	1027.04	2	0.15	0.78	1.51	0.06	0.05	256.76
	Semi End Dump 20 TON		0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	12	0.04	0.47	0.05	0.02	0.01	146.97
	Pickup 4x4 3/4 TON		0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.00	0.00	0.00	0.00	0.00	0.00	120	0.41	4.73	0.52	0.15	0.07	1469.73
	Water Truck		0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Service Truck	1	0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.03	0.15	1.47	0.03	0.02	357.84	16	0.07	0.30	2.94	0.07	0.04	715.69
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		6	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.11	1.20	0.13	0.04	0.02	354.51	22	0.39	4.45	0.48	0.14	0.06	1314.62
Sub Total										2.06	13.51	21.45	0.91	0.80	3514.85		2.10	16.81	15.85	0.92	0.67	5056.52

Table 9 - 03 Emissions from Task 03 - Terrestrial Species Control

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader		0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00

	10 Wheel Dump 10 TON		0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	108	0.37	4.26	0.47	0.14	0.06	1322.75
	Pickup 4x4 3/4 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	160	0.55	6.31	0.69	0.21	0.09	1959.63
	Water Truck		0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Service Truck		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		2	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.04	0.40	0.04	0.01	0.01	118.17	34	0.59	6.70	0.72	0.21	0.09	1979.32
Sub Total										0.09	1.03	0.11	0.03	0.01	314.13		1.51	17.27	1.88	0.55	0.23	5261.71

Table 9 - 04 Emissions from Task 04 - Initial Dewatering (Surface Water)

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"	2	0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.54	5.52	6.23	0.29	0.27	1022.96	56	1.90	19.33	21.79	1.01	0.93	3580.36
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	1	0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	0.72	3.53	7.30	0.41	0.37	651.45	16	1.45	7.06	14.61	0.81	0.75	1302.91
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	3	0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	1.58	21.94	17.72	0.57	0.53	4506.74	512	33.69	468.08	377.97	12.24	11.26	96143.89
	Telescopic Handler (Forklift)	1	0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.22	1.43	2.23	0.12	0.11	263.05	80	2.25	14.33	22.28	1.21	1.12	2630.52
	950G Rubber Tire Loader	1	0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.50	3.51	5.93	0.20	0.18	746.33	28	1.75	12.28	20.74	0.70	0.65	2612.16
	140H Motor Grader		0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton	1	0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.50	2.03	5.06	0.27	0.25	405.72	80	5.02	20.26	50.60	2.71	2.49	4057.16
	RT Crane 60 Ton	2	0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	1.06	7.17	12.70	0.51	0.47	1435.06	352	23.34	157.66	279.50	11.28	10.37	31571.36
	Small Generator	1	0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.09	0.47	0.62	0.03	0.03	74.10	20	0.22	1.17	1.56	0.08	0.07	185.26
	Large Generator	6	0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	24	7.59	33.84	35.57	2.19	2.01	4468.49	3232	170.32	759.50	798.25	49.05	45.12	100292.74
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON	8	0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	4.69	24.88	48.24	1.76	1.62	8216.34	64	4.69	24.88	48.24	1.76	1.62	8216.34
	Semi End Dump 20 TON	9	0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	8.92	47.29	91.70	3.35	3.08	15618.13	1152	142.64	756.58	1467.21	53.55	49.27	249890.07
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	120	0.41	4.73	0.52	0.15	0.07	1469.73
	Pickup 4x4 3/4 TON		0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.00	0.00	0.00	0.00	0.00	0.00	64	0.22	2.52	0.28	0.08	0.03	783.85
	Water Truck		0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Service Truck	1	0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.03	0.15	1.47	0.03	0.02	357.84	544	2.23	10.08	99.80	2.34	1.33	24333.44
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		37	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.66	7.40	0.80	0.23	0.10	2186.12	790	13.99	157.90	17.00	4.90	2.06	46676.51
Sub Total										27.13	159.46	235.60	9.97	9.04	40050.32		404.13	2416.37	3220.34	141.88	127.15	573746.30

Table 9 - 05 Emissions from Task 05 - Maintenance Dewatering (Groundwater)

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	1	0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.53	7.31	5.91	0.19	0.18	1502.25	80	5.26	73.14	59.06	1.91	1.76	15022.48
	Telescopic Handler (Forklift)	1	0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.22	1.43	2.23	0.12	0.11	263.05	960	26.98	172.01	267.35	14.56	13.39	31566.24
	950G Rubber Tire Loader		0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader		0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton	1	0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.50	2.03	5.06	0.27	0.25	405.72	1020	63.96	258.32	645.13	34.54	31.78	51728.76
	RT Crane 60 Ton		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator	1	0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.09	0.47	0.62	0.03	0.03	74.10	240	2.69	14.03	18.69	0.96	0.88	2223.13
	Large Generator	8	0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	3.37	15.04	15.81	0.97	0.89	1985.99	8960	472.17	2105.56	2212.98	135.97	125.10	278039.29
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig	1	0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.30	3.79	3.93	0.11	0.10	942.54	240	8.85	113.60	117.82	3.33	3.06	28276.19
	10 Wheel Dump 10 TON	2	0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	1.17	6.22	12.06	0.44	0.40	2054.09	160	11.73	62.19	120.60	4.40	4.05	20540.85
	Semi End Dump 20 TON		0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON		0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Pickup 4x4 3/4 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	40	0.14	1.58	0.17	0.05	0.02	489.91
	Water Truck		0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Service Truck	1	0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.03	0.15	1.47	0.03	0.02	357.84	1420	5.83	26.32	260.50	6.10	3.48	63517.43
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		17	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.30	3.40	0.37	0.11	0.04	1004.43	1640	29.05	327.79	35.28	10.17	4.28	96898.07
Sub Total										6.54	40.15	47.48	2.29	2.04	8688.00		626.66	3154.54	3737.60	212.00	187.81	588302.36

Table 9 - 06 Emissions from Task 06 - Aquatic Species control

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00

Off-Road Construction Vehicles	LGP 375L Excavator		0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader		0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	32	0.11	1.26	0.14	0.04	0.02	391.93
	Pickup 4x4 3/4 TON		0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Water Truck		0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Service Truck		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Helicopter for Herbicide Spraying		1	6.1125	7.7642	3.9282	0.1220	0.1220	1993.0133	8	48.90	62.11	31.43	0.98	0.98	15944.11	8	48.90	62.11	31.43	0.98	0.98	15944.11
Worker Commute Emissions		2	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.04	0.40	0.04	0.01	0.01	118.17	5	0.09	1.00	0.11	0.03	0.01	295.42
Sub Total										48.96	62.83	31.50	1.00	0.99	16160.26		49.10	64.38	31.67	1.05	1.01	16631.45

Table 9 - 07

Emissions from Task 07 - Clearing and Grubbing

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	7	0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	5.07	24.71	51.13	2.84	2.61	4560.17	4750	429.93	2095.88	4336.96	240.92	221.65	386800.49
	LGP 325L Excavator	2	0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.65	5.76	6.61	0.32	0.29	1183.12	744	30.05	267.84	307.39	14.91	13.72	55015.11
	LGP 375L Excavator		0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader	1	0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.50	3.51	5.93	0.20	0.18	746.33	744	46.56	326.30	551.14	18.69	17.20	69408.92
	140H Motor Grader		0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder	1	0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.76	6.62	8.59	0.33	0.30	1270.24	290	27.37	240.04	311.47	11.80	10.85	46046.09
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON	2	0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	1.98	10.51	20.38	0.74	0.68	3470.70	1034	128.03	679.08	1316.93	48.07	44.22	224293.69
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	372	1.27	14.68	1.61	0.48	0.20	4556.15
	Pickup 4x4 3/4 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	186	0.64	7.34	0.80	0.24	0.10	2278.08
	Water Truck	2	0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.03	0.12	1.17	0.03	0.02	286.28	1488	2.44	11.03	109.19	2.56	1.46	26623.64
	Service Truck		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		17	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.30	3.40	0.37	0.11	0.04	1004.43	1201	21.28	240.05	25.84	7.45	3.14	70960.11
Sub Total										9.33	55.26	94.25	4.58	4.15	12717.23		687.57	3882.24	6961.33	345.11	312.53	885982.30

Table 9 - 08

Emissions from Task 08 - Construct Ramps

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"	2	0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.54	5.52	6.23	0.29	0.27	1022.96	184	6.25	63.51	71.60	3.31	3.05	11764.05
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	2	0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	1.45	7.06	14.61	0.81	0.75	1302.91	192	17.38	84.72	175.30	9.74	8.96	15634.88
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader	1	0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.50	3.51	5.93	0.20	0.18	746.33	48	3.00	21.05	35.56	1.21	1.11	4478.00
	140H Motor Grader	2	0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	1.07	7.31	14.05	0.46	0.42	1407.79	160	10.72	73.05	140.45	4.57	4.20	14077.90
	RT Crane 30 Ton		0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	32	0.11	1.26	0.14	0.04	0.02	391.93
	Pickup 4x4 3/4 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	20	0.07	0.79	0.09	0.03	0.01	244.95
	Water Truck	2	0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.03	0.12	1.17	0.03	0.02	286.28	80	0.13	0.59	5.87	0.14	0.08	1431.38
	Service Truck		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		11	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.19	2.20	0.24	0.07	0.03	649.93	90	1.59	17.89	1.93	0.56	0.23	5288.04
Sub Total										3.84	26.34	42.29	1.87	1.67	5612.16		39.24	262.87	430.93	19.58	17.66	53311.12

Table 9 - 09 Emissions from Task 09 - Construct Access Roads

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"	2	0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.54	5.52	6.23	0.29	0.27	1022.96	776	26.35	267.86	301.95	13.97	12.86	49613.60
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	2	0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	1.45	7.06	14.61	0.81	0.75	1302.91	848	76.75	374.17	774.26	43.01	39.57	69054.07
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)	1	0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.22	1.43	2.23	0.12	0.11	263.05	16	0.45	2.87	4.46	0.24	0.22	526.10
	950G Rubber Tire Loader	1	0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.50	3.51	5.93	0.20	0.18	746.33	144	9.01	63.15	106.67	3.62	3.33	13433.99
	140H Motor Grader	2	0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	1.07	7.31	14.05	0.46	0.42	1407.79	704	47.16	321.42	617.99	20.09	18.48	61942.77
	RT Crane 30 Ton		0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton	1	0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.53	3.58	6.35	0.26	0.24	717.53	16	1.06	7.17	12.70	0.51	0.47	1435.06
	Small Generator		0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	128	0.44	5.05	0.55	0.17	0.07	1567.71
	Pickup 4x4 3/4 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	96	0.33	3.79	0.41	0.12	0.05	1175.78
	Water Truck	2	0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.03	0.12	1.17	0.03	0.02	286.28	352	0.58	2.61	25.83	0.60	0.35	6298.07
	Service Truck		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		13	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.23	2.60	0.28	0.08	0.03	768.09	385	6.82	76.95	8.28	2.39	1.01	22747.41
Sub Total										4.63	31.76	50.91	2.26	2.02	6710.91		168.95	1125.04	1853.11	84.73	76.40	227794.55

Table 9 - 10 Emissions from Task 10 - Interior Staging Area Construction

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"	2	0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.54	5.52	6.23	0.29	0.27	1022.96	288	9.78	99.41	112.06	5.19	4.77	18413.29
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	2	0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	1.45	7.06	14.61	0.81	0.75	1302.91	288	26.07	127.08	262.96	14.61	13.44	23452.32
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader	2	0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	1.07	7.31	14.05	0.46	0.42	1407.79	288	19.29	131.49	252.81	8.22	7.56	25340.22
	RT Crane 30 Ton		0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	36	0.12	1.42	0.16	0.05	0.02	440.92
	Pickup 4x4 3/4 TON		0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Water Truck	2	0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.03	0.12	1.17	0.03	0.02	286.28	144	0.24	1.07	10.57	0.25	0.14	2576.48
	Service Truck		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		9	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.16	1.80	0.19	0.06	0.02	531.76	131	2.31	26.08	2.81	0.81	0.34	7710.49
Sub Total										3.28	22.12	36.28	1.65	1.48	4649.67		57.81	386.55	641.36	29.12	26.27	77933.73

Table 9 - 11 Emissions from Task 11 - Old infrastructure rem

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	1	0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	0.72	3.53	7.30	0.41	0.37	651.45	40	3.62	17.65	36.52	2.03	1.87	3257.27
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	1	0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.53	7.31	5.91	0.19	0.18	1502.25	40	2.63	36.57	29.53	0.96	0.88	7511.24
	Telescopic Handler (Forklift)		0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader		0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00

	Semi End Dump 20 TON		0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	10	0.03	0.39	0.04	0.01	0.01	122.48
	Pickup 4x4 3/4 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	20	0.07	0.79	0.09	0.03	0.01	244.95
	Water Truck		0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Service Truck		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		4	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.07	0.80	0.09	0.02	0.01	236.34	14	0.24	2.75	0.30	0.09	0.04	812.41
Sub Total										1.38	12.27	13.37	0.64	0.57	2586.00		6.60	58.15	66.48	3.11	2.80	11948.35

Table 9 - 12 Emissions from Task 12 - Remove Pump Station:

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.053567	0.599483	0.647782	0.024895	0.022904	111.037026	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.033951	0.345182	0.389106	0.018009	0.016568	63.935050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.090511	0.441238	0.913044	0.050721	0.046663	81.431682	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator		0.040386	0.360004	0.413164	0.020038	0.018435	73.945044	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	1	0.065802	0.914218	0.738222	0.023911	0.021998	187.781032	8	0.53	7.31	5.91	0.19	0.18	1502.25	24	1.58	21.94	17.72	0.57	0.53	4506.74
	Telescopic Handler (Forklift)	1	0.028109	0.179179	0.278495	0.015164	0.013951	32.881502	8	0.22	1.43	2.23	0.12	0.11	263.05	55	1.55	9.85	15.32	0.83	0.77	1808.48
	950G Rubber Tire Loader		0.062581	0.438572	0.740773	0.025124	0.023114	93.291565	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader		0.066988	0.456564	0.877827	0.028536	0.026254	87.986885	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton	1	0.062706	0.253251	0.632484	0.033867	0.031158	50.714470	8	0.50	2.03	5.06	0.27	0.25	405.72	40	2.51	10.13	25.30	1.35	1.25	2028.58
	RT Crane 60 Ton	1	0.066301	0.447889	0.794032	0.032037	0.029474	89.691369	8	0.53	3.58	6.35	0.26	0.24	717.53	40	2.65	17.92	31.76	1.28	1.18	3587.65
	Small Generator	1	0.011204	0.058470	0.077875	0.003990	0.003671	9.263039	8	0.09	0.47	0.62	0.03	0.03	74.10	10	0.11	0.58	0.78	0.04	0.04	92.63
	Large Generator	1	0.052697	0.234995	0.246984	0.015176	0.013962	31.031171	8	0.42	1.88	1.98	0.12	0.11	248.25	40	2.11	9.40	9.88	0.61	0.56	1241.25
	Concrete Crane Pump Truck		0.088993	0.780438	1.012672	0.038355	0.035287	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.094387	0.827737	1.074046	0.040680	0.037426	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.036881	0.473327	0.490917	0.013872	0.012762	117.817478	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.073282	0.388690	0.753777	0.027513	0.025312	128.380314	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON	3	0.123822	0.656752	1.273623	0.046487	0.042768	216.918461	8	2.97	15.76	30.57	1.12	1.03	5206.04	72	8.92	47.29	91.70	3.35	3.08	15618.13
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	52	0.18	2.05	0.22	0.07	0.03	636.88
	Pickup 4x4 3/4 TON	1	0.003424	0.039450	0.004319	0.001290	0.000542	12.247718	8	0.03	0.32	0.03	0.01	0.00	97.98	12	0.04	0.47	0.05	0.02	0.01	146.97
	Water Truck	1	0.001642	0.007415	0.073380	0.001717	0.000980	17.892234	8	0.01	0.06	0.59	0.01	0.01	143.14	24	0.04	0.18	1.76	0.04	0.02	429.41
	Service Truck	1	0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.03	0.15	1.47	0.03	0.02	357.84	20	0.08	0.37	3.67	0.09	0.05	894.61
	Flatbed 2 TON		0.004106	0.018536	0.183451	0.004294	0.002451	44.730584	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		13	0.017715	0.199875	0.021515	0.006202	0.002612	59.084192	1	0.23	2.60	0.28	0.08	0.03	768.09	49	0.86	9.72	1.05	0.30	0.13	2872.97
Sub Total										5.60	35.90	55.12	2.26	2.01	9881.98		20.62	129.90	199.21	8.55	7.63	33864.32

Note

1. Off-Road and On-Road Construction Vehicle emissions, Column D is the maximum number of pieces of construction equipment on a day, Column R is the total number of hours for that type of equipment.
Column K contains hours of operation for that type of construction equipment.
Data for Columns D and K are obtained from datasheets provided by Engineers from DOE.
Columns E - J are hourly emission rates from Tables 5A-5F.
Daily Emissions (Columns L -Q) are the maximum daily emissions from that type of equipment, by assuming all construction vehicles for that task are in operation on the same day, the values are Columns E-J multiply Column D and K
Task Emissions (Columns S -X) are the total emissions from that type of equipment for that task, the values are Columns E-J multiply Column R
2. Emissions generated by the helicopter for spraying herbicide in Task 06 Aquatic Species control are calculated the same way as construction vehicles.
Columns E - J, the hourly emission rates for the helicopter are from Tables 5-E on the UnitEmissionRates tab.
3. Worker Commute Emissions, Column D is the maximum number of workers for that task, and Colomn R is the total worker days for that task.
Colunm D is the maximum workers are based on the number of pieces of construction vehicles for that task.
Colunm R is the worker days for that task, estimated by number of pieces of equipment and number of worker days.
Columns E - J are daily worker commute emissions from Tables 3-C on the UnitEmissionRates tab.
Daily Emissions (Columns L -Q) are obtained by multiply emissions of one worker commute (Columns E-J) with number of workers (Column D) and K (no meaning, set to 1)
Task Emissions (Columns S -X) are the total emissions from worker commute trips for that task, obtained by multiplying Columns E-J with Column R

Table 9 - 13 Emissions from Task 13 - Breach (Cross Levee)

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.051235	0.599447	0.608108	0.023191	0.021336	111.030330	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.029554	0.345280	0.330170	0.015159	0.013946	63.953141	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.084311	0.440765	0.838724	0.046690	0.042955	81.344350	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator		0.036417	0.359917	0.357912	0.017261	0.015880	73.927125	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	2	0.061076	0.914181	0.640802	0.020808	0.019143	187.773277	8	0.98	14.63	10.25	0.33	0.31	3004.37	320	19.54	292.54	205.06	6.66	6.13	60087.45
	Telescopic Handler (Forklift)		0.025155	0.179179	0.242958	0.013213	0.012156	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.058060	0.438594	0.671416	0.022512	0.020711	93.296359	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader		0.062738	0.455483	0.810345	0.026007	0.023927	87.778585	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.057305	0.253275	0.573777	0.030647	0.028195	50.719322	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010929	0.058221	0.076170	0.003800	0.003496	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.046855	0.230547	0.240499	0.013700	0.012604	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.087493	0.780438	0.968534	0.036707	0.033770	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.092796	0.827737	1.027233	0.038932	0.035817	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.034211	0.472337	0.431914	0.012249	0.011269	117.571065	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.067273	0.388525	0.650970	0.023672	0.021779	128.325967	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON	6	0.113668	0.656474	1.099915	0.039998	0.036798	216.826634	8	5.46	31.51	52.80	1.92	1.77	10407.68	960	109.12	630.22	1055.92	38.40	35.33	208153.57
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.03	0.29	0.03	0.01	0.00	97.51	80	0.25	2.91	0.31	0.10	0.04	975.10
	Pickup 4x4 3/4 TON	1	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.03	0.29	0.03	0.01	0.00	97.51	80	0.25	2.91	0.31	0.10	0.04	975.10
	Water Truck	1	0.001682	0.007622	0.064722	0.001717	0.000979	17.582528	8	0.01	0.06	0.52	0.01	0.01	140.66	160	0.27	1.22	10.36	0.27	0.16	2813.20
	Service Truck		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
										0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		11	0.016476	0.184272	0.019532	0.006196	0.002607	58.801773	1	0.18	2.03	0.21	0.07	0.03	646.82	200	3.30	36.85	3.91	1.24	0.52	11760.35
Sub Total										6.68	48.81	63.84	2.36	2.12	14394.55		132.74	966.65	1275.87	46.78	42.22	284764.79

Table 9 - 14 Emissions from Task 14 - Interior Channel Network

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.051235	0.599447	0.608108	0.023191	0.021336	111.030330	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.029554	0.345280	0.330170	0.015159	0.013946	63.953141	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.084311	0.440765	0.838724	0.046690	0.042955	81.344350	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator		0.036417	0.359917	0.357912	0.017261	0.015880	73.927125	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	6	0.061076	0.914181	0.640802	0.020808	0.019143	187.773277	8	2.93	43.88	30.76	1.00	0.92	9013.12	5136	313.69	4695.23	3291.16	106.87	98.32	964403.55
	Telescopic Handler (Forklift)		0.025155	0.179179	0.242958	0.013213	0.012156	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.058060	0.438594	0.671416	0.022512	0.020711	93.296359	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader		0.062738	0.455483	0.810345	0.026007	0.023927	87.778585	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.057305	0.253275	0.573777	0.030647	0.028195	50.719322	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010929	0.058221	0.076170	0.003800	0.003496	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.046855	0.230547	0.240499	0.013700	0.012604	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.087493	0.780438	0.968534	0.036707	0.033770	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.092796	0.827737	1.027233	0.038932	0.035817	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.034211	0.472337	0.431914	0.012249	0.011269	117.571065	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.067273	0.388525	0.650970	0.023672	0.021779	128.325967	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON	18	0.113668	0.656474	1.099915	0.039998	0.036798	216.826634	8	16.37	94.53	158.39	5.76	5.30	31223.04	15408	1751.39	10114.95	16947.50	616.29	566.99	3340864.78
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.03	0.29	0.03	0.01	0.00	97.51	316	1.01	11.50	1.24	0.41	0.17	3851.66
	Pickup 4x4 3/4 TON	2	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.05	0.58	0.06	0.02	0.01	195.02	540	1.72	19.65	2.12	0.70	0.29	6581.96
	Water Truck	3	0.001682	0.007622	0.064722	0.001717	0.000979	17.582528	8	0.04	0.18	1.55	0.04	0.02	421.98	1712	2.88	13.05	110.80	2.94	1.68	30101.29
	Service Truck		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		30	0.016476	0.184272	0.019532	0.006196	0.002607	58.801773	1	0.49	5.53	0.59	0.19	0.08	1764.05	2889	47.60	532.36	56.43	17.90	7.53	169878.32
Sub Total										19.91	145.00	191.38	7.02	6.33	42714.72		2118.28	15386.75	20409.25	745.10	674.98	4515681.55

Table 9 - 15 Emissions from Task 15 - Dry Excavated Material

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.051235	0.599447	0.608108	0.023191	0.021336	111.030330	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.029554	0.345280	0.330170	0.015159	0.013946	63.953141	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	3	0.084311	0.440765	0.838724	0.046690	0.042955	81.344350	8	2.02	10.58	20.13	1.12	1.03	1952.26	2352	198.30	1036.68	1972.68	109.82	101.03	191321.91
	LGP 325L Excavator		0.036417	0.359917	0.357912	0.017261	0.015880	73.927125	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.061076	0.914181	0.640802	0.020808	0.019143	187.773277	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.025155	0.179179	0.242958	0.013213	0.012156	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.058060	0.438594	0.671416	0.022512	0.020711	93.296359	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader	3	0.062738	0.455483	0.810345	0.026007	0.023927	87.778585	8	1.51	10.93	19.45	0.62	0.57	2106.69	2352	147.56	1071.30	1905.93	61.17	56.28	206455.23
	RT Crane 30 Ton		0.057305	0.253275	0.573777	0.030647	0.028195	50.719322	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010929	0.058221	0.076170	0.003800	0.003496	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.046855	0.230547	0.240499	0.013700	0.012604	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.087493	0.780438	0.968534	0.036707	0.033770	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.092796	0.827737	1.027233	0.038932	0.035817	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.034211	0.472337	0.431914	0.012249	0.011269	117.571065	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00

	10 Wheel Dump 10 TON		0.067273	0.388525	0.650970	0.023672	0.021779	128.325967	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.113668	0.656474	1.099915	0.039998	0.036798	216.826634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Foreman Op PU 4x2 TON		0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Pickup 4x4 3/4 TON	1	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.03	0.29	0.03	0.01	0.00	97.51	784	2.50	28.54	3.08	1.01	0.42	9556.03
On-Road Trucks	Water Truck	1	0.001682	0.007622	0.064722	0.001717	0.000979	17.582528	8	0.01	0.06	0.52	0.01	0.01	140.66	392	0.66	2.99	25.37	0.67	0.38	6892.35
	Service Truck		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		8	0.016476	0.184272	0.019532	0.006196	0.002607	58.801773	1	0.13	1.47	0.16	0.05	0.02	470.41	735	12.11	135.44	14.36	4.55	1.92	43219.30
Sub Total										3.70	23.34	40.28	1.82	1.64	4767.54		361.13	2274.94	3921.41	177.22	160.03	457444.83

Table 9 - 16 Emissions from Task 16 - Remove existing Pump (Southeast corner)

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
	815F Sheepfoot Compactor		0.051235	0.599447	0.608108	0.023191	0.021336	111.030330	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.029554	0.345280	0.330170	0.015159	0.013946	63.953141	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.084311	0.440765	0.838724	0.046690	0.042955	81.344350	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator		0.036417	0.359917	0.357912	0.017261	0.015880	73.927125	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.061076	0.914181	0.640802	0.020808	0.019143	187.773277	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)	1	0.025155	0.179179	0.242958	0.013213	0.012156	32.881502	8	0.20	1.43	1.94	0.11	0.10	263.05	16	0.40	2.87	3.89	0.21	0.19	526.10
	950G Rubber Tire Loader		0.058060	0.438594	0.671416	0.022512	0.020711	93.296359	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader		0.062738	0.455483	0.810345	0.026007	0.023927	87.778585	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Construction Vehicles	RT Crane 30 Ton	1	0.057305	0.253275	0.573777	0.030647	0.028195	50.719322	8	0.46	2.03	4.59	0.25	0.23	405.75	32	1.83	8.10	18.36	0.98	0.90	1623.02
	RT Crane 60 Ton		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator	1	0.010929	0.058221	0.076170	0.003800	0.003496	9.263039	8	0.09	0.47	0.61	0.03	0.03	74.10	16	0.17	0.93	1.22	0.06	0.06	148.21
	Large Generator		0.046855	0.230547	0.240499	0.013700	0.012604	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.087493	0.780438	0.968534	0.036707	0.033770	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00	8	0.70	6.24	7.75	0.29	0.27	1197.65
	Tub Grinder		0.092796	0.827737	1.027233	0.038932	0.035817	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.034211	0.472337	0.431914	0.012249	0.011269	117.571065	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON	1	0.067273	0.388525	0.650970	0.023672	0.021779	128.325967	8	0.54	3.11	5.21	0.19	0.17	1026.61	32	2.15	12.43	20.83	0.76	0.70	4106.43
	Semi End Dump 20 TON		0.113668	0.656474	1.099915	0.039998	0.036798	216.826634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Foreman Op PU 4x2 TON	1	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.03	0.29	0.03	0.01	0.00	97.51	20	0.06	0.73	0.08	0.03	0.01	243.78
	Pickup 4x4 3/4 TON		0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Water Truck		0.001682	0.007622	0.064722	0.001717	0.000979	17.582528	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Service Truck	1	0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.03	0.15	1.29	0.03	0.02	351.65	8	0.03	0.15	1.29	0.03	0.02	351.65
	Flatbed 2 TON		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		6	0.016476	0.184272	0.019532	0.006196	0.002607	58.801773	1	0.10	1.11	0.12	0.04	0.02	352.81	17	0.27	3.04	0.32	0.10	0.04	970.23
Sub Total										1.44	8.58	13.79	0.65	0.56	2571.49		5.63	34.50	53.74	2.47	2.19	9167.07

Table 9 - 17 Emissions from Task 17 - Fill Agricultural Ditches

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
	815F Sheepfoot Compactor	3	0.051235	0.599447	0.608108	0.023191	0.021336	111.030330	8	1.23	14.39	14.59	0.56	0.51	2664.73	168	8.61	100.71	102.16	3.90	3.58	18653.10
	RT Sheepfoot 60"		0.029554	0.345280	0.330170	0.015159	0.013946	63.953141	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	3	0.084311	0.440765	0.838724	0.046690	0.042955	81.344350	8	2.02	10.58	20.13	1.12	1.03	1952.26	168	14.16	74.05	140.91	7.84	7.22	13665.85
	LGP 325L Excavator		0.036417	0.359917	0.357912	0.017261	0.015880	73.927125	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.061076	0.914181	0.640802	0.020808	0.019143	187.773277	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.025155	0.179179	0.242958	0.013213	0.012156	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.058060	0.438594	0.671416	0.022512	0.020711	93.296359	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Construction Vehicles	140H Motor Grader		0.062738	0.455483	0.810345	0.026007	0.023927	87.778585	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.057305	0.253275	0.573777	0.030647	0.028195	50.719322	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010929	0.058221	0.076170	0.003800	0.003496	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.046855	0.230547	0.240499	0.013700	0.012604	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.087493	0.780438	0.968534	0.036707	0.033770	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.092796	0.827737	1.027233	0.038932	0.035817	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.034211	0.472337	0.431914	0.012249	0.011269	117.571065	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.067273	0.388525	0.650970	0.023672	0.021779	128.325967	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.113668	0.656474	1.099915	0.039998	0.036798	216.826634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Foreman Op PU 4x2 TON		0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Pickup 4x4 3/4 TON	1	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.03	0.29	0.03	0.01	0.00	97.51	28	0.09	1.02	0.11	0.04	0.02	341.29
On-Road Trucks	Water Truck	1	0.001682	0.007622	0.064722	0.001717	0.000979	17.582528	8	0.01	0.06	0.52	0.01	0.01	140.66	56	0.09	0.43	3.62	0.10	0.05	984.62
	Service Truck		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		8	0.016476	0.184272	0.019532	0.006196	0.002607	58.801773	1	0.13	1.47	0.16	0.05	0.02	470.41	53	0.87	9.67	1.03	0.33	0.14	3087.09
Sub Total										3.42	26.79	35.43	1.75	1.58	5325.58		23.82	185.88	247.83	12.20	11.01	36731.95

Table 9 - 18 Emissions from Task 18 - Construct Interior Mounds

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
	815F Sheepfoot Compactor	3	0.051235	0.599447	0.608108	0.023191	0.021336	111.030330	8	1.23	14.39	14.59	0.56	0.51	2664.73	432	22.13	258.96	262.70	10.02	9.22	47965.10
	RT Sheepfoot 60"		0.029554	0.345280	0.330170	0.015159	0.013946	63.953141	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00

Off-Road Construction Vehicles	Dozer (D-6H Dozer)	3	0.084311	0.440765	0.838724	0.046690	0.042955	81.344350	8	2.02	10.58	20.13	1.12	1.03	1952.26	432	36.42	190.41	362.33	20.17	18.56	35140.76
	LGP 325L Excavator		0.036417	0.359917	0.357912	0.017261	0.015880	73.927125	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.061076	0.914181	0.640802	0.020808	0.019143	187.773277	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.025155	0.179179	0.242958	0.013213	0.012156	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.058060	0.438594	0.671416	0.022512	0.020711	93.296359	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader	3	0.062738	0.455483	0.810345	0.026007	0.023927	87.778585	8	1.51	10.93	19.45	0.62	0.57	2106.69	432	27.10	196.77	350.07	11.24	10.34	37920.35
	RT Crane 30 Ton		0.057305	0.253275	0.573777	0.030647	0.028195	50.719322	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010929	0.058221	0.076170	0.003800	0.003496	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.046855	0.230547	0.240499	0.013700	0.012604	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.087493	0.780438	0.968534	0.036707	0.033770	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.092796	0.827737	1.027233	0.038932	0.035817	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.034211	0.472337	0.431914	0.012249	0.011269	117.571065	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.067273	0.388525	0.650970	0.023672	0.021779	128.325967	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.113668	0.656474	1.099915	0.039998	0.036798	216.826634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON		0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Pickup 4x4 3/4 TON	1	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.03	0.29	0.03	0.01	0.00	97.51	72	0.23	2.62	0.28	0.09	0.04	877.59
	Water Truck	2	0.001682	0.007622	0.064722	0.001717	0.000979	17.582528	8	0.03	0.12	1.04	0.03	0.02	281.32	288	0.48	2.20	18.64	0.49	0.28	5063.77
	Service Truck		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		12	0.016476	0.184272	0.019532	0.006196	0.002607	58.801773	1	0.20	2.21	0.23	0.07	0.03	705.62	207	3.41	38.14	4.04	1.28	0.54	12171.97
Sub Total										5.01	38.52	55.47	2.41	2.17	7808.13		89.78	689.10	998.07	43.29	38.97	139139.54

Table 9 - 19 Emissions from Task 19 - Construct Eastern Toe Berm

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor	3	0.051235	0.599447	0.608108	0.023191	0.021336	111.030330	8	1.23	14.39	14.59	0.56	0.51	2664.73	1848	94.68	1107.78	1123.78	42.86	39.43	205184.05
	RT Sheepfoot 60"		0.029554	0.345280	0.330170	0.015159	0.013946	63.953141	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	3	0.084311	0.440765	0.838724	0.046690	0.042955	81.344350	8	2.02	10.58	20.13	1.12	1.03	1952.26	1848	155.81	814.53	1549.96	86.28	79.38	150324.36
	LGP 325L Excavator		0.036417	0.359917	0.357912	0.017261	0.015880	73.927125	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.061076	0.914181	0.640802	0.020808	0.019143	187.773277	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.025155	0.179179	0.242958	0.013213	0.012156	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.058060	0.438594	0.671416	0.022512	0.020711	93.296359	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader	3	0.062738	0.455483	0.810345	0.026007	0.023927	87.778585	8	1.51	10.93	19.45	0.62	0.57	2106.69	1848	115.94	841.73	1497.52	48.06	44.22	162214.83
	RT Crane 30 Ton		0.057305	0.253275	0.573777	0.030647	0.028195	50.719322	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010929	0.058221	0.076170	0.003800	0.003496	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.046855	0.230547	0.240499	0.013700	0.012604	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.087493	0.780438	0.968534	0.036707	0.033770	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.092796	0.827737	1.027233	0.038932	0.035817	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.034211	0.472337	0.431914	0.012249	0.011269	117.571065	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.067273	0.388525	0.650970	0.023672	0.021779	128.325967	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.113668	0.656474	1.099915	0.039998	0.036798	216.826634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON		0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Pickup 4x4 3/4 TON	1	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.03	0.29	0.03	0.01	0.00	97.51	308	0.98	11.21	1.21	0.40	0.17	3754.15
	Water Truck	2	0.001682	0.007622	0.064722	0.001717	0.000979	17.582528	8	0.03	0.12	1.04	0.03	0.02	281.32	1232	2.07	9.39	79.74	2.11	1.21	21661.67
	Service Truck		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		12	0.016476	0.184272	0.019532	0.006196	0.002607	58.801773	1	0.20	2.21	0.23	0.07	0.03	705.62	886	14.59	163.17	17.30	5.49	2.31	52068.97
Sub Total										5.01	38.52	55.47	2.41	2.17	7808.13		384.07	2947.82	4269.50	185.20	166.71	595208.03

Table 9 - 20 Emissions from Task 20 - Construct Intertidal Bench

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor	6	0.051235	0.599447	0.608108	0.023191	0.021336	111.030330	8	2.46	28.77	29.19	1.11	1.02	5329.46	5136	263.14	3078.76	3123.24	119.11	109.58	570251.77
	RT Sheepfoot 60"		0.029554	0.345280	0.330170	0.015159	0.013946	63.953141	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	6	0.084311	0.440765	0.838724	0.046690	0.042955	81.344350	8	4.05	21.16	40.26	2.24	2.06	3904.53	5136	433.02	2263.77	4307.69	239.80	220.62	417784.58
	LGP 325L Excavator		0.036417	0.359917	0.357912	0.017261	0.015880	73.927125	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.061076	0.914181	0.640802	0.020808	0.019143	187.773277	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.025155	0.179179	0.242958	0.013213	0.012156	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.058060	0.438594	0.671416	0.022512	0.020711	93.296359	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader	6	0.062738	0.455483	0.810345	0.026007	0.023927	87.778585	8	3.01	21.86	38.90	1.25	1.15	4213.37	5136	322.22	2339.36	4161.93	133.57	122.89	450830.82
	RT Crane 30 Ton		0.057305	0.253275	0.573777	0.030647	0.028195	50.719322	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.062597	0.448006	0.736157	0.029648	0.027277	89.714819	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010929	0.058221	0.076170	0.003800	0.003496	9.263039	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.046855	0.230547	0.240499	0.013700	0.012604	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.087493	0.780438	0.968534	0.036707	0.033770	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.092796	0.827737	1.027233	0.038932	0.035817	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.034211	0.472337	0.431914	0.012249	0.011269	117.571065	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.067273	0.388525	0.650970	0.023672	0.021779	128.325967	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.113668	0.656474	1.099915	0.039998	0.036798	216.826634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON		0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Pickup 4x4 3/4 TON	2	0.003187	0.036398	0.003923	0.001289	0.000541	12.188810	8	0.05	0.58	0.06	0.02	0.01	195.02	856	2.73	31.16	3.36	1.10	0.46	10433.62
	Water Truck	3	0.001682	0.007622	0.064722	0.001717	0.000979	17.582528	8	0.04	0.18	1.55	0.04	0.02	421.98	2568	4.32	19.57	166.21	4.41	2.52	45151.93
	Service Truck		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004204	0.019055	0.161805	0.004291	0.002449	43.956320	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00

Worker Commute Emissions	23	0.016476	0.184272	0.019532	0.006196	0.002607	58.801773	1	0.38	4.24	0.45	0.14	0.06	1352.44	2354	38.79	433.78	45.98	14.59	6.14	138419.37
Sub Total									9.99	76.80	110.41	4.81	4.33	15416.80		1064.22	8166.39	11808.40	512.58	462.20	1632872.10

Table 9 - 21 Emissions from Task 21 - Fill borrow ditch

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor	2	0.051429	0.599446	0.591347	0.022878	0.021047	111.030255	8	0.82	9.59	9.46	0.37	0.34	1776.48	48	2.47	28.77	28.38	1.10	1.01	5329.45
	RT Sheepfoot 60"		0.027551	0.345245	0.299880	0.013775	0.012673	63.946723	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	2	0.077651	0.440637	0.759299	0.042419	0.039025	81.320666	8	1.24	7.05	12.15	0.68	0.62	1301.13	48	3.73	21.15	36.45	2.04	1.87	3903.39
	LGP 325L Excavator		0.034218	0.359992	0.321981	0.015596	0.014349	73.942541	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator		0.057797	0.913251	0.565964	0.018647	0.017155	187.582279	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.022246	0.179179	0.208696	0.011297	0.010393	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.054465	0.438454	0.613435	0.020364	0.018735	93.266561	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader	2	0.061334	0.455049	0.779056	0.024906	0.022913	87.695050	8	0.98	7.28	12.46	0.40	0.37	1403.12	48	2.94	21.84	37.39	1.20	1.10	4209.36
	RT Crane 30 Ton		0.054200	0.253254	0.537233	0.028727	0.026429	50.715012	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010670	0.057976	0.074537	0.003611	0.003322	9.263038	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.042379	0.227131	0.234202	0.012340	0.011352	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.084951	0.780438	0.922264	0.034414	0.031661	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.090100	0.827737	0.978159	0.036500	0.033580	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.033980	0.473745	0.412080	0.011873	0.010923	117.921634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.062838	0.388319	0.572483	0.020858	0.019189	128.257698	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.106175	0.656125	0.967299	0.035242	0.032423	216.711283	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON		0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Pickup 4x4 3/4 TON	1	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.02	0.27	0.03	0.01	0.00	97.54	12	0.04	0.40	0.04	0.02	0.01	146.30
	Water Truck	1	0.001726	0.007867	0.051457	0.001710	0.000974	17.165125	8	0.01	0.06	0.41	0.01	0.01	137.32	24	0.04	0.19	1.23	0.04	0.02	411.96
	Service Truck		0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
										0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		8	0.015485	0.170450	0.017920	0.006194	0.002606	58.817686	1	0.12	1.36	0.14	0.05	0.02	470.54		0.00	0.00	0.00	0.00	0.00	0.00
Sub Total										3.21	25.62	34.66	1.52	1.36	5186.13		9.22	72.36	103.50	4.39	4.01	14000.47

Table 9 - 22 Emissions from Task 22 - Dredge Miner Slough

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor	3	0.051429	0.599446	0.591347	0.022878	0.021047	111.030255	8	1.23	14.39	14.19	0.55	0.51	2664.73	1040	53.49	623.42	615.00	23.79	21.89	115471.46
	RT Sheepfoot 60"		0.027551	0.345245	0.299880	0.013775	0.012673	63.946723	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge	1	0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.46	3.58	5.29	0.21	0.20	717.60	240	13.80	107.50	158.83	6.37	5.86	21527.86
	Dozer (D-6H Dozer)	3	0.077651	0.440637	0.759299	0.042419	0.039025	81.320666	8	1.86	10.58	18.22	1.02	0.94	1951.70	1040	80.76	458.26	789.67	44.12	40.59	84573.49
	LGP 325L Excavator		0.034218	0.359992	0.321981	0.015596	0.014349	73.942541	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	1	0.057797	0.913251	0.565964	0.018647	0.017155	187.582279	8	0.46	7.31	4.53	0.15	0.14	1500.66	240	13.87	219.18	135.83	4.48	4.12	45019.75
	Telescopic Handler (Forklift)		0.022246	0.179179	0.208696	0.011297	0.010393	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.054465	0.438454	0.613435	0.020364	0.018735	93.266561	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader	3	0.061334	0.455049	0.779056	0.024906	0.022913	87.695050	8	1.47	10.92	18.70	0.60	0.55	2104.68	1040	63.79	473.25	810.22	25.90	23.83	91202.85
	RT Crane 30 Ton		0.054200	0.253254	0.537233	0.028727	0.026429	50.715012	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010670	0.057976	0.074537	0.003611	0.003322	9.263038	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.042379	0.227131	0.234202	0.012340	0.011352	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.084951	0.780438	0.922264	0.034414	0.031661	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.090100	0.827737	0.978159	0.036500	0.033580	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.033980	0.473745	0.412080	0.011873	0.010923	117.921634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.062838	0.388319	0.572483	0.020858	0.019189	128.257698	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON	6	0.106175	0.656125	0.967299	0.035242	0.032423	216.711283	8	5.10	31.49	46.43	1.69	1.56	10402.14	1440	152.89	944.82	1392.91	50.75	46.69	312064.25
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.02	0.27	0.03	0.01	0.00	97.54	200	0.60	6.74	0.72	0.26	0.11	2438.41
	Pickup 4x4 3/4 TON	1	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.02	0.27	0.03	0.01	0.00	97.54	220	0.66	7.41	0.79	0.28	0.12	2682.25
	Water Truck	2	0.001726	0.007867	0.051457	0.001710	0.000974	17.165125	8	0.03	0.13	0.82	0.03	0.02	274.64	320	0.55	2.52	16.47	0.55	0.31	5492.84
	Service Truck		0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		21	0.015485	0.170450	0.017920	0.006194	0.002606	58.817686	1	0.33	3.58	0.38	0.13	0.05	1235.17		0.00	0.00	0.00	0.00	0.00	0.00
Sub Total										10.99	82.51	108.62	4.40	3.96	21046.38		380.40	2843.11	3920.44	156.49	143.51	680473.16

Table 9 - 23 Emissions from Task 23 - Remove Access Roads

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.051429	0.599446	0.591347	0.022878	0.021047	111.030255	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.027551	0.345245	0.299880	0.013775	0.012673	63.946723	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	1	0.077651	0.440637	0.759299	0.042419	0.039025	81.320666	8	0.62	3.53	6.07	0.34	0.31	650.57	184	14.29	81.08	139.71	7.81	7.18	14963.00
	LGP 325L Excavator		0.034218	0.359992	0.321981	0.015596	0.014349	73.942541	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	1	0.057797	0.913251	0.565964	0.018647	0.017155	187.582279	8	0.46	7.31	4.53	0.15	0.14	1500.66	184	10.63	168.04	104.14	3.43	3.16	34515.14
	Telescopic Handler (Forklift)		0.022246	0.179179	0.208696	0.011297	0.010393	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader	1	0.054465	0.438454	0.613435	0.020364	0.018735	93.266561	8	0.44	3.51	4.91	0.16	0.15	746.13	184	10.02	80.68	112.87	3.75	3.45	17161.05
	140H Motor Grader		0.061334	0.455049	0.779056	0.024906	0.022913	87.695050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.054200	0.253254	0.537233	0.028727	0.026429	50.715012	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010670	0.057976	0.074537	0.003611	0.003322	9.263038	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00

	Large Generator		0.042379	0.227131	0.234202	0.012340	0.011352	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.084951	0.780438	0.922264	0.034414	0.031661	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.090100	0.827737	0.978159	0.036500	0.033580	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.033980	0.473745	0.412080	0.011873	0.010923	117.921634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.062838	0.388319	0.572483	0.020858	0.019189	128.257698	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON	8	0.106175	0.656125	0.967299	0.035242	0.032423	216.711283	8	6.80	41.99	61.91	2.26	2.08	13869.52	1472	156.29	965.82	1423.86	51.88	47.73	318999.01
	Foreman Op PU 4x2 TON	1	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.02	0.27	0.03	0.01	0.00	97.54	92	0.28	3.10	0.33	0.12	0.05	1121.67
	Pickup 4x4 3/4 TON	2	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.05	0.54	0.06	0.02	0.01	195.07	184	0.55	6.20	0.66	0.24	0.10	2243.34
On-Road Trucks	Water Truck	1	0.001726	0.007867	0.051457	0.001710	0.000974	17.165125	8	0.01	0.06	0.41	0.01	0.01	137.32	184	0.32	1.45	9.47	0.31	0.18	3158.38
	Service Truck		0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
										0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		15	0.015485	0.170450	0.017920	0.006194	0.002606	58.817686	1	0.23	2.56	0.27	0.09	0.04	882.27		0.00	0.00	0.00	0.00	0.00	0.00
Sub Total										8.63	59.76	78.18	3.04	2.73	18079.07		192.38	1306.35	1791.05	67.53	61.84	392161.59

Table 9 - 24 Emissions from Task 24 - Remove Ramps

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
	815F Sheepfoot Compactor		0.051429	0.599446	0.591347	0.022878	0.021047	111.030255	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.027551	0.345245	0.299880	0.013775	0.012673	63.946723	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)	1	0.077651	0.440637	0.759299	0.042419	0.039025	81.320666	8	0.62	3.53	6.07	0.34	0.31	650.57	64	4.97	28.20	48.60	2.71	2.50	5204.52
	LGP 325L Excavator		0.034218	0.359992	0.321981	0.015596	0.014349	73.942541	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	1	0.057797	0.913251	0.565964	0.018647	0.017155	187.582279	8	0.46	7.31	4.53	0.15	0.14	1500.66	64	3.70	58.45	36.22	1.19	1.10	12005.27
	Telescopic Handler (Forklift)		0.022246	0.179179	0.208696	0.011297	0.010393	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader		0.054465	0.438454	0.613435	0.020364	0.018735	93.266561	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Construction Vehicles	140H Motor Grader		0.061334	0.455049	0.779056	0.024906	0.022913	87.695050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.054200	0.253254	0.537233	0.028727	0.026429	50.715012	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010670	0.057976	0.074537	0.003611	0.003322	9.263038	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.042379	0.227131	0.234202	0.012340	0.011352	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.084951	0.780438	0.922264	0.034414	0.031661	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.090100	0.827737	0.978159	0.036500	0.033580	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.033980	0.473745	0.412080	0.011873	0.010923	117.921634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.062838	0.388319	0.572483	0.020858	0.019189	128.257698	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON	3	0.106175	0.656125	0.967299	0.035242	0.032423	216.711283	8	2.55	15.75	23.22	0.85	0.78	5201.07	192	20.39	125.98	185.72	6.77	6.23	41608.57
	Foreman Op PU 4x2 TON	1	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.02	0.27	0.03	0.01	0.00	97.54	32	0.10	1.08	0.12	0.04	0.02	390.15
	Pickup 4x4 3/4 TON	2	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.05	0.54	0.06	0.02	0.01	195.07	64	0.19	2.16	0.23	0.08	0.03	780.29
On-Road Trucks	Water Truck	1	0.001726	0.007867	0.051457	0.001710	0.000974	17.165125	8	0.01	0.06	0.41	0.01	0.01	137.32	64	0.11	0.50	3.29	0.11	0.06	1098.57
	Service Truck		0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		9	0.015485	0.170450	0.017920	0.006194	0.002606	58.817686	1	0.14	1.53	0.16	0.06	0.02	529.36		0.00	0.00	0.00	0.00	0.00	0.00
Sub Total										3.86	28.98	34.48	1.43	1.27	8311.58		29.45	216.36	274.18	10.91	9.93	61087.36

Table 9 - 25 Emissions from Task 25 - Breach (Northern Breach)

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
	815F Sheepfoot Compactor		0.051429	0.599446	0.591347	0.022878	0.021047	111.030255	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.027551	0.345245	0.299880	0.013775	0.012673	63.946723	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.077651	0.440637	0.759299	0.042419	0.039025	81.320666	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator		0.034218	0.359992	0.321981	0.015596	0.014349	73.942541	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	2	0.057797	0.913251	0.565964	0.018647	0.017155	187.582279	8	0.92	14.61	9.06	0.30	0.27	3001.32	384	22.19	350.69	217.33	7.16	6.59	72031.60
	Telescopic Handler (Forklift)	1	0.022246	0.179179	0.208696	0.011297	0.010393	32.881502	8	0.18	1.43	1.67	0.09	0.08	263.05	48	1.07	8.60	10.02	0.54	0.50	1578.31
	950G Rubber Tire Loader		0.054465	0.438454	0.613435	0.020364	0.018735	93.266561	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Off-Road Construction Vehicles	140H Motor Grader		0.061334	0.455049	0.779056	0.024906	0.022913	87.695050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.054200	0.253254	0.537233	0.028727	0.026429	50.715012	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton	1	0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.46	3.58	5.29	0.21	0.20	717.60	128	7.36	57.33	84.71	3.40	3.12	11481.52
	Small Generator		0.010670	0.057976	0.074537	0.003611	0.003322	9.263038	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator	1	0.042379	0.227131	0.234202	0.012340	0.011352	31.031175	8	0.34	1.82	1.87	0.10	0.09	248.25	128	5.42	29.07	29.98	1.58	1.45	3971.99
	Concrete Crane Pump Truck		0.084951	0.780438	0.922264	0.034414	0.031661	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.090100	0.827737	0.978159	0.036500	0.033580	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.033980	0.473745	0.412080	0.011873	0.010923	117.921634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.062838	0.388319	0.572483	0.020858	0.019189	128.257698	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON	6	0.106175	0.656125	0.967299	0.035242	0.032423	216.711283	8	5.10	31.49	46.43	1.69	1.56	10402.14	1056	112.12	692.87	1021.47	37.22	34.24	228847.11
	Foreman Op PU 4x2 TON	1	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.02	0.27	0.03	0.01	0.00	97.54	74	0.22	2.49	0.27	0.10	0.04	902.21
	Pickup 4x4 3/4 TON	1	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.02	0.27	0.03	0.01	0.00	97.54	176	0.53	5.93	0.63	0.23	0.10	2145.80
On-Road Trucks	Water Truck	1	0.001726	0.007867	0.051457	0.001710	0.000974	17.165125	8	0.01	0.06	0.41	0.01	0.01	137.32	176	0.30	1.38	9.06	0.30	0.17	3021.06
	Service Truck	1	0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.03	0.16	1.03	0.03	0.02	343.30	32	0.14	0.63	4.12	0.14	0.08	1373.21
	Flatbed 2 TON	1	0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.03	0.16	1.03	0.03	0.02	343.30	16	0.07	0.31	2.06	0.07	0.04	686.60
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		16	0.015485	0.170450	0.017920	0.006194	0.002606	58.817686	1	0.25	2.73	0.29	0.10	0.04	941.08		0.00	0.00	0.00	0.00	0.00	0.00
Sub Total										7.38	56.58	67.14	2.59	2.30	16592.44		149.43	1149.32	1379.63	50.72	46.32	326039.42

Table 9 - 26 Emissions from Task 26 - Breach (Southern Breach)

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.051429	0.599446	0.591347	0.022878	0.021047	111.030255	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.027551	0.345245	0.299880	0.013775	0.012673	63.946723	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.077651	0.440637	0.759299	0.042419	0.039025	81.320666	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator		0.034218	0.359992	0.321981	0.015596	0.014349	73.942541	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 375L Excavator	2	0.057797	0.913251	0.565964	0.018647	0.017155	187.582279	8	0.92	14.61	9.06	0.30	0.27	3001.32	384	22.19	350.69	217.33	7.16	6.59	72031.60
	Telescopic Handler (Forklift)	1	0.022246	0.179179	0.208696	0.011297	0.010393	32.881502	8	0.18	1.43	1.67	0.09	0.08	263.05	48	1.07	8.60	10.02	0.54	0.50	1578.31
	950G Rubber Tire Loader		0.054465	0.438454	0.613435	0.020364	0.018735	93.266561	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	140H Motor Grader		0.061334	0.455049	0.779056	0.024906	0.022913	87.695050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.054200	0.253254	0.537233	0.028727	0.026429	50.715012	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton	1	0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.46	3.58	5.29	0.21	0.20	717.60	128	7.36	57.33	84.71	3.40	3.12	11481.52
	Small Generator		0.010670	0.057976	0.074537	0.003611	0.003322	9.263038	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator	1	0.042379	0.227131	0.234202	0.012340	0.011352	31.031175	8	0.34	1.82	1.87	0.10	0.09	248.25	128	5.42	29.07	29.98	1.58	1.45	3971.99
	Concrete Crane Pump Truck		0.084951	0.780438	0.922264	0.034414	0.031661	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.090100	0.827737	0.978159	0.036500	0.033580	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig		0.033980	0.473745	0.412080	0.011873	0.010923	117.921634	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	10 Wheel Dump 10 TON		0.062838	0.388319	0.572483	0.020858	0.019189	128.257698	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON	6	0.106175	0.656125	0.967299	0.035242	0.032423	216.711283	8	5.10	31.49	46.43	1.69	1.56	10402.14	1056	112.12	692.87	1021.47	37.22	34.24	228847.11
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.02	0.27	0.03	0.01	0.00	97.54	74	0.22	2.49	0.27	0.10	0.04	902.21
	Pickup 4x4 3/4 TON	1	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.02	0.27	0.03	0.01	0.00	97.54	176	0.53	5.93	0.63	0.23	0.10	2145.80
	Water Truck	1	0.001726	0.007867	0.051457	0.001710	0.000974	17.165125	8	0.01	0.06	0.41	0.01	0.01	137.32	176	0.30	1.38	9.06	0.30	0.17	3021.06
	Service Truck	1	0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.03	0.16	1.03	0.03	0.02	343.30	32	0.14	0.63	4.12	0.14	0.08	1373.21
	Flatbed 2 TON	1	0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.03	0.16	1.03	0.03	0.02	343.30	16	0.07	0.31	2.06	0.07	0.04	686.60
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		16	0.015485	0.170450	0.017920	0.006194	0.002606	58.817686	1	0.25	2.73	0.29	0.10	0.04	941.08		0.00	0.00	0.00	0.00	0.00	0.00
Sub Total										7.38	56.58	67.14	2.59	2.30	16592.44		149.43	1149.32	1379.63	50.72	46.32	326039.42

Table 9 - 27 Emissions from Task 27 - Planting and revegetation

Emission Sources		Source Quantities	unit hourly emissions (pounds per day per construction vehicle)						Hours Per Day	Daily Emissions (pounds per day)							Emissions for the Task					
			ROG	CO	NOx	PM10	PM2.5	CO2		ROG	CO	NOx	PM10	PM2.5	CO2	hours	ROG	CO	NOx	PM10	PM2.5	CO2
Off-Road Construction Vehicles	815F Sheepfoot Compactor		0.051429	0.599446	0.591347	0.022878	0.021047	111.030255	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Sheepfoot 60"		0.027551	0.345245	0.299880	0.013775	0.012673	63.946723	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Barge Mounted Dredge		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Dozer (D-6H Dozer)		0.077651	0.440637	0.759299	0.042419	0.039025	81.320666	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	LGP 325L Excavator	1	0.034218	0.359992	0.321981	0.015596	0.014349	73.942541	8	0.27	2.88	2.58	0.12	0.11	591.54	60	2.05	21.60	19.32	0.94	0.86	4436.55
	LGP 375L Excavator		0.057797	0.913251	0.565964	0.018647	0.017155	187.582279	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Telescopic Handler (Forklift)		0.022246	0.179179	0.208696	0.011297	0.010393	32.881502	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	950G Rubber Tire Loader	2	0.054465	0.438454	0.613435	0.020364	0.018735	93.266561	8	0.87	7.02	9.81	0.33	0.30	1492.26	240	13.07	105.23	147.22	4.89	4.50	22383.97
	140H Motor Grader		0.061334	0.455049	0.779056	0.024906	0.022913	87.695050	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 30 Ton		0.054200	0.253254	0.537233	0.028727	0.026429	50.715012	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	RT Crane 60 Ton		0.057492	0.447929	0.661777	0.026526	0.024404	89.699404	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Small Generator		0.010670	0.057976	0.074537	0.003611	0.003322	9.263038	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Large Generator		0.042379	0.227131	0.234202	0.012340	0.011352	31.031175	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Concrete Crane Pump Truck		0.084951	0.780438	0.922264	0.034414	0.031661	149.706511	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Tub Grinder		0.090100	0.827737	0.978159	0.036500	0.033580	158.779633	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Drill Rig	1	0.033980	0.473745	0.412080	0.011873	0.010923	117.921634	8	0.27	3.79	3.30	0.09	0.09	943.37	30	1.02	14.21	12.36	0.36	0.33	3537.65
	10 Wheel Dump 10 TON		0.062838	0.388319	0.572483	0.020858	0.019189	128.257698	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Semi End Dump 20 TON		0.106175	0.656125	0.967299	0.035242	0.032423	216.711283	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
On-Road Trucks	Foreman Op PU 4x2 TON	1	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.02	0.27	0.03	0.01	0.00	97.54	60	0.18	2.02	0.22	0.08	0.03	731.52
	Pickup 4x4 3/4 TON	2	0.002999	0.033696	0.003602	0.001288	0.000541	12.192047	8	0.05	0.54	0.06	0.02	0.01	195.07	240	0.72	8.09	0.86	0.31	0.13	2926.09
	Water Truck		0.001726	0.007867	0.051457	0.001710	0.000974	17.165125	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Service Truck		0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
	Flatbed 2 TON		0.004316	0.019668	0.128643	0.004276	0.002434	42.912812	8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
			0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Worker Commute Emissions		7	0.015485	0.170450	0.017920	0.006194	0.002606	58.817686	1	0.11	1.19	0.13	0.04	0.02	411.72		0.00	0.00	0.00	0.00	0.00	0.00
Sub Total										1.60	15.69	15.90	0.62	0.53	3731.51		17.04	151.15	179.99	6.57	5.85	34015.79

Table 10-A Task Emission Summary for Option B Barges

	Tasks	Start	End	Year	Total Emissions for the Task (Construction Vehicles, Deliveries, and Fugitive Dust)						Emissions from Construction Vehicles from tabs Tasks 2018, Tasks 2019 and Tasks 2020						Emissions from Material Deliveries from tab Emissions-Deliveries						Fugitive Dust Emissions From tab Emissions-Fugitive Dust					
					ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
Task01	South Property Levee Repair	5/9/2018	6/5/2018	2018	143.85	896.98	1970.82	83.24	66.77	273637.11	65.59	487.02	707.23	31.04	27.90	97394.34	78.25	409.96	1263.60	37.20	35.75	176242.77				15.00	3.12	
Task02	Plug Existing Culvert	6/6/2018	6/12/2018	2018	2.48	18.54	32.92	1.32	0.90	9218.44	2.10	16.81	15.85	0.92	0.67	5056.52	0.38	1.72	17.07	0.40	0.23	4161.91				0.00	0.00	
Task03	Terrestrial Species control	4/10/2018	4/23/2018	2018	1.51	17.27	1.88	0.55	0.23	5261.71	1.51	17.27	1.88	0.55	0.23	5261.71										0.00	0.00	
Task04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	432.53	2563.81	3755.17	476.78	207.64	651801.78	404.13	2416.37	3220.34	141.88	127.15	573746.30	28.40	147.44	534.83	14.90	13.93	78055.48				320.00	66.56	
Task05	Maintenance Dewatering (Ground	9/11/2018	11/4/2019	2018-2019	627.35	3157.66	3768.45	212.72	188.22	595823.89	626.66	3154.54	3737.60	212.00	187.81	588302.36	0.69	3.12	30.85	0.72	0.41	7521.53				0.00	0.00	
Task06	Aquatic Species control	10/1/2018	10/31/2018	2018	49.10	64.38	31.67	1.05	1.01	16631.45	49.10	64.38	31.67	1.05	1.01	16631.45										0.00	0.00	
Task07	Clearing and Grubbing	9/11/2018	1/17/2019	2018-2019	687.57	3882.24	6961.33	3600.11	989.57	885982.30	687.57	3882.24	6961.33	345.11	312.53	885982.30										3255.00	677.04	
Task08	Construct Ramps	8/28/2018	9/24/2018	2018	144.58	815.29	2098.29	119.04	75.76	284411.91	39.24	262.87	430.93	19.58	17.66	53311.12	105.33	552.43	1667.36	49.46	47.70	231100.79				50.00	10.40	
Task09	Construct Access Roads	8/28/2018	12/7/2018	2018	610.46	3445.94	8341.51	503.54	312.39	1156681.12	168.95	1125.04	1853.11	84.73	76.40	227794.55	441.52	2320.90	6488.40	198.81	190.22	928886.57				220.00	45.76	
Task10	Interior Staging Area Construction	9/25/2018	10/24/2018	2018	402.21	2196.56	5740.93	184.85	175.40	805465.43	57.81	386.55	641.36	29.12	26.27	77933.73	344.40	1810.01	5099.56	155.73	149.13	727531.70				0.00	0.00	
Task11	Old infrastructure removal	11/20/2018	3/7/2019	2018-2019	6.60	58.15	66.48	3.11	2.80	11948.35	6.60	58.15	66.48	3.11	2.80	11948.35										0.00	0.00	
Task12	Remove Pump Stations (6)	11/20/2018	12/6/2018	2018	20.62	129.90	199.21	16.05	9.19	33864.32	20.62	129.90	199.21	8.55	7.63	33864.32										7.50	1.56	
Task13	Breach (Cross Levee)	1/18/2019	1/31/2019	2019	132.74	966.65	1275.87	146.78	63.02	284764.79	132.74	966.65	1275.87	46.78	42.22	284764.79										100.00	20.80	
Task14	Interior Channel Network	2/15/2019	6/5/2019	2019	2118.28	15386.75	20409.25	1535.10	839.30	4515681.55	2118.28	15386.75	20409.25	745.10	674.98	4515681.55										790.00	164.32	
Task15	Dry Excavated Material	3/29/2019	8/13/2019	2019	361.13	2274.94	3921.41	177.22	160.03	457444.83	361.13	2274.94	3921.41	177.22	160.03	457444.83										0.00	0.00	
Task16	Remove existing Pump (Southeast	10/1/2019	12/6/2019	2019	5.69	34.78	56.07	2.53	2.23	9800.61	5.63	34.50	53.74	2.47	2.19	9167.07	0.06	0.27	2.33	0.06	0.04	633.54				0.00	0.00	
Task17	Fill Agricultural Ditches	6/6/2019	6/10/2019	2019	23.82	185.88	247.83	52.20	19.33	36731.95	23.82	185.88	247.83	12.20	11.01	36731.95										40.00	8.32	
Task18	Construct Interior Mounds	6/11/2019	7/4/2019	2019	89.78	689.10	998.07	133.29	57.69	139139.54	89.78	689.10	998.07	43.29	38.97	139139.54										90.00	18.72	
Task19	Construct Eastern Toe Berm	6/6/2019	9/20/2019	2019	384.07	2947.82	4269.50	570.20	246.79	595208.03	384.07	2947.82	4269.50	185.20	166.71	595208.03										385.00	80.08	
Task20	Construct Intertidal Bench	8/14/2019	1/9/2020	2019-2020	1064.22	8166.39	11808.40	1582.58	684.76	1632872.10	1064.22	8166.39	11808.40	512.58	462.20	1632872.10										1070.00	222.56	
Task21	Fill borrow ditch	1/20/2020	1/24/2020	2020	9.22	72.36	103.50	49.39	13.37	14000.47	9.22	72.36	103.50	4.39	4.01	14000.47										45.00	9.36	
Task22	Dredge Miner Slough	1/10/2020	3/19/2020	2020	459.91	3260.63	5127.49	492.95	240.91	850801.86	380.40	2843.11	3920.44	156.49	143.51	680473.16	79.51	417.52	1207.05	36.46	35.00	170328.70				300.00	62.40	
Task23	Remove Access Roads	3/20/2020	4/21/2020	2020	192.38	1306.35	1791.05	136.53	76.19	392161.59	192.38	1306.35	1791.05	67.53	61.84	392161.59										69.00	14.35	
Task24	Remove Ramps	4/22/2020	5/1/2020	2020	29.45	216.36	274.18	34.91	14.93	61087.36	29.45	216.36	274.18	10.91	9.93	61087.36										24.00	4.99	
Task25	Breach (Northern Breach)	5/4/2020	6/23/2020	2020	149.43	1149.32	1379.63	160.72	69.20	326039.42	149.43	1149.32	1379.63	50.72	46.32	326039.42	0.00	0.00	0.00	0.00	0.00	0.00				110.00	22.88	
Task26	Breach (Southern Breach)	6/24/2020	8/13/2020	2020	149.43	1149.32	1379.63	160.72	69.20	326039.42	149.43	1149.32	1379.63	50.72	46.32	326039.42	0.00	0.00	0.00	0.00	0.00	0.00				110.00	22.88	
Task27	Planting and revegetation	8/14/2020	11/24/2020	2020	18.08	155.87	210.89	7.59	6.43	44324.17	17.04	151.15	179.99	6.57	5.85	34015.79	1.04	4.72	30.90	1.03	0.58	10308.38				0.00	0.00	
Total Emissions					8316.49	55209.24	86221.41	10445.07	4593.26	14416825.50	7236.91	49541.13	69879.46	2949.79	2664.16	12082054.12	1079.58	5668.10	16341.95	494.78	473.00	2334771.38				7000.50	1456.10	

Table 10-B Emission Summary for the years 2018, 2019 and 2020 for Option B Barges

	Tasks	Start	End	Year	Task Emissions in each year						
					ROG	CO	NOx	PM10	PM2.5	CO2	
Task01	South Property Levee Repair	5/9/2018	6/5/2018		143.85	896.98	1970.82	83.24	66.77	273637.11	2018
Task02	Plug Existing Culvert	6/6/2018	6/12/2018		2.48	18.54	32.92	1.32	0.90	9218.44	2018
Task03	Terrestrial Species control	4/10/2018	4/23/2018		1.51	17.27	1.88	0.55	0.23	5261.71	2018
Task04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018		432.53	2563.81	3755.17	476.78	207.64	651801.78	2018
Task06	Aquatic Species control	10/1/2018	10/31/2018		49.10	64.38	31.67	1.05	1.01	16631.45	2018
Task08	Construct Ramps	8/28/2018	9/24/2018		144.58	815.29	2098.29	119.04	75.76	284411.91	2018
Task09	Construct Access Roads	8/28/2018	12/7/2018		610.46	3445.94	8341.51	503.54	312.39	1156681.12	2018
Task10	Interior Staging Area Construction	9/25/2018	10/24/2018		402.21	2196.56	5740.93	184.85	175.40	805465.43	2018
Task12	Remove Pump Stations (6)	11/20/2018	12/6/2018	2018	20.62	129.90	199.21	16.05	9.19	33864.32	2018
Task05	Maintenance Dewatering (Ground	9/11/2018	11/4/2019		167.29	842.04	1004.92	56.73	50.19	158886.37	2018-2019
Task07	Clearing and Grubbing	9/11/2018	1/17/2019		591.46	3339.56	5988.24	3096.87	851.25	762135.31	2018-2019
Task11	Old infrastructure removal	11/20/2018	3/7/2019		2.54	22.37	25.57	1.20	1.08	4595.52	2018-2019
Total Emissions in Year 2018				**pounds**	**2568.63**	**14352.65**	**29191.12**	**4541.21**	**1751.79**	**4162590.47**	
				tons	**1.17**	**6.51**	**13.24**	**2.06**	**0.79**	**1888.65**	
Task05	Maintenance Dewatering (Ground	9/11/2018	11/4/2019		460.06	2315.61	2763.53	155.99	138.03	83287.21	2018-2019
Task07	Clearing and Grubbing	9/11/2018	1/17/2019		96.11	542.68	973.09	503.24	138.33	123846.99	2018-2019
Task11	Old infrastructure removal	11/20/2018	3/7/2019		4.06	35.78	40.91	1.91	1.72	7352.83	2018-2019
Task13	Breach (Cross Levee)	1/18/2019	1/31/2019		132.74	966.65	1275.87	146.78	63.02	284764.79	2019
Task14	Interior Channel Network	2/15/2019	6/5/2019		2118.28	15386.75	20409.25	1535.10	839.30	4515681.55	2019
Task15	Dry Excavated Material	3/29/2019	8/13/2019	2019	361.13	2274.94	3921.41	177.22	160.03	457444.83	2019
Task16	Remove existing Pump (Southeast	10/1/2019	12/6/2019		5.69	34.78	56.07	2.53	2.23	9800.61	2019
Task17	Fill Agricultural Ditches	6/6/2019	6/10/2019		23.82	185.88	247.83	52.20	19.33	36731.95	2019
Task18	Construct Interior Mounds	6/11/2019	7/4/2019		89.78	689.10	998.07	133.29	57.69	139139.54	2019
Task19	Construct Eastern Toe Berm	6/6/2019	9/20/2019		384.07	2947.82	4269.50	570.20	246.79	595208.03	2019
Task20	Construct Intertidal Bench	8/14/2019	1/9/2020		994.60	7632.14	11035.89	1479.05	639.96	1534899.77	2019-2020
Total Emissions in Year 2019				**pounds**	**4670.35**	**33012.13**	**45991.41**	**4757.52**	**2306.42**	**7788158.10**	
				tons	**2.12**	**14.98**	**20.87**	**2.16**	**1.05**	**3533.65**	
Task20	Construct Intertidal Bench	8/14/2019	1/9/2020		69.62	534.25	772.51	103.53	44.80	106823.41	2019-2020
Task21	Fill borrow ditch	1/20/2020	1/24/2020		9.22	72.36	103.50	49.39	13.37	14000.47	2020
Task22	Dredge Miner Slough	1/10/2020	3/19/2020		459.91	3260.63	5127.49	492.95	240.91	850801.86	2020
Task23	Remove Access Roads	3/20/2020	4/21/2020		192.38	1306.35	1791.05	136.53	76.19	392161.59	2020
Task24	Remove Ramps	4/22/2020	5/1/2020		29.45	216.36	274.18	34.91	14.93	61087.36	2020
Task25	Breach (Northern Breach)	5/4/2020	6/23/2020	2020	149.43	1149.32	1379.63	160.72	69.20	326039.42	2020
Task26	Breach (Southern Breach)	6/24/2020	8/13/2020		149.43	1149.32	1379.63	160.72	69.20	326039.42	2020
Task27	Planting and revegetation	8/14/2020	11/24/2020		18.08	155.87	210.89	7.59	6.43	44324.17	2020
Total Emissions in Year 2020				**pounds**	**1077.52**	**7844.46**	**11038.88**	**1146.34**	**535.04**	**2121277.71**	
				tons	**0.49**	**3.56**	**5.01**	**0.52**	**0.24**	**962.47**	
Total Project Emissions (2018+2019+2020)				**pounds**	**8316.49**	**55209.24**	**86221.41**	**10445.07**	**4593.26**	**14072026.27**	
				tons	**3.77**	**25.05**	**39.12**	**4.74**	**2.08**	**6384.77**	

Note: The emissions for T-05, 07 11 and 20 are prorated based on the number of workdays in the years as shown in lines 48-54 and 61-63.
So for T-05, 27 percent emissions are in 2018 and 73 percent are in 2019
for T-07, 86 percent emissions are in 2018 and 14 percent are in 2019
for T-11, 38 percent emissions are in 2018 and 62 percent are in 2019
for T-20, 93 percent emissions are in 2018 and 7 percent are in 2019

Table 11-A Task Emission Summary for Option A Trucks

	Tasks	Start	End	Year	Total Emissions for the Task (Construction Vehicles, Deliveries, and Fugitive Dust)						Emissions from Construction Vehicles from tabs Tasks 2018, Tasks 2019 and Tasks 2020						Emissions from Material Deliveries from tab Emissions-Deliveries						Fugitive Dust Emissions From tab Emissions-Fugitive Dust					
					ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
Task01	South Property Levee Repair	5/9/2018	6/5/2018	2018	70.81	510.56	940.23	51.49	34.13	154206.97	65.59	487.02	707.23	31.04	27.90	97394.34	5.22	23.54	233.00	5.45	3.11	56812.63				15.00	3.12	
Task02	Plug Existing Culvert	6/6/2018	6/12/2018	2018	2.48	18.54	32.92	1.32	0.90	9218.44	2.10	16.81	15.85	0.92	0.67	5056.52	0.38	1.72	17.07	0.40	0.23	4161.91				0.00	0.00	
Task03	Terrestrial Species control	4/10/2018	4/23/2018	2018	1.51	17.27	1.88	0.55	0.23	5261.71	1.51	17.27	1.88	0.55	0.23	5261.71										0.00	0.00	
Task04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	407.06	2429.63	3351.55	464.95	195.46	605737.88	404.13	2416.37	3220.34	141.88	127.15	573746.30	2.94	13.26	131.21	3.07	1.75	31991.58				320.00	66.56	
Task05	Maintenance Dewatering (Ground	9/11/2018	11/4/2019	2018-2019	627.35	3157.66	3768.45	212.72	188.22	595823.89	626.66	3154.54	3737.60	212.00	187.81	588302.36	0.69	3.12	30.85	0.72	0.41	7521.53				0.00	0.00	
Task06	Aquatic Species control	10/1/2018	10/31/2018	2018	49.10	64.38	31.67	1.05	1.01	16631.45	49.10	64.38	31.67	1.05	1.01	16631.45										0.00	0.00	
Task07	Clearing and Grubbing	9/11/2018	1/17/2019	2018-2019	687.57	3882.24	6961.33	3600.11	989.57	885982.30	687.57	3882.24	6961.33	345.11	312.53	885982.30										3255.00	677.04	
Task08	Construct Ramps	8/28/2018	9/24/2018	2018	47.13	298.49	783.47	77.83	32.77	139271.48	39.24	262.87	430.93	19.58	17.66	53311.12	7.89	35.62	352.54	8.25	4.71	85960.35				50.00	10.40	
Task09	Construct Access Roads	8/28/2018	12/7/2018	2018	208.34	1302.88	3613.18	345.92	145.68	656951.61	168.95	1125.04	1853.11	84.73	76.40	227794.55	39.39	177.84	1760.07	41.19	23.51	429157.05				220.00	45.76	
Task10	Interior Staging Area Construction	9/25/2018	10/24/2018	2018	87.40	520.13	1963.40	60.06	43.93	400285.05	57.81	386.55	641.36	29.12	26.27	77933.73	29.59	133.58	1322.04	30.94	17.66	322351.32				0.00	0.00	
Task11	Old infrastructure removal	11/20/2018	3/7/2019	2018-2019	6.60	58.15	66.48	3.11	2.80	11948.35	6.60	58.15	66.48	3.11	2.80	11948.35										0.00	0.00	
Task12	Remove Pump Stations (6)	11/20/2018	12/6/2018	2018	20.62	129.90	199.21	16.05	9.19	33864.32	20.62	129.90	199.21	8.55	7.63	33864.32										7.50	1.56	
Task13	Breach (Cross Levee)	1/18/2019	1/31/2019	2019	132.74	966.65	1275.87	146.78	63.02	284764.79	132.74	966.65	1275.87	46.78	42.22	284764.79										100.00	20.80	
Task14	Interior Channel Network	2/15/2019	6/5/2019	2019	2118.28	15386.75	20409.25	1535.10	839.30	4515681.55	2118.28	15386.75	20409.25	745.10	674.98	4515681.55										790.00	164.32	
Task15	Dry Excavated Material	3/29/2019	8/13/2019	2019	361.13	2274.94	3921.41	177.22	160.03	457444.83	361.13	2274.94	3921.41	177.22	160.03	457444.83										0.00	0.00	
Task16	Remove existing Pump (Southeast	10/1/2019	12/6/2019	2019	5.69	34.78	56.07	2.53	2.23	9800.61	5.63	34.50	53.74	2.47	2.19	9167.07	0.06	0.27	2.33	0.06	0.04	633.54				0.00	0.00	
Task17	Fill Agricultural Ditches	6/6/2019	6/10/2019	2019	23.82	185.88	247.83	52.20	19.33	36731.95	23.82	185.88	247.83	12.20	11.01	36731.95										40.00	8.32	
Task18	Construct Interior Mounds	6/11/2019	7/4/2019	2019	89.78	689.10	998.07	133.29	57.69	139139.54	89.78	689.10	998.07	43.29	38.97	139139.54										90.00	18.72	
Task19	Construct Eastern Toe Berm	6/6/2019	9/20/2019	2019	384.07	2947.82	4269.50	570.20	246.79	595208.03	384.07	2947.82	4269.50	185.20	166.71	595208.03										385.00	80.08	
Task20	Construct Intertidal Bench	8/14/2019	1/9/2020	2019-2020	1064.22	8166.39	11808.40	1582.58	684.76	1632872.10	1064.22	8166.39	11808.40	512.58	462.20	1632872.10										1070.00	222.56	
Task21	Fill borrow ditch	1/20/2020	1/24/2020	2020	9.22	72.36	103.50	49.39	13.37	14000.47	9.22	72.36	103.50	4.39	4.01	14000.47										45.00	9.36	
Task22	Dredge Miner Slough	1/10/2020	3/19/2020	2020	387.25	2874.29	4124.39	463.27	209.77	748508.50	380.40	2843.11	3920.44	156.49	143.51	680473.16	6.84	31.18	203.95	6.78	3.86	68035.34				300.00	62.40	
Task23	Remove Access Roads	3/20/2020	4/21/2020	2020	192.38	1306.35	1791.05	136.53	76.19	392161.59	192.38	1306.35	1791.05	67.53	61.84	392161.59										69.00	14.35	
Task24	Remove Ramps	4/22/2020	5/1/2020	2020	29.45	216.36	274.18	34.91	14.93	61087.36	29.45	216.36	274.18	10.91	9.93	61087.36										24.00	4.99	
Task25	Breach (Northern Breach)	5/4/2020	6/23/2020	2020	149.55	1149.88	1383.34	160.84	69.28	327276.43	149.43	1149.32	1379.63	50.72	46.32	326039.42	0.12	0.57	3.71	0.12	0.07	1237.01				110.00	22.88	
Task26	Breach (Southern Breach)	6/24/2020	8/13/2020	2020	149.55	1149.88	1383.34	160.84	69.28	327276.43	149.43	1149.32	1379.63	50.72	46.32	326039.42	0.12	0.57	3.71	0.12	0.07	1237.01				110.00	22.88	
Task27	Planting and revegetation	8/14/2020	11/24/2020	2020	18.08	155.87	210.89	7.59	6.43	44324.17	17.04	151.15	179.99	6.57	5.85	34015.79	1.04	4.72	30.90	1.03	0.58	10308.38				0.00	0.00	
Total Emissions					7331.20	49967.14	73970.85	10048.44	4176.27	13101461.77	7236.91	49541.13	69879.46	2949.79	2664.16	12082054.12	94.29	426.00	4091.39	98.15	56.01	1019407.65				7000.50	1456.10	

Table 11-B Emission Summary for the years 2018, 2019 and 2020 for Option A Trucks

	Tasks	Start	End	Year	Task Emissions in each year						
					ROG	CO	NOx	PM10	PM2.5	CO2	
Task01	South Property Levee Repair	5/9/2018	6/5/2018		70.81	510.56	940.23	51.49	34.13	154206.97	2018
Task02	Plug Existing Culvert	6/6/2018	6/12/2018		2.48	18.54	32.92	1.32	0.90	9218.44	2018
Task03	Terrestrial Species control	4/10/2018	4/23/2018		1.51	17.27	1.88	0.55	0.23	5261.71	2018
Task04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018		407.06	2429.63	3351.55	464.95	195.46	605737.88	2018
Task06	Aquatic Species control	10/1/2018	10/31/2018		49.10	64.38	31.67	1.05	1.01	16631.45	2018
Task08	Construct Ramps	8/28/2018	9/24/2018		47.13	298.49	783.47	77.83	32.77	139271.48	2018
Task09	Construct Access Roads	8/28/2018	12/7/2018	2018	208.34	1302.88	3613.18	345.92	145.68	656951.61	2018
Task10	Interior Staging Area Construction	9/25/2018	10/24/2018		87.40	520.13	1963.40	60.06	43.93	400285.05	2018
Task12	Remove Pump Stations (6)	11/20/2018	12/6/2018		20.62	129.90	199.21	16.05	9.19	33864.32	2018
Task05	Maintenance Dewatering (Ground	9/11/2018	11/4/2019		167.29	842.04	1004.92	56.73	50.19	158886.37	2018-2019
Task07	Clearing and Grubbing	9/11/2018	1/17/2019		591.46	3339.56	5988.24	3096.87	851.25	762135.31	2018-2019
Task11	Old infrastructure removal	11/20/2018	3/7/2019		2.54	22.37	25.57	1.20	1.08	4595.52	2018-2019
Total Emissions in Year 2018				**pounds**	**1655.75**	**9495.75**	**17936.23**	**4174.02**	**1365.81**	**2947046.08**	
				tons	**0.75**	**4.31**	**8.14**	**1.89**	**0.62**	**1337.14**	
Task05	Maintenance Dewatering (Ground	9/11/2018	11/4/2019		460.06	2315.61	2763.53	155.99	138.03	83287.21	2018-2019
Task07	Clearing and Grubbing	9/11/2018	1/17/2019		96.11	542.68	973.09	503.24	138.33	123846.99	2018-2019
Task11	Old infrastructure removal	11/20/2018	3/7/2019		4.06	35.78	40.91	1.91	1.72	7352.83	2018-2019
Task13	Breach (Cross Levee)	1/18/2019	1/31/2019		132.74	966.65	1275.87	146.78	63.02	284764.79	2019
Task14	Interior Channel Network	2/15/2019	6/5/2019		2118.28	15386.75	20409.25	1535.10	839.30	4515681.55	2019
Task15	Dry Excavated Material	3/29/2019	8/13/2019	2019	361.13	2274.94	3921.41	177.22	160.03	457444.83	2019
Task16	Remove existing Pump (Southeast	10/1/2019	12/6/2019		5.69	34.78	56.07	2.53	2.23	9800.61	2019
Task17	Fill Agricultural Ditches	6/6/2019	6/10/2019		23.82	185.88	247.83	52.20	19.33	36731.95	2019
Task18	Construct Interior Mounds	6/11/2019	7/4/2019		89.78	689.10	998.07	133.29	57.69	139139.54	2019
Task19	Construct Eastern Toe Berm	6/6/2019	9/20/2019		384.07	2947.82	4269.50	570.20	246.79	595208.03	2019
Task20	Construct Intertidal Bench	8/14/2019	1/9/2020		994.60	7632.14	11035.89	1479.05	639.96	1534899.77	2019-2020
Total Emissions in Year 2019				**pounds**	**4670.35**	**33012.13**	**45991.41**	**4757.52**	**2306.42**	**7788158.10**	
				tons	**2.12**	**14.98**	**20.87**	**2.16**	**1.05**	**3533.65**	
Task20	Construct Intertidal Bench	8/14/2019	1/9/2020		69.62	534.25	772.51	103.53	44.80	106823.41	2019-2020
Task21	Fill borrow ditch	1/20/2020	1/24/2020		9.22	72.36	103.50	49.39	13.37	14000.47	2020
Task22	Dredge Miner Slough	1/10/2020	3/19/2020		387.25	2874.29	4124.39	463.27	209.77	748508.50	2020
Task23	Remove Access Roads	3/20/2020	4/21/2020	2020	192.38	1306.35	1791.05	136.53	76.19	392161.59	2020
Task24	Remove Ramps	4/22/2020	5/1/2020		29.45	216.36	274.18	34.91	14.93	61087.36	2020
Task25	Breach (Northern Breach)	5/4/2020	6/23/2020		149.55	1149.88	1383.34	160.84	69.28	327276.43	2020
Task26	Breach (Southern Breach)	6/24/2020	8/13/2020		149.55	1149.88	1383.34	160.84	69.28	327276.43	2020
Task27	Planting and revegetation	8/14/2020	11/24/2020		18.08	155.87	210.89	7.59	6.43	44324.17	2020
Total Emissions in Year 2020				**pounds**	**1005.10**	**7459.26**	**10043.21**	**1116.91**	**504.04**	**2021458.36**	
				tons	**0.46**	**3.38**	**4.56**	**0.51**	**0.23**	**917.18**	
Total Project Emissions (2018+2019+2020)				**pounds**	**7331.20**	**49967.14**	**73970.85**	**10048.44**	**4176.27**	**12756662.54**	
				tons	**3.33**	**22.67**	**33.56**	**4.56**	**1.89**	**5787.96**	

Note: The emissions for T-05, 07 11 and 20 are prorated based on the number of workdays in the years as shown in lines 48-54 and 61-63.
So for T-05, 27 percent emissions are in 2018 and 73 percent are in 2019
for T-07, 86 percent emissions are in 2018 and 14 percent are in 2019
for T-11, 38 percent emissions are in 2018 and 62 percent are in 2019
for T-20, 93 percent emissions are in 2018 and 7 percent are in 2019

Table 12-A Maximum Daily Emission Summary for Tasks and Overlapping Task Groups for Option A

	Tasks	Start	End	Year	Maximum Daily Emissions for the Task (Construction Vehicles, Deliveries, and Fugitive Dust)						Maximum Daily Emissions from Construction Vehicles from tabs Tasks 2018, Tasks 2019 and Tasks 2020						Maximum Emissions from Material Deliveries from tab Emissions-Deliveries						Fugitive Dust Emissions From tab Emissions-Fugitive Dust					
					ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
Task01	South Property Levee Repair	5/9/2018	6/5/2018	2018	13.16	81.81	205.88	7.61	6.29	30065.83	5.38	41.46	56.42	2.47	2.22	8325.57	7.78	40.36	149.47	4.13	3.87	21740.27				1.00	0.21	
Task02	Plug Existing Culvert	6/6/2018	6/12/2018	2018	2.15	13.96	25.85	1.01	0.86	4589.35	2.06	13.51	21.45	0.91	0.80	3514.85	0.10	0.45	4.41	0.10	0.06	1074.50				0.00	0.00	
Task03	Terrestrial Species control	4/10/2018	4/23/2018	2018	0.09	1.03	0.11	0.03	0.01	314.13	0.09	1.03	0.11	0.03	0.01	314.13										0.00	0.00	
Task04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	34.86	199.57	382.62	39.05	18.08	61196.03	27.13	159.46	235.60	9.97	9.04	40050.32	7.73	40.11	147.03	4.08	3.83	21145.71				25.00	5.20	
Task05	Maintenance Dewatering (Ground	9/11/2018	11/4/2019	2018-2019	6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90				0.00	0.00	
Task06	Aquatic Species control	10/1/2018	10/31/2018	2018	48.96	62.83	31.50	1.00	0.99	16160.26	48.96	62.83	31.50	1.00	0.99	16160.26										0.00	0.00	
Task07	Clearing and Grubbing	9/11/2018	1/17/2019	2018-2019	9.33	55.26	94.25	44.58	12.47	12717.23	9.33	55.26	94.25	4.58	4.15	12717.23										40.00	8.32	
Task08	Construct Ramps	8/28/2018	9/24/2018	2018	11.22	64.89	173.80	15.59	7.38	22975.61	3.84	26.34	42.29	1.87	1.67	5612.16	7.38	38.55	131.52	3.71	3.63	17363.45				10.00	2.08	
Task09	Construct Access Roads	8/28/2018	12/7/2018	2018	12.03	70.40	183.31	16.00	7.74	24289.26	4.63	31.76	50.91	2.26	2.02	6710.91	7.40	38.63	132.40	3.74	3.64	17578.35				10.00	2.08	
Task10	Interior Staging Area Construction	9/25/2018	10/24/2018	2018	10.66	60.67	167.80	5.36	5.10	22013.13	3.28	22.12	36.28	1.65	1.48	4649.67	7.38	38.55	131.52	3.71	3.63	17363.45				0.00	0.00	
Task11	Old Infrastructure removal	11/20/2018	3/7/2019	2018-2019	1.38	12.27	13.37	0.64	0.57	2586.00	1.38	12.27	13.37	0.64	0.57	2586.00										0.00	0.00	
Task12	Remove Pump Stations (6)	11/20/2018	12/6/2018	2018	5.60	35.90	55.12	4.76	2.53	9881.98	5.60	35.90	55.12	2.26	2.01	9881.98										2.50	0.52	
Task13	Breach (Cross Levee)	1/18/2019	1/31/2019	2019	6.68	48.81	63.84	12.36	4.20	14394.55	6.68	48.81	63.84	2.36	2.12	14394.55										10.00	2.08	
Task14	Interior Channel Network	2/15/2019	6/5/2019	2019	19.91	145.00	191.38	27.02	10.49	42714.72	19.91	145.00	191.38	7.02	6.33	42714.72										20.00	4.16	
Task15	Dry Excavated Material	3/29/2019	8/13/2019	2019	3.70	23.34	40.28	1.82	1.64	4767.54	3.70	23.34	40.28	1.82	1.64	4767.54										0.00	0.00	
Task16	Remove existing Pump (Southeast	10/1/2019	12/6/2019	2019	1.50	8.86	16.13	0.71	0.60	3205.03	1.44	8.58	13.79	0.65	0.56	2571.49	0.06	0.27	2.33	0.06	0.04	633.54				0.00	0.00	
Task17	Fill Agricultural Ditches	6/6/2019	6/10/2019	2019	3.42	26.79	35.43	11.75	3.66	5325.58	3.42	26.79	35.43	1.75	1.58	5325.58										10.00	2.08	
Task18	Construct Interior Mounds	6/11/2019	7/4/2019	2019	5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13										10.00	2.08	
Task19	Construct Eastern Toe Berm	6/6/2019	9/20/2019	2019	5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13										10.00	2.08	
Task20	Construct Intertidal Bench	8/14/2019	1/9/2020	2019-2020	9.99	76.80	110.41	24.81	8.49	15416.80	9.99	76.80	110.41	4.81	4.33	15416.80										20.00	4.16	
Task21	Fill borrow ditch	1/20/2020	1/24/2020	2020	3.21	25.62	34.66	21.52	5.52	5186.13	3.21	25.62	34.66	1.52	1.36	5186.13										20.00	4.16	
Task22	Dredge Miner Slough	1/10/2020	3/19/2020	2020	18.37	121.06	240.14	28.11	11.75	38409.84	10.99	82.51	108.62	4.40	3.96	21046.38	7.38	38.55	131.52	3.71	3.63	17363.45				20.00	4.16	
Task23	Remove Access Roads	3/20/2020	4/21/2020	2020	8.63	59.76	78.18	6.04	3.36	18079.07	8.63	59.76	78.18	3.04	2.73	18079.07										3.00	0.62	
Task24	Remove Ramps	4/22/2020	5/1/2020	2020	3.86	28.98	34.48	4.43	1.90	8311.58	3.86	28.98	34.48	1.43	1.27	8311.58										3.00	0.62	
Task25	Breach (Northern Breach)	5/4/2020	6/23/2020	2020	10.31	72.13	97.29	18.69	6.43	21727.65	7.38	56.58	67.14	2.59	2.30	16592.44	2.93	15.55	30.15	1.10	1.01	5135.21				15.00	3.12	
Task26	Breach (Southern Breach)	6/24/2020	8/13/2020	2020	10.31	72.13	97.29	18.69	6.43	21727.65	7.38	56.58	67.14	2.59	2.30	16592.44	2.93	15.55	30.15	1.10	1.01	5135.21				15.00	3.12	
Task27	Planting and revegetation	8/14/2020	11/24/2020	2020	1.70	16.16	18.99	0.72	0.59	4762.35	1.60	15.69	15.90	0.62	0.53	3731.51	0.10	0.47	3.09	0.10	0.06	1030.84				0.00	0.00	
	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task07				9.33	55.26	94.25	44.58	12.47	12717.23	9.33	55.26	94.25	4.58	4.15	12717.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	8.32	0.00
overlapping task group 1	Task08				11.22	64.89	173.80	15.59	7.38	22975.61	3.84	26.34	42.29	1.87	1.67	5612.16	7.38	38.55	131.52	3.71	3.63	17363.45	0.00	0.00	0.00	10.00	2.08	0.00
	Task09				12.03	70.40	183.31	16.00	7.74	24289.26	4.63	31.76	50.91	2.26	2.02	6710.91	7.40	38.63	132.40	3.74	3.64	17578.35	0.00	0.00	0.00	10.00	2.08	0.00
	Sum				**39.15**	**230.78**	**499.72**	**78.48**	**29.63**	**68885.00**	**24.35**	**153.51**	**234.92**	**11.01**	**9.87**	**33728.29**	**14.80**	**77.27**	**264.80**	**7.47**	**7.28**	**35156.71**	**0.00**	**0.00**	**0.00**	**60.00**	**12.48**	**0.00**
	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task06				48.96	62.83	31.50	1.00	0.99	16160.26	48.96	62.83	31.50	1.00	0.99	16160.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
overlapping task group 2	Task07				9.33	55.26	94.25	44.58	12.47	12717.23	9.33	55.26	94.25	4.58	4.15	12717.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	8.32	0.00
	Task09				12.03	70.40	183.31	16.00	7.74	24289.26	4.63	31.76	50.91	2.26	2.02	6710.91	7.40	38.63	132.40	3.74	3.64	17578.35	0.00	0.00	0.00	10.00	2.08	0.00
	Task10				10.66	60.67	167.80	5.36	5.10	22013.13	3.28	22.12	36.28	1.65	1.48	4649.67	7.38	38.55	131.52	3.71	3.63	17363.45	0.00	0.00	0.00	0.00	0.00	0.00
	Sum				**87.55**	**289.38**	**525.22**	**69.26**	**28.34**	**84082.77**	**72.75**	**212.11**	**260.42**	**11.79**	**10.66**	**48926.06**	**14.80**	**77.27**	**264.80**	**7.47**	**7.28**	**35156.71**	**0.00**	**0.00**	**0.00**	**50.00**	**10.40**	**0.00**
	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task07				9.33	55.26	94.25	44.58	12.47	12717.23	9.33	55.26	94.25	4.58	4.15	12717.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	8.32	0.00
overlapping task group 3	Task09				12.03	70.40	183.31	16.00	7.74	24289.26	4.63	31.76	50.91	2.26	2.02	6710.91	7.40	38.63	132.40	3.74	3.64	17578.35	0.00	0.00	0.00	10.00	2.08	0.00
	Task11				1.38	12.27	13.37	0.64	0.57	2586.00	1.38	12.27	13.37	0.64	0.57	2586.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Task12				5.60	35.90	55.12	4.76	2.53	9881.98	5.60	35.90	55.12	2.26	2.01	9881.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.52	0.00
	Sum				**34.90**	**214.07**	**394.39**	**68.29**	**25.35**	**58377.38**	**27.48**	**175.34**	**261.12**	**12.04**	**10.78**	**40584.12**	**7.42**	**38.72**	**133.28**	**3.76**	**3.65**	**17793.26**	**0.00**	**0.00**	**0.00**	**52.50**	**10.92**	**0.00**
	Task05				6.68	48.81	63.84	12.36	4.20	14394.55	6.68	48.81	63.84	2.36	2.12	14394.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Task11				1.38	12.27	13.37	0.64	0.57	2586.00	1.38	12.27	13.37	0.64	0.57	2586.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
overlapping task group 4	Task13				6.68	48.81	63.84	12.36	4.20	14394.55	6.68	48.81	63.84	2.36	2.12	14394.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Sum				**14.73**	**109.89**	**141.05**	**25.35**	**8.96**	**31375.11**	**14.73**	**109.89**	**141.05**	**5.35**	**4.80**	**31375.11**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task11				1.38	12.27	13.37	0.64	0.57	2586.00	1.38	12.27	13.37	0.64	0.57	2586.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
overlapping task group 5	Task14				19.91	145.00	191.38	27.02	10.49	42714.72	19.91	145.00	191.38	7.02	6.33	42714.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	4.16	0.00
	Sum				**27.85**	**197.51**	**253.11**	**29.97**	**13.11**	**54203.62**	**27.83**	**197.42**	**252.22**	**9.95**	**8.94**	**53988.72**	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task14				19.91	145.00	191.38	27.02	10.49	42714.72	19.91	145.00	191.38	7.02	6.33	42714.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	4.16	0.00
overlapping task group 6	Task15				3.70	23.34	40.28	1.82	1.64	4767.54	3.70	23.34	40.28	1.82	1.64	4767.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sum				**30.17**	**208.57**	**280.02**	**31.14**	**14.18**	**56385.15**	**30.15**	**208.48**	**279.14**	**11.12**	**10.01**	**56170.25**	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task15				3.70	23.34	40.28	1.82	1.64	4767.54	3.70	23.34	40.28	1.82	1.64	4767.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
overlapping task group 6	Task17				3.42	26.79	35.43	11.75	3.66	5325.58	3.42	26.79	35.43	1.75	1.58	5325.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Task19				5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Sum				**18.70**	**128.89**	**179.55**	**28.29**	**11.59**	**26804.14**	**18.68**	**128.80**	**178.67**	**8.27**	**7.42**	**26589.24**	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task15				3.70	23.34	40.28	1.82	1.64	4767.54	3.70	23.34	40.28	1.82	1.64	4767.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
overlapping task group 7	Task18				5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Task19				5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Sum				**20.28**	**140.62**	**199.59**	**28.95**	**12.18**	**29286.70**	**20.26**	**140.53**	**198.71**	**8.93**	**8.01**	**29071.79**	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task15				3.70	23.34	40.28	1.82	1.64	4767.54	3.70	23.34	40.28	1.82	1.64	4767.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
overlapping task group 8	Task19				5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Task20				9.99	76.80	110.41	24.81	8.49	15416.80	9.99	76.80	110.41	4.81	4.33	15416.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	4.16	0.00
	Sum				**25.26**	**178.89**	**254.53**	**41.35**	**16.42**	**36895.36**	**25.24**	**178.80**	**253.65**	**11.33**	**10.17**	**36680.46**	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	**0.00**	**0.00**	**0.00**	**30.00**	**6.24**	**0.00**
	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task16				1.50	8.86	16.13	0.71	0.60	3205.03	1.44	8.58	13.79	0.65	0.56	2571.49	0.06	0.27	2.33	0.06	0.04	633.54	0.00	0.00	0.00	0.00	0.00	0.00
overlapping task group 9	Task20				9.99	76.80	110.41	24.81	8.49	15416.80	9.99	76.80	110.41	4.81	4.33	15416.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	4.16	0.00
	Sum				**18.06**	**125.89**	**174.90**	**27.83**	**11.13**	**27524.73**	**17.98**	**125.53**	**171.68**	**7.75**	**6.93**	**26676.29**	**0.08**	**0.36**	**3.21**	**0.08**	**0.05**	**848.44**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
	Task21				3.21	25.62	34.66	21.52	5.52	5186.13	3.21	25.62	34.66	1.52	1.36	5186.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	4.16	0.00
overlapping task group 10	Task22				18.37	121.06	240.14	28.11	11.75	38409.84	10.99	82.51	108.62	4.40	3.96	21046.38	7.38	38.55	131.52	3.71	3.63	17363.45	0.00	0.00	0.00	20.00	4.16	0.00
	Sum				**21.58**	**146.67**	**274.80**	**49.63**	**17.27**	**43595.97**	**14.20**	**108.13**	**143.28**	**5.91**	**5.32**	**26232.52**	**7.38**	**38.55**	**131.52**	**3.71**	**3.63**	**17363.45**	**0.00**	**0.00**	**0.00**	**40.00**	**8.32**	**0.00**
	Maximum Daily Emissions for each task and overlapping tasks				**87.55**	**289.38**	**525.22**	**78.48**	**29.63**	**84082.77**	**72.75**	**212.11**	**279.14**	**12.04**	**10.78**	**56170.25**	**14.80**	**77.27**	**264.80**	**7.47**	**7.28**	**35156.71**	**0.00**	**0.00**	**0.00**	**60.00**	**12.48**	**0.00**

Table 12-B Maximum Daily Emission Summary for Tasks and Overlapping Task Groups -Option B (material delivery by trucks only)

	Tasks	Start	End	Year	Maximum Daily Emissions for the Task (Construction Vehicles, Deliveries, and Fugitive Dust)						Maximum Daily Emissions from Construction Vehicles from tabs Tasks 2018, Tasks 2019 and Tasks 2020						Maximum Emissions from Material Deliveries from tab Emissions-Deliveries						Fugitive Dust Emissions From tab Emissions-Fugitive Dust					
					ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2	ROG	CO	NOx	PM10	PM2.5	CO2
Task01	South Property Levee Repair	5/9/2018	6/5/2018	2018	6.31	45.67	98.16	4.45	2.98	18504.70	5.38	41.46	56.42	2.47	2.22	8325.57	0.93	4.22	41.75	0.98	0.56	10179.14				1.00	0.21	
Task02	Plug Existing Culvert	6/6/2018	6/12/2018	2018	2.15	13.96	25.85	1.01	0.86	4589.35	2.06	13.51	21.45	0.91	0.80	3514.85	0.10	0.45	4.41	0.10	0.06	1074.50				0.00	0.00	
Task03	Terrestrial Species control	4/10/2018	4/23/2018	2018	0.09	1.03	0.11	0.03	0.01	314.13	0.09	1.03	0.11	0.03	0.01	314.13										0.00	0.00	
Task04	Initial Dewatering (Surface Water)	6/13/2018	8/27/2018	2018	27.72	162.09	261.68	35.58	14.59	46411.39	27.13	159.46	235.60	9.97	9.04	40050.32	0.58	2.64	26.09	0.61	0.35	6361.07				25.00	5.20	
Task05	Maintenance Dewatering (Grounds	9/11/2018	11/4/2019	2018-2019	6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90				0.00	0.00	
Task06	Aquatic Species control	10/1/2018	10/31/2018	2018	48.96	62.83	31.50	1.00	0.99	16160.26	48.96	62.83	31.50	1.00	0.99	16160.26										0.00	0.00	
Task07	Clearing and Grubbing	9/11/2018	1/17/2019	2018-2019	9.33	55.26	94.25	44.58	12.47	12717.23	9.33	55.26	94.25	4.58	4.15	12717.23										40.00	8.32	
Task08	Construct Ramps	8/28/2018	9/24/2018	2018	5.08	31.96	97.81	13.17	4.49	19150.91	3.84	26.34	42.29	1.87	1.67	5612.16	1.24	5.61	55.53	1.30	0.74	13538.76				10.00	2.08	
Task09	Construct Access Roads	8/28/2018	12/7/2018	2018	6.62	40.76	139.93	14.35	5.29	28415.90	4.63	31.76	50.91	2.26	2.02	6710.91	1.99	8.99	89.02	2.08	1.19	21704.99				10.00	2.08	
Task10	Interior Staging Area Construction	9/25/2018	10/24/2018	2018	5.05	30.14	115.60	3.51	2.53	23990.75	3.28	22.12	36.28	1.65	1.48	4649.67	1.78	8.01	79.32	1.86	1.06	19341.08				0.00	0.00	
Task11	Old infrastructure removal	11/20/2018	3/7/2019	2018-2019	1.38	12.27	13.37	0.64	0.57	2586.00	1.38	12.27	13.37	0.64	0.57	2586.00										0.00	0.00	
Task12	Remove Pump Stations (6)	11/20/2018	12/6/2018	2018	5.60	35.90	55.12	4.76	2.53	9881.98	5.60	35.90	55.12	2.26	2.01	9881.98										2.50	0.52	
Task13	Breach (Cross Levee)	1/18/2019	1/31/2019	2019	6.68	48.81	63.84	12.36	4.20	14394.55	6.68	48.81	63.84	2.36	2.12	14394.55										10.00	2.08	
Task14	Interior Channel Network	2/15/2019	6/5/2019	2019	19.91	145.00	191.38	27.02	10.49	42714.72	19.91	145.00	191.38	7.02	6.33	42714.72										20.00	4.16	
Task15	Dry Excavated Material	3/29/2019	8/13/2019	2019	3.70	23.34	40.28	1.82	1.64	4767.54	3.70	23.34	40.28	1.82	1.64	4767.54										0.00	0.00	
Task16	Remove existing Pump (Southeast	10/1/2019	12/6/2019	2019	1.50	8.86	16.13	0.71	0.60	3205.03	1.44	8.58	13.79	0.65	0.56	2571.49	0.06	0.27	2.33	0.06	0.04	633.54				0.00	0.00	
Task17	Fill Agricultural Ditches	6/6/2019	6/10/2019	2019	3.42	26.79	35.43	11.75	3.66	5325.58	3.42	26.79	35.43	1.75	1.58	5325.58										10.00	2.08	
Task18	Construct Interior Mounds	6/11/2019	7/4/2019	2019	5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13										10.00	2.08	
Task19	Construct Eastern Toe Berm	6/6/2019	9/20/2019	2019	5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13										10.00	2.08	
Task20	Construct Intertidal Bench	8/14/2019	1/9/2020	2019-2020	9.99	76.80	110.41	24.81	8.49	15416.80	9.99	76.80	110.41	4.81	4.33	15416.80										20.00	4.16	
Task21	Fill borrow ditch	1/20/2020	1/24/2020	2020	3.21	25.62	34.66	21.52	5.52	5186.13	3.21	25.62	34.66	1.52	1.36	5186.13										20.00	4.16	
Task22	Dredge Miner Slough	1/10/2020	3/19/2020	2020	11.40	84.40	120.98	24.81	8.35	25169.74	10.99	82.51	108.62	4.40	3.96	21046.38	0.41	1.89	12.36	0.41	0.23	4123.35				20.00	4.16	
Task23	Remove Access Roads	3/20/2020	4/21/2020	2020	8.63	59.76	78.18	6.04	3.36	18079.07	8.63	59.76	78.18	3.04	2.73	18079.07										3.00	0.62	
Task24	Remove Ramps	4/22/2020	5/1/2020	2020	3.86	28.98	34.48	4.43	1.90	8311.58	3.86	28.98	34.48	1.43	1.27	8311.58										3.00	0.62	
Task25	Breach (Northern Breach)	5/4/2020	6/23/2020	2020	7.56	57.43	72.70	17.78	5.52	18447.95	7.38	56.58	67.14	2.59	2.30	16592.44	0.19	0.85	5.56	0.18	0.11	1855.51				15.00	3.12	
Task26	Breach (Southern Breach)	6/24/2020	8/13/2020	2020	7.56	57.43	72.70	17.78	5.52	18447.95	7.38	56.58	67.14	2.59	2.30	16592.44	0.19	0.85	5.56	0.18	0.11	1855.51				15.00	3.12	
Task27	Planting and revegetation	8/14/2020	11/24/2020	2020	1.70	16.16	18.99	0.72	0.59	4762.35	1.60	15.69	15.90	0.62	0.53	3731.51	0.10	0.47	3.09	0.10	0.06	1030.84				0.00	0.00	
overlapping task group 1	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task07				9.33	55.26	94.25	44.58	12.47	12717.23	9.33	55.26	94.25	4.58	4.15	12717.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	8.32	0.00
	Task08				5.08	31.96	97.81	13.17	4.49	19150.91	3.84	26.34	42.29	1.87	1.67	5612.16	1.24	5.61	55.53	1.30	0.74	13538.76	0.00	0.00	0.00	10.00	2.08	0.00
	Task09				6.62	40.76	139.93	14.35	5.29	28415.90	4.63	31.76	50.91	2.26	2.02	6710.91	1.99	8.99	89.02	2.08	1.19	21704.99	0.00	0.00	0.00	10.00	2.08	0.00
	Sum				**27.60**	**168.20**	**380.34**	**74.41**	**24.30**	**69186.94**	**24.35**	**153.51**	**234.92**	**11.01**	**9.87**	**33728.29**	**3.25**	**14.69**	**145.42**	**3.40**	**1.94**	**35458.64**	**0.00**	**0.00**	**0.00**	**60.00**	**12.48**	**0.00**
overlapping task group 2	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task06				48.96	62.83	31.50	1.00	0.99	16160.26	48.96	62.83	31.50	1.00	0.99	16160.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Task07				9.33	55.26	94.25	44.58	12.47	12717.23	9.33	55.26	94.25	4.58	4.15	12717.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	8.32	0.00
	Task09				6.62	40.76	139.93	14.35	5.29	28415.90	4.63	31.76	50.91	2.26	2.02	6710.91	1.99	8.99	89.02	2.08	1.19	21704.99	0.00	0.00	0.00	10.00	2.08	0.00
	Task10				5.05	30.14	115.60	3.51	2.53	23990.75	3.28	22.12	36.28	1.65	1.48	4649.67	1.78	8.01	79.32	1.86	1.06	19341.08	0.00	0.00	0.00	0.00	0.00	0.00
	Sum				**76.54**	**229.21**	**429.64**	**65.75**	**23.32**	**90187.03**	**72.75**	**212.11**	**260.42**	**11.79**	**10.66**	**48926.06**	**3.79**	**17.10**	**169.22**	**3.96**	**2.26**	**41260.97**	**0.00**	**0.00**	**0.00**	**50.00**	**10.40**	**0.00**
overlapping task group 3	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task07				9.33	55.26	94.25	44.58	12.47	12717.23	9.33	55.26	94.25	4.58	4.15	12717.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.00	8.32	0.00
	Task09				6.62	40.76	139.93	14.35	5.29	28415.90	4.63	31.76	50.91	2.26	2.02	6710.91	1.99	8.99	89.02	2.08	1.19	21704.99	0.00	0.00	0.00	10.00	2.08	0.00
	Task11				1.38	12.27	13.37	0.64	0.57	2586.00	1.38	12.27	13.37	0.64	0.57	2586.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Task12				5.60	35.90	55.12	4.76	2.53	9881.98	5.60	35.90	55.12	2.26	2.01	9881.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.50	0.52	0.00
	Sum				**29.49**	**184.43**	**351.01**	**66.64**	**22.90**	**62504.01**	**27.48**	**175.34**	**261.12**	**12.04**	**10.78**	**40584.12**	**2.01**	**9.08**	**89.90**	**2.10**	**1.20**	**21919.89**	**0.00**	**0.00**	**0.00**	**52.50**	**10.92**	**0.00**
overlapping task group 4	Task05				6.68	48.81	63.84	12.36	4.20	14394.55	6.68	48.81	63.84	2.36	2.12	14394.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Task11				1.38	12.27	13.37	0.64	0.57	2586.00	1.38	12.27	13.37	0.64	0.57	2586.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Task13				6.68	48.81	63.84	12.36	4.20	14394.55	6.68	48.81	63.84	2.36	2.12	14394.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Sum				**14.73**	**109.89**	**141.05**	**25.35**	**8.96**	**31375.11**	**14.73**	**109.89**	**141.05**	**5.35**	**4.80**	**31375.11**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
overlapping task group 5	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task11				1.38	12.27	13.37	0.64	0.57	2586.00	1.38	12.27	13.37	0.64	0.57	2586.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Task14				19.91	145.00	191.38	27.02	10.49	42714.72	19.91	145.00	191.38	7.02	6.33	42714.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	4.16	0.00
	Sum				**27.85**	**197.51**	**253.11**	**29.97**	**13.11**	**54203.62**	**27.83**	**197.42**	**252.22**	**9.95**	**8.94**	**53988.72**	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
overlapping task group 6	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task14				19.91	145.00	191.38	27.02	10.49	42714.72	19.91	145.00	191.38	7.02	6.33	42714.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	4.16	0.00
	Task15				3.70	23.34	40.28	1.82	1.64	4767.54	3.70	23.34	40.28	1.82	1.64	4767.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sum				**30.17**	**208.57**	**280.02**	**31.14**	**14.18**	**56385.15**	**30.15**	**208.48**	**279.14**	**11.12**	**10.01**	**56170.25**	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
overlapping task group 7	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task15				3.70	23.34	40.28	1.82	1.64	4767.54	3.70	23.34	40.28	1.82	1.64	4767.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Task17				3.42	26.79	35.43	11.75	3.66	5325.58	3.42	26.79	35.43	1.75	1.58	5325.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Task19				5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Sum				**18.70**	**128.89**	**179.55**	**28.29**	**11.59**	**26804.14**	**18.68**	**128.80**	**178.67**	**8.27**	**7.42**	**26589.24**	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
overlapping task group 8	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task15				3.70	23.34	40.28	1.82	1.64	4767.54	3.70	23.34	40.28	1.82	1.64	4767.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Task18				5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Task19				5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Sum				**20.28**	**140.62**	**199.59**	**28.95**	**12.18**	**29286.70**	**20.26**	**140.53**	**198.71**	**8.93**	**8.01**	**29071.79**	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
overlapping task group 9	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task15				3.70	23.34	40.28	1.82	1.64	4767.54	3.70	23.34	40.28	1.82	1.64	4767.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Task19				5.01	38.52	55.47	12.41	4.25	7808.13	5.01	38.52	55.47	2.41	2.17	7808.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	2.08	0.00
	Task20				9.99	76.80	110.41	24.81	8.49	15416.80	9.99	76.80	110.41	4.81	4.33	15416.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	4.16	0.00
	Sum				**25.26**	**178.89**	**254.53**	**41.35**	**16.42**	**36895.36**	**25.24**	**178.80**	**253.65**	**11.33**	**10.17**	**36680.46**	**0.02**	**0.09**	**0.88**	**0.02**	**0.01**	**214.90**	**0.00**	**0.00**	**0.00**	**30.00**	**6.24**	**0.00**
overlapping task group 10	Task05				6.56	40.24	48.36	2.31	2.05	8902.90	6.54	40.15	47.48	2.29	2.04	8688.00	0.02	0.09	0.88	0.02	0.01	214.90	0.00	0.00	0.00	0.00	0.00	0.00
	Task16				1.50	8.86	16.13	0.71	0.60	3205.03	1.44	8.58	13.79	0.65	0.56	2571.49	0.06	0.27	2.33	0.06	0.04	633.54	0.00	0.00	0.00	0.00	0.00	0.00
	Task20				9.99	76.80	110.41	24.81	8.49	15416.80	9.99	76.80	110.41	4.81	4.33	15416.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	4.16	0.00
	Sum				**18.06**	**125.89**	**174.90**	**27.83**	**11.13**	**27524.73**	**17.98**	**125.53**	**171.68**	**7.75**	**6.93**	**26676.29**	**0.08**	**0.36**	**3.21**	**0.08**	**0.05**	**848.44**	**0.00**	**0.00**	**0.00**	**20.00**	**4.16**	**0.00**
overlapping task group 10	Task21				3.21	25.62	34.66	21.52	5.52	5186.13	3.21	25.62	34.66	1.52	1.36	5186.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00	4.16	0.00
	Task22				11.40	84.40	120.98	24.81	8.35	25169.74	10.99	82.51	108.62	4.40	3.96	21046.38	0.41	1.89	12.36	0.41	0.23	4123.35	0.00	0.00	0.00	20.00	4.16	0.00
	Sum				**14.61**	**110.02**	**155.64**	**46.32**	**13.87**	**30355.87**	**14.20**	**108.13**	**143.28**	**5.91**	**5.32**	**26232.52**	**0.41**	**1.89**	**12.36**	**0.41**	**0.23**	**4123.35**	**0.00**	**0.00**	**0.00**	**40.00**	**8.32**	**0.00**
Maximum Daily Emissions for each task and overlapping tasks					**76.54**	**229.21**	**429.64**	**74.41**	**24.30**	**90187.03**	**72.75**	**212.11**	**279.14**	**12.04**	**10.78**	**56170.25**	**3.79**	**17.10**	**169.22**	**3.96**	**2.26**	**41260.97**	**0.00**	**0.00**	**0.00**	**60.00**	**12.48**	**0.00**

Table 13 Project Emission Summary

Option A: Material Delivery Using Barges						
Pollutants	ROG	CO	NOx	PM10	PM2.5	CO2
2018 Emissions (tons)	1.2	6.5	13.2	2.1	0.8	1888.7
2019 Emissions (tons)	2.1	15.0	20.9	2.2	1.0	3533.6
2020 Emissions (tons)	0.5	3.6	5.0	0.5	0.2	962.5
Maximum Annual Emissions (tons)	2.1	15.0	20.9	2.2	1.0	3533.6
Total Project Emissions (tons)	3.8	25.0	39.1	4.7	2.1	6384.8
Option B: Material Delivery Using Trucks						
2018 Emissions (tons)	0.8	4.3	8.1	1.9	0.6	1337.1
2019 Emissions (tons)	2.1	15.0	20.9	2.2	1.0	3533.6
2020 Emissions (tons)	0.5	3.4	4.6	0.5	0.2	917.2
Maximum Annual Emissions (tons)	2.1	15.0	20.9	2.2	1.0	3533.6
Total Project Emissions (tons)	3.3	22.7	33.6	4.6	1.9	5788.0

Table 14 Maximum Daily Emissions

	ROG	CO	NOx	PM10	PM2.5	CO2
Maximum Daily Emissions Option A (pounds per day)	87.5	289.4	525.2	78.5	29.6	84082.8
Maximum Daily Emissions Option B (pounds per day)	76.5	229.2	429.6	74.4	24.3	90187.0

Attachment 2

Roadway Construction Emission Model Projects Description

Roadway Construction Emission Model – Project 1A and 1B

These Roadway Construction Emission Model project are created to calculate the emissions rates in pounds per hour for different types of off-road construction equipment for the years 2018, 2019 and 2020, by entering the following information in the “Data Entry” sheet.

The “Construction Start Year” was set to 2018 and “Project Construction Time” was set to 48 months. In the Construction Periods table, override the construction months of each construction phase to 12 months, so the first phase “Grubbing/Land Clearing” phase is for the year of 2018, the second phase “Grading /Excavation” is for the 2019 and so on.

In the last table of the “Data Entry” sheet, override the horsepower values with the values in Table 3-A “Construction Equipment Descriptions” of Attachment 1, and change “hours per day” from the default value 8 to 1. In “Off-Road Equipment Emissions” tables for each construction phases, override of default number of vehicles to 1 for all the equipment type. These tables contain the emission rates in pounds per hour per vehicle. The table for the first phase “Grubbing/Land Clearing” contains the emission rates for the year of 2018, the table for the second phase “Grading /Excavation” contains the emission rates for the year of 2019, and the table for the third phase “Grading /Excavation” contains the emission rates for the year of 2020.

Road Construction Emissions Model

Version 7.1.5.1

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a
yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

Input Type

Project Name	Project 1-A Construction Equipment Set 1	
Construction Start Year	2018	Enter a Year between 2009 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	48.00	months
Predominant Soil/Site Type: Enter 1, 2, or 3	1	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length	4.00	miles
Total Project Area	5.00	acres
Maximum Area Disturbed/Day	5.00	acres
Water Trucks Used?	1	1. Yes 2. No
Soil Imported	0.00	yd^3/day
Soil Exported	0.00	yd^3/day
Average Truck Capacity	20	yd^3 (assume 20 if unknown)

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months
Grubbing/Land Clearing	12.00	4.80
Grading/Excavation	12.00	19.20
Drainage/Utilities/Sub-Grade	12.00	16.80
Paving	12.00	7.20
Totals	48.00	48.00

2005	%	2006	%	2007	%
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00

NOTE: soil hauling emissions are included in the Grading/Excavation Construction Period Phase, therefore the Construction Period for Grading/Excavation cannot be zero if hauling is part of the project.

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions	User Override of Soil Hauling Defaults	Default Values
User Input		
Miles/round trip	50.00	30
Round trips/day		0
Vehicle miles traveled/day (calculated)		0

Hauling Emissions	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate (grams/mile)	0.15	5.88	0.69	0.16	0.09	1596.49
Emission rate (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day	0.00	0.00	0.00	0.00	0.00	0.00
Tons per contruction period	0.00	0.00	0.00	0.00	0.00	0.00

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	30.00	20
One-way trips/day	2.00	2
No. of employees: Grubbing/Land Clearing	1.00	13
No. of employees: Grading/Excavation	1.00	25
No. of employees: Drainage/Utilities/Sub-Grade	1.00	23
No. of employees: Paving	1.00	19

	ROG	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate - Grubbing/Land Clearing (grams/mile)	0.120	0.154	1.399	0.047	0.020	443.880
Emission rate - Grading/Excavation (grams/mile)	0.112	0.140	1.291	0.047	0.020	441.739
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.105	0.129	1.196	0.047	0.020	441.856
Emission rate - Paving (grams/mile)	0.101	0.120	1.122	0.047	0.020	441.814
Emission rate - Grubbing/Land Clearing (grams/trip)	0.415	0.255	3.410	0.004	0.003	95.711
Emission rate - Grading/Excavation (grams/trip)	0.382	0.228	3.101	0.004	0.003	95.822
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.353	0.205	2.824	0.004	0.004	95.943
Emission rate - Paving (grams/trip)	0.330	0.185	2.592	0.004	0.004	96.043
Pounds per day - Grubbing/Land Clearing	0.018	0.022	0.200	0.006	0.003	59.084
Tons per const. Period - Grub/Land Clear	0.002	0.003	0.026	0.001	0.000	7.799
Pounds per day - Grading/Excavation	0.016	0.020	0.184	0.006	0.003	58.802
Tons per const. Period - Grading/Excavation	0.002	0.003	0.024	0.001	0.000	7.762
Pounds per day - Drainage/Utilities/Sub-Grade	0.015	0.018	0.170	0.006	0.003	58.818
Tons per const. Period - Drain/Util/Sub-Grade	0.002	0.002	0.022	0.001	0.000	7.764
Pounds per day - Paving	0.015	0.017	0.160	0.006	0.003	58.813
Tons per const. Period - Paving	0.002	0.002	0.021	0.001	0.000	7.763
tons per construction period	0.009	0.010	0.094	0.003	0.001	31.088

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day
Grubbing/Land Clearing - Exhaust	1.00	1	5.00	40
Grading/Excavation - Exhaust	1.00	1	5.00	40
Drainage/Utilities/Subgrade	1.00	1	5.00	40

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.15	6.66	0.67	0.16	0.09	1624.61
Emission rate - Grading/Excavation (grams/mile)	0.15	5.88	0.69	0.16	0.09	1596.49
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.16	4.67	0.71	0.16	0.09	1558.59
Pounds per day - Grubbing/Land Clearing	0.00	0.07	0.01	0.00	0.00	17.89
Tons per const. Period - Grub/Land Clear	0.00	0.01	0.00	0.00	0.00	2.36
Pound per day - Grading/Excavation	0.00	0.06	0.01	0.00	0.00	17.58
Tons per const. Period - Grading/Excavation	0.00	0.01	0.00	0.00	0.00	2.32
Pound per day - Drainage/Utilities/Subgrade	0.00	0.05	0.01	0.00	0.00	17.17
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.01	0.00	0.00	0.00	2.27

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		5	50.0	6.6	10.4	1.4
Fugitive Dust - Grading/Excavation		5	50.0	10.6	10.4	2.2
Fugitive Dust - Drainage/Utilities/Subgrade		5	50.0	9.2	10.4	1.9

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Bore/Drill Rigs	0.04	0.47	0.49	0.01	0.01	117.82
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.07	0.45	0.79	0.03	0.03	89.69
1.00	1	Crawler Tractors	0.09	0.44	0.91	0.05	0.05	81.43
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1	Excavators	0.04	0.36	0.41	0.02	0.02	73.95
1.00		Forklifts	0.03	0.18	0.28	0.02	0.01	32.88
1.00		Generator Sets	0.01	0.06	0.08	0.00	0.00	9.26
1.00		Graders	0.07	0.46	0.88	0.03	0.03	87.99
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.07	0.39	0.75	0.03	0.03	128.38
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.09	0.78	1.01	0.04	0.04	149.71
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rollers	0.05	0.60	0.65	0.02	0.02	111.04
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rubber Tired Loaders	0.06	0.44	0.74	0.03	0.02	93.29
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	0.6	4.6	7.0	0.3	0.3	975.4
	Grubbing/Land Clearing	tons per phase	0.1	0.6	0.9	0.0	0.0	128.8

Grading/Excavation	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Bore/Drill Rigs	0.03	0.47	0.43	0.01	0.01	117.57
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0	Cranes	0.06	0.45	0.74	0.03	0.03	89.71
1.00	1	Crawler Tractors	0.08	0.44	0.84	0.05	0.04	81.34
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00	3	Excavators	0.04	0.36	0.36	0.02	0.02	73.93
1.00		Forklifts	0.03	0.18	0.24	0.01	0.01	32.88
1.00		Generator Sets	0.01	0.06	0.08	0.00	0.00	9.26
1.00	1	Graders	0.06	0.46	0.81	0.03	0.02	87.78
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.07	0.39	0.65	0.02	0.02	128.33
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.09	0.78	0.97	0.04	0.03	149.71
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00	2	Rollers	0.05	0.60	0.61	0.02	0.02	111.03
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1	Rubber Tired Loaders	0.06	0.44	0.67	0.02	0.02	93.30
	2	Scrapers	2.21	14.51	25.55	1.00	0.92	3216.00
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.49	3.14	4.70	0.31	0.29	669.58
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	3.3	22.3	36.6	1.6	1.4	4860.4
	Grading	tons per phase	0.4	2.9	4.8	0.2	0.2	641.6

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
	1	Air Compressors	0.06	0.42	0.42	0.03	0.03	63.49
1.00		Bore/Drill Rigs	0.03	0.47	0.41	0.01	0.01	117.92
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.06	0.45	0.66	0.03	0.02	89.70
1.00		Crawler Tractors	0.08	0.44	0.76	0.04	0.04	81.32
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Excavators	0.03	0.36	0.32	0.02	0.01	73.94
1.00		Forklifts	0.02	0.18	0.21	0.01	0.01	32.88
1.00	1	Generator Sets	0.01	0.06	0.07	0.00	0.00	9.26
1.00	1	Graders	0.06	0.46	0.78	0.02	0.02	87.70
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.06	0.39	0.57	0.02	0.02	128.26
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.08	0.78	0.92	0.03	0.03	149.71
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Plate Compactors	0.01	0.03	0.03	0.00	0.00	4.31
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Pumps	0.04	0.30	0.31	0.02	0.02	49.52
1.00		Rollers	0.05	0.60	0.59	0.02	0.02	111.03
	1	Rough Terrain Forklifts	0.02	0.25	0.22	0.01	0.01	46.60
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rubber Tired Loaders	0.05	0.44	0.61	0.02	0.02	93.27
	2	Scrapers	2.06	14.51	23.25	0.91	0.83	3215.57
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.44	3.13	4.23	0.27	0.25	669.38
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	3.2	23.3	34.4	1.5	1.4	5023.9
	Drainage	tons per phase	0.4	3.1	4.5	0.2	0.2	663.1

Paving			ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Bore/Drill Rigs	0.03	0.47	0.35	0.01	0.01	118.21
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.05	0.45	0.59	0.02	0.02	89.68
1.00		Crawler Tractors	0.07	0.44	0.68	0.04	0.04	81.39
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Excavators	0.03	0.36	0.29	0.01	0.01	73.95
1.00		Forklifts	0.02	0.18	0.18	0.01	0.01	32.88
1.00		Generator Sets	0.01	0.06	0.07	0.00	0.00	9.26
1.00		Graders	0.06	0.45	0.73	0.02	0.02	87.55
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.06	0.39	0.48	0.02	0.02	128.25
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.08	0.78	0.75	0.03	0.03	149.71
	1	Pavers	0.03	0.35	0.31	0.01	0.01	60.23
	1	Paving Equipment	0.02	0.34	0.24	0.01	0.01	53.27
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00	3	Rollers	0.05	0.60	0.54	0.02	0.02	111.03
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rubber Tired Loaders	0.05	0.44	0.54	0.02	0.02	93.28
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.39	3.14	3.81	0.22	0.21	669.68
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	1.0	8.4	9.6	0.5	0.4	1758.4
	Paving	tons per phase	0.1	1.1	1.3	0.1	0.1	232.1
Total Emissions all Phases (tons per construction period) =>			1.1	7.7	11.6	0.5	0.5	1665.6

Equipment default values for horsepower and hours/day can be overridden in cells C289 through C322 and E289 through E322.

Equipment		Default Values Horsepower		Default Values Hours/day
Aerial Lifts		63	1.00	8
Air Compressors		106	1.00	8
Bore/Drill Rigs	206.00	206	1.00	8
Cement and Mortar Mixers		10	1.00	8
Concrete/Industrial Saws		64	1.00	8
Cranes	270.00	226	1.00	8
Crawler Tractors	165.00	208	1.00	8
Crushing/Proc. Equipment		142	1.00	8
Excavators	168.00	163	1.00	8
Forklifts	142.00	89	1.00	8
Generator Sets	10.00	66	1.00	8
Graders	185.00	175	1.00	8
Off-Highway Tractors		123	1.00	8
Off-Highway Trucks	290.00	400	1.00	8
Other Construction Equipment		172	1.00	8
Other General Industrial Equipment		88	1.00	8
Other Material Handling Equipment	330.00	167	1.00	8
Pavers		126	1.00	8
Paving Equipment		131	1.00	8
Plate Compactors		8	1.00	8
Pressure Washers		26	1.00	8
Pumps		53	1.00	8
Rollers	253.00	81	1.00	8
Rough Terrain Forklifts		100	1.00	8
Rubber Tired Dozers		255	1.00	8
Rubber Tired Loaders	225.00	200	1.00	8
Scrapers		362		8
Signal Boards		20		8
Skid Steer Loaders		65		8
Surfacing Equipment		254		8
Sweepers/Scrubbers		64		8
Tractors/Loaders/Backhoes		98		8
Trenchers		81		8
Welders		45		8

END OF DATA ENTRY SHEET

Road Construction Emissions Model

Version 7.1.5.1

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a
yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

Input Type

Project Name	Project 1-B Construction Equipment Set 2	
Construction Start Year	2018	Enter a Year between 2009 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	48.00	months
Predominant Soil/Site Type: Enter 1, 2, or 3	1	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length	4.00	miles
Total Project Area	5.00	acres
Maximum Area Disturbed/Day	5.00	acres
Water Trucks Used?	1	1. Yes 2. No
Soil Imported	0.00	yd^3/day
Soil Exported	0.00	yd^3/day
Average Truck Capacity	20	yd^3 (assume 20 if unknown)

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months
Grubbing/Land Clearing	12.00	4.80
Grading/Excavation	12.00	19.20
Drainage/Utilities/Sub-Grade	12.00	16.80
Paving	12.00	7.20
Totals	48.00	48.00

2005	%	2006	%	2007	%
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00

NOTE: soil hauling emissions are included in the Grading/Excavation Construction Period Phase, therefore the Construction Period for Grading/Excavation cannot be zero if hauling is part of the project.

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions	User Override of Soil Hauling Defaults	Default Values
User Input		
Miles/round trip	50.00	30
Round trips/day		0
Vehicle miles traveled/day (calculated)		0

Hauling Emissions	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate (grams/mile)	0.15	5.88	0.69	0.16	0.09	1596.49
Emission rate (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day	0.00	0.00	0.00	0.00	0.00	0.00
Tons per contruction period	0.00	0.00	0.00	0.00	0.00	0.00

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	30.00	20
One-way trips/day		2
No. of employees: Grubbing/Land Clearing	1.00	13
No. of employees: Grading/Excavation	1.00	25
No. of employees: Drainage/Utilities/Sub-Grade	1.00	23
No. of employees: Paving	1.00	19

	ROG	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate - Grubbing/Land Clearing (grams/mile)	0.120	0.154	1.399	0.047	0.020	443.880
Emission rate - Grading/Excavation (grams/mile)	0.112	0.140	1.291	0.047	0.020	441.739
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.105	0.129	1.196	0.047	0.020	441.856
Emission rate - Paving (grams/mile)	0.101	0.120	1.122	0.047	0.020	441.814
Emission rate - Grubbing/Land Clearing (grams/trip)	0.415	0.255	3.410	0.004	0.003	95.711
Emission rate - Grading/Excavation (grams/trip)	0.382	0.228	3.101	0.004	0.003	95.822
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.353	0.205	2.824	0.004	0.004	95.943
Emission rate - Paving (grams/trip)	0.330	0.185	2.592	0.004	0.004	96.043
Pounds per day - Grubbing/Land Clearing	0.018	0.022	0.200	0.006	0.003	59.084
Tons per const. Period - Grub/Land Clear	0.002	0.003	0.026	0.001	0.000	7.799
Pounds per day - Grading/Excavation	0.016	0.020	0.184	0.006	0.003	58.802
Tons per const. Period - Grading/Excavation	0.002	0.003	0.024	0.001	0.000	7.762
Pounds per day - Drainage/Utilities/Sub-Grade	0.015	0.018	0.170	0.006	0.003	58.818
Tons per const. Period - Drain/Util/Sub-Grade	0.002	0.002	0.022	0.001	0.000	7.764
Pounds per day - Paving	0.015	0.017	0.160	0.006	0.003	58.813
Tons per const. Period - Paving	0.002	0.002	0.021	0.001	0.000	7.763
tons per construction period	0.009	0.010	0.094	0.003	0.001	31.088

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day
Grubbing/Land Clearing - Exhaust	1.00	1	100.00	40
Grading/Excavation - Exhaust	1.00	1	100.00	40
Drainage/Utilities/Subgrade	1.00	1	100.00	40

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.15	6.66	0.67	0.16	0.09	1624.61
Emission rate - Grading/Excavation (grams/mile)	0.15	5.88	0.69	0.16	0.09	1596.49
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.16	4.67	0.71	0.16	0.09	1558.59
Pounds per day - Grubbing/Land Clearing	0.03	1.47	0.15	0.03	0.02	357.84
Tons per const. Period - Grub/Land Clear	0.00	0.19	0.02	0.00	0.00	47.24
Pound per day - Grading/Excavation	0.03	1.29	0.15	0.03	0.02	351.65
Tons per const. Period - Grading/Excavation	0.00	0.17	0.02	0.00	0.00	46.42
Pound per day - Drainage/Utilities/Subgrade	0.03	1.03	0.16	0.03	0.02	343.30
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.14	0.02	0.00	0.00	45.32

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		5	50.0	6.6	10.4	1.4
Fugitive Dust - Grading/Excavation		5	50.0	10.6	10.4	2.2
Fugitive Dust - Drainage/Utilities/Subgrade		5	50.0	9.2	10.4	1.9

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.06	0.25	0.63	0.03	0.03	50.71
	1	Crawler Tractors	0.08	0.56	1.04	0.04	0.04	103.12
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1	Excavators	0.07	0.91	0.74	0.02	0.02	187.78
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Generator Sets	0.05	0.23	0.25	0.02	0.01	31.03
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.99	5.25	10.19	0.37	0.34	1735.35
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.09	0.83	1.07	0.04	0.04	158.78
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rollers	0.03	0.35	0.39	0.02	0.02	63.94
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	8	Signal Boards	0.28	1.29	1.23	0.07	0.07	157.43
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	1.7	9.7	15.5	0.6	0.6	2488.1
	Grubbing/Land Clearing	tons per phase	0.2	1.3	2.1	0.1	0.1	328.4

Grading/Excavation	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0	Cranes	0.06	0.25	0.57	0.03	0.03	50.72
	1	Crawler Tractors	0.08	0.56	0.98	0.04	0.03	103.06
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00	3	Excavators	0.06	0.91	0.64	0.02	0.02	187.77
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Generator Sets	0.05	0.23	0.24	0.01	0.01	31.03
	1	Graders	0.10	0.43	0.95	0.05	0.05	83.36
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.91	5.25	8.80	0.32	0.29	1734.61
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.09	0.83	1.03	0.04	0.04	158.78
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00	2	Rollers	0.03	0.35	0.33	0.02	0.01	63.95
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Rubber Tired Loaders	0.05	0.39	0.60	0.02	0.02	82.82
	2	Scrapers	0.28	1.81	3.19	0.13	0.12	402.00
	8	Signal Boards	0.25	1.26	1.18	0.07	0.06	157.43
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.06	0.39	0.59	0.04	0.04	83.70
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	2.0	12.7	19.1	0.8	0.7	3139.2
	Grading	tons per phase	0.3	1.7	2.5	0.1	0.1	414.4

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
	1	Air Compressors	0.06	0.42	0.42	0.03	0.03	63.49
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.05	0.25	0.54	0.03	0.03	50.72
		Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Excavators	0.06	0.91	0.57	0.02	0.02	187.58
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1	Generator Sets	0.04	0.23	0.23	0.01	0.01	31.03
	1	Graders	0.09	0.43	0.87	0.05	0.04	83.30
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.85	5.25	7.74	0.28	0.26	1733.69
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.09	0.83	0.98	0.04	0.03	158.78
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Plate Compactors	0.01	0.03	0.03	0.00	0.00	4.31
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Pumps	0.04	0.30	0.31	0.02	0.02	49.52
1.00		Rollers	0.03	0.35	0.30	0.01	0.01	63.95
	1	Rough Terrain Forklifts	0.02	0.25	0.22	0.01	0.01	46.60
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
	2	Scrapers	0.26	1.81	2.91	0.11	0.10	401.95
	8	Signal Boards	0.22	1.23	1.14	0.06	0.05	157.43
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.06	0.39	0.53	0.03	0.03	83.67
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	1.9	12.7	16.8	0.7	0.6	3116.0
	Drainage	tons per phase	0.2	1.7	2.2	0.1	0.1	411.3

Paving	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.05	0.25	0.49	0.03	0.02	50.71
		Crawler Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Excavators	0.05	0.91	0.48	0.02	0.01	187.31
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Generator Sets	0.03	0.21	0.22	0.01	0.01	31.03
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.78	5.25	6.44	0.24	0.22	1733.56
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.08	0.83	0.79	0.03	0.03	158.78
	1	Pavers	0.03	0.35	0.31	0.01	0.01	60.23
	1	Paving Equipment	0.02	0.34	0.24	0.01	0.01	53.27
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00	3	Rollers	0.02	0.35	0.26	0.01	0.01	63.96
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
	8	Signal Boards	0.20	1.21	1.11	0.05	0.05	157.43
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.05	0.39	0.48	0.03	0.03	83.71
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	1.3	10.1	10.8	0.4	0.4	2580.0
	Paving	tons per phase	0.2	1.3	1.4	0.1	0.1	340.6
Total Emissions all Phases (tons per construction period) =>			0.9	6.0	8.2	0.3	0.3	1494.7

Equipment default values for horsepower and hours/day can be overridden in cells C289 through C322 and E289 through E322.

Equipment		Default Values Horsepower		Default Values Hours/day
Aerial Lifts		63	1.00	8
Air Compressors		106	1.00	8
Bore/Drill Rigs		206	1.00	8
Cement and Mortar Mixers		10	1.00	8
Concrete/Industrial Saws		64	1.00	8
Cranes	152.00	226	1.00	8
Crawler Tractors		208	1.00	8
Crushing/Proc. Equipment		142	1.00	8
Excavators	428.00	163	1.00	8
Forklifts		89	1.00	8
Generator Sets	33.50	66	1.00	8
Graders		175	1.00	8
Off-Highway Tractors		123	1.00	8
Off-Highway Trucks	490.00	400	8.00	8
Other Construction Equipment		172	1.00	8
Other General Industrial Equipment		88	1.00	8
Other Material Handling Equipment	350.00	167	1.00	8
Pavers		126	1.00	8
Paving Equipment		131	1.00	8
Plate Compactors		8	1.00	8
Pressure Washers		26	1.00	8
Pumps		53	1.00	8
Rollers	148.00	81	1.00	8
Rough Terrain Forklifts		100	1.00	8
Rubber Tired Dozers		255	1.00	8
Rubber Tired Loaders		200	1.00	8
Scrapers		362	1.00	8
Signal Boards		20	1.00	8
Skid Steer Loaders		65	1.00	8
Surfacing Equipment		254	1.00	8
Sweepers/Scrubbers		64	1.00	8
Tractors/Loaders/Backhoes		98	1.00	8
Trenchers		81	1.00	8
Welders		45	1.00	8

END OF DATA ENTRY SHEET

Roadway Construction Emission Model – Project 2A and 2B

These Roadway Construction Emission Model projects are created to calculate the emissions rates for worker commute trips in pounds per day per worker for the years 2018, 2019 and 2020. It also calculates the emissions rates for water trucks.

The "Construction Start Year" was set to 2018 and "Project Construction Time" was set to 48 months. In the Construction Periods table, override the construction months of each construction phase to 12 months, so the first phase "Grubbing/Land Clearing" phase is for the year of 2018, the second phase "Grading /Excavation" is for the 2019 and so on.

In Worker Commute Emissions table, enter 30 miles for one-way trip and set number of one-way trips to 2. Set the number of employees to 1. The resulting emissions for each construction phase are the emission rates in pounds per day per employee for the years 2018 through 2021 (Project 2A). The Roadway Model uses the EMFAC2011 emission factors for "Light Duty Trucks" to calculate worker commute emissions. The hourly emissions for pick-ups and foreman trucks are calculated using the same method. Assuming these vehicles would travel 100 miles per day on a typical workday, the daily emissions are obtained (Project 2B). The hourly emissions for the years 2018, 2019 and 2020 are one eighth of the daily emissions, and the assumptions and results are summarized in Table 5-B of Attachment 1.

The hourly emissions of the water trucks, service trucks and flat-bed trucks are calculated by inputting miles travelled per day in Water Truck Emissions table. The Roadway Model uses the EMFAC2011 emission factors for the "Heavy-Heavy Duty Diesel Truck" to calculate emissions of water trucks, so the emissions of the service trucks and flat-bed trucks are calculated the same way. Assume a water truck would travel 40 miles per day on an eight-hour workday. To calculate the emissions per hour, enter 5 miles per day in Water Truck Emissions table (Project 2A). The resulting emissions would be the water truck emissions in pounds per hour for the years 2018 through 2021. Assuming the service trucks and flat-bed trucks would travel 100 miles on a typical workday (namely 12.5 miles per hour), the hourly emissions can be obtained (Project 2B). The assumptions and results are summarized in Table 5-B of Attachment 1.

In addition, the emission rates (in grams per mile) for on-road soil hauling trucks are obtained from the Soil Hauling Emissions section and Water Truck Emissions section of the Roadway Construction Emission Model, both of them are based on the EMFAC2011 emission factors for "Heavy-Heavy Duty Diesel Trucks". The results are summarized in Table 5-G of Attachment 1.

Road Construction Emissions Model

Version 7.1.5.1

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a
yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

Input Type		
Project Name	Project 2-A Worker Commute and Water Truck	
Construction Start Year	2018	Enter a Year between 2009 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	48.00	months
Predominant Soil/Site Type: Enter 1, 2, or 3	1	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length	4.00	miles
Total Project Area	5.00	acres
Maximum Area Disturbed/Day	5.00	acres
Water Trucks Used?	1	1. Yes 2. No
Soil Imported	0.00	yd^3/day
Soil Exported	0.00	yd^3/day
Average Truck Capacity	20	yd^3 (assume 20 if unknown)

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months
Grubbing/Land Clearing	12.00	4.80
Grading/Excavation	12.00	19.20
Drainage/Utilities/Sub-Grade	12.00	16.80
Paving	12.00	7.20
Totals	48.00	48.00

NOTE: soil hauling emissions are included in the Grading/Excavation Construction Period Phase, therefore the Construction Period for Grading/Excavation cannot be zero if hauling is part of the project.

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions	User Override of Soil Hauling Defaults	Default Values
User Input		
Miles/round trip	50.00	30
Round trips/day		0
Vehicle miles traveled/day (calculated)		0

Hauling Emissions	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate (grams/mile)	0.15	5.88	0.69	0.16	0.09	1596.49
Emission rate (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day	0.00	0.00	0.00	0.00	0.00	0.00
Tons per contruction period	0.00	0.00	0.00	0.00	0.00	0.00

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	30.00	20
One-way trips/day	2.00	2
No. of employees: Grubbing/Land Clearing	1.00	13
No. of employees: Grading/Excavation	1.00	25
No. of employees: Drainage/Utilities/Sub-Grade	1.00	23
No. of employees: Paving	1.00	19

	ROG	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**
Emission rate - Grubbing/Land Clearing (grams/mile)	0.120	0.154	1.399	0.047	0.020	443.880
Emission rate - Grading/Excavation (grams/mile)	0.112	0.140	1.291	0.047	0.020	441.739
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.105	0.129	1.196	0.047	0.020	441.856
Emission rate - Paving (grams/mile)	0.101	0.120	1.122	0.047	0.020	441.814
Emission rate - Grubbing/Land Clearing (grams/trip)	0.415	0.255	3.410	0.004	0.003	95.711
Emission rate - Grading/Excavation (grams/trip)	0.382	0.228	3.101	0.004	0.003	95.822
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.353	0.205	2.824	0.004	0.004	95.943
Emission rate - Paving (grams/trip)	0.330	0.185	2.592	0.004	0.004	96.043
Pounds per day - Grubbing/Land Clearing	0.018	0.022	0.200	0.006	0.003	59.084
Tons per const. Period - Grub/Land Clear	0.002	0.003	0.026	0.001	0.000	7.799
Pounds per day - Grading/Excavation	0.016	0.020	0.184	0.006	0.003	58.802
Tons per const. Period - Grading/Excavation	0.002	0.003	0.024	0.001	0.000	7.762
Pounds per day - Drainage/Utilities/Sub-Grade	0.015	0.018	0.170	0.006	0.003	58.818
Tons per const. Period - Drain/Util/Sub-Grade	0.002	0.002	0.022	0.001	0.000	7.764
Pounds per day - Paving	0.015	0.017	0.160	0.006	0.003	58.813
Tons per const. Period - Paving	0.002	0.002	0.021	0.001	0.000	7.763
tons per construction period	0.009	0.010	0.094	0.003	0.001	31.088

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day
Grubbing/Land Clearing - Exhaust	1.00	1	5.00	40
Grading/Excavation - Exhaust	1.00	1	5.00	40
Drainage/Utilities/Subgrade	1.00	1	5.00	40

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.15	6.66	0.67	0.16	0.09	1624.61
Emission rate - Grading/Excavation (grams/mile)	0.15	5.88	0.69	0.16	0.09	1596.49
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.16	4.67	0.71	0.16	0.09	1558.59
Pounds per day - Grubbing/Land Clearing	0.00	0.07	0.01	0.00	0.00	17.89
Tons per const. Period - Grub/Land Clear	0.00	0.01	0.00	0.00	0.00	2.36
Pound per day - Grading/Excavation	0.00	0.06	0.01	0.00	0.00	17.58
Tons per const. Period - Grading/Excavation	0.00	0.01	0.00	0.00	0.00	2.32
Pound per day - Drainage/Utilities/Subgrade	0.00	0.05	0.01	0.00	0.00	17.17
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.01	0.00	0.00	0.00	2.27

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		5	50.0	6.6	10.4	1.4
Fugitive Dust - Grading/Excavation		5	50.0	10.6	10.4	2.2
Fugitive Dust - Drainage/Utilities/Subgrade		5	50.0	9.2	10.4	1.9

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Bore/Drill Rigs	0.04	0.47	0.49	0.01	0.01	117.82
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.07	0.45	0.79	0.03	0.03	89.69
1.00	1	Crawler Tractors	0.09	0.44	0.91	0.05	0.05	81.43
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1	Excavators	0.04	0.36	0.41	0.02	0.02	73.95
1.00		Forklifts	0.03	0.18	0.28	0.02	0.01	32.88
1.00		Generator Sets	0.01	0.06	0.08	0.00	0.00	9.26
1.00		Graders	0.07	0.46	0.88	0.03	0.03	87.99
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.07	0.39	0.75	0.03	0.03	128.38
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.09	0.78	1.01	0.04	0.04	149.71
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rollers	0.05	0.60	0.65	0.02	0.02	111.04
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rubber Tired Loaders	0.06	0.44	0.74	0.03	0.02	93.29
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	0.6	4.6	7.0	0.3	0.3	975.4
	Grubbing/Land Clearing	tons per phase	0.1	0.6	0.9	0.0	0.0	128.8

Grading/Excavation	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Bore/Drill Rigs	0.03	0.47	0.43	0.01	0.01	117.57
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0	Cranes	0.06	0.45	0.74	0.03	0.03	89.71
1.00	1	Crawler Tractors	0.08	0.44	0.84	0.05	0.04	81.34
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00	3	Excavators	0.04	0.36	0.36	0.02	0.02	73.93
1.00		Forklifts	0.03	0.18	0.24	0.01	0.01	32.88
1.00		Generator Sets	0.01	0.06	0.08	0.00	0.00	9.26
1.00	1	Graders	0.06	0.46	0.81	0.03	0.02	87.78
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.07	0.39	0.65	0.02	0.02	128.33
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.09	0.78	0.97	0.04	0.03	149.71
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00	2	Rollers	0.05	0.60	0.61	0.02	0.02	111.03
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1	Rubber Tired Loaders	0.06	0.44	0.67	0.02	0.02	93.30
	2	Scrapers	2.21	14.51	25.55	1.00	0.92	3216.00
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.49	3.14	4.70	0.31	0.29	669.58
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	3.3	22.3	36.6	1.6	1.4	4860.4
	Grading	tons per phase	0.4	2.9	4.8	0.2	0.2	641.6

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
	1	Air Compressors	0.06	0.42	0.42	0.03	0.03	63.49
1.00		Bore/Drill Rigs	0.03	0.47	0.41	0.01	0.01	117.92
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.06	0.45	0.66	0.03	0.02	89.70
1.00		Crawler Tractors	0.08	0.44	0.76	0.04	0.04	81.32
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Excavators	0.03	0.36	0.32	0.02	0.01	73.94
1.00		Forklifts	0.02	0.18	0.21	0.01	0.01	32.88
1.00	1	Generator Sets	0.01	0.06	0.07	0.00	0.00	9.26
1.00	1	Graders	0.06	0.46	0.78	0.02	0.02	87.70
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.06	0.39	0.57	0.02	0.02	128.26
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.08	0.78	0.92	0.03	0.03	149.71
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Plate Compactors	0.01	0.03	0.03	0.00	0.00	4.31
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Pumps	0.04	0.30	0.31	0.02	0.02	49.52
1.00		Rollers	0.05	0.60	0.59	0.02	0.02	111.03
	1	Rough Terrain Forklifts	0.02	0.25	0.22	0.01	0.01	46.60
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rubber Tired Loaders	0.05	0.44	0.61	0.02	0.02	93.27
	2	Scrapers	2.06	14.51	23.25	0.91	0.83	3215.57
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.44	3.13	4.23	0.27	0.25	669.38
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	3.2	23.3	34.4	1.5	1.4	5023.9
	Drainage	tons per phase	0.4	3.1	4.5	0.2	0.2	663.1

Paving			ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Bore/Drill Rigs	0.03	0.47	0.35	0.01	0.01	118.21
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.05	0.45	0.59	0.02	0.02	89.68
1.00		Crawler Tractors	0.07	0.44	0.68	0.04	0.04	81.39
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Excavators	0.03	0.36	0.29	0.01	0.01	73.95
1.00		Forklifts	0.02	0.18	0.18	0.01	0.01	32.88
1.00		Generator Sets	0.01	0.06	0.07	0.00	0.00	9.26
1.00		Graders	0.06	0.45	0.73	0.02	0.02	87.55
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.06	0.39	0.48	0.02	0.02	128.25
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.08	0.78	0.75	0.03	0.03	149.71
	1	Pavers	0.03	0.35	0.31	0.01	0.01	60.23
	1	Paving Equipment	0.02	0.34	0.24	0.01	0.01	53.27
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00	3	Rollers	0.05	0.60	0.54	0.02	0.02	111.03
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rubber Tired Loaders	0.05	0.44	0.54	0.02	0.02	93.28
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.39	3.14	3.81	0.22	0.21	669.68
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	1.0	8.4	9.6	0.5	0.4	1758.4
	Paving	tons per phase	0.1	1.1	1.3	0.1	0.1	232.1
Total Emissions all Phases (tons per construction period) =>			1.1	7.7	11.6	0.5	0.5	1665.6

Equipment default values for horsepower and hours/day can be overridden in cells C289 through C322 and E289 through E322.

Equipment		Default Values Horsepower		Default Values Hours/day
Aerial Lifts		63	1.00	8
Air Compressors		106	1.00	8
Bore/Drill Rigs	206.00	206	1.00	8
Cement and Mortar Mixers		10	1.00	8
Concrete/Industrial Saws		64	1.00	8
Cranes	270.00	226	1.00	8
Crawler Tractors	165.00	208	1.00	8
Crushing/Proc. Equipment		142	1.00	8
Excavators	168.00	163	1.00	8
Forklifts	142.00	89	1.00	8
Generator Sets	10.00	66	1.00	8
Graders	185.00	175	1.00	8
Off-Highway Tractors		123	1.00	8
Off-Highway Trucks	290.00	400	1.00	8
Other Construction Equipment		172	1.00	8
Other General Industrial Equipment		88	1.00	8
Other Material Handling Equipment	330.00	167	1.00	8
Pavers		126	1.00	8
Paving Equipment		131	1.00	8
Plate Compactors		8	1.00	8
Pressure Washers		26	1.00	8
Pumps		53	1.00	8
Rollers	253.00	81	1.00	8
Rough Terrain Forklifts		100	1.00	8
Rubber Tired Dozers		255	1.00	8
Rubber Tired Loaders	225.00	200	1.00	8
Scrapers		362		8
Signal Boards		20		8
Skid Steer Loaders		65		8
Surfacing Equipment		254		8
Sweepers/Scrubbers		64		8
Tractors/Loaders/Backhoes		98		8
Trenchers		81		8
Welders		45		8

END OF DATA ENTRY SHEET

Road Construction Emissions Model

Version 7.1.5.1

Data Entry Worksheet

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a
yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Input Type

Project Name	Project 2-B Foreman Truck and	Service Trucks
Construction Start Year	2018	Enter a Year between 2009 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	48.00	months
Predominant Soil/Site Type: Enter 1, 2, or 3	1	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length	4.00	miles
Total Project Area	5.00	acres
Maximum Area Disturbed/Day	5.00	acres
Water Trucks Used?	1	1. Yes 2. No
Soil Imported	0.00	yd^3/day
Soil Exported	0.00	yd^3/day
Average Truck Capacity	20	yd^3 (assume 20 if unknown)

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months
Grubbing/Land Clearing	12.00	4.80
Grading/Excavation	12.00	19.20
Drainage/Utilities/Sub-Grade	12.00	16.80
Paving	12.00	7.20
Totals	48.00	48.00

2005	%	2006	%	2007	%
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00

NOTE: soil hauling emissions are included in the Grading/Excavation Construction Period Phase, therefore the Construction Period for Grading/Excavation cannot be zero if hauling is part of the project.

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions

User Input	User Override of Soil Hauling Defaults	Default Values
Miles/round trip	50.00	30
Round trips/day		0
Vehicle miles traveled/day (calculated)		0

Hauling Emissions	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate (grams/mile)	0.15	5.88	0.69	0.16	0.09	1596.49
Emission rate (grams/trip)	0.00	0.00	0.00	0.00	0.00	0.00
Pounds per day	0.00	0.00	0.00	0.00	0.00	0.00
Tons per contruction period	0.00	0.00	0.00	0.00	0.00	0.00

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions

	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip	100.00	20
One-way trips/day	1.00	2
No. of employees: Grubbing/Land Clearing	1.00	13
No. of employees: Grading/Excavation	1.00	25
No. of employees: Drainage/Utilities/Sub-Grade	1.00	23
No. of employees: Paving	1.00	19

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.120	0.154	1.399	0.047	0.020	443.880
Emission rate - Grading/Excavation (grams/mile)	0.112	0.140	1.291	0.047	0.020	441.739
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.105	0.129	1.196	0.047	0.020	441.856
Emission rate - Paving (grams/mile)	0.101	0.120	1.122	0.047	0.020	441.814
Emission rate - Grubbing/Land Clearing (grams/trip)	0.415	0.255	3.410	0.004	0.003	95.711
Emission rate - Grading/Excavation (grams/trip)	0.382	0.228	3.101	0.004	0.003	95.822
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.353	0.205	2.824	0.004	0.004	95.943
Emission rate - Paving (grams/trip)	0.330	0.185	2.592	0.004	0.004	96.043
Pounds per day - Grubbing/Land Clearing	0.027	0.035	0.316	0.010	0.004	97.982
Tons per const. Period - Grub/Land Clear	0.004	0.005	0.042	0.001	0.001	12.934
Pounds per day - Grading/Excavation	0.025	0.031	0.291	0.010	0.004	97.510
Tons per const. Period - Grading/Excavation	0.003	0.004	0.038	0.001	0.001	12.871
Pounds per day - Drainage/Utilities/Sub-Grade	0.024	0.029	0.270	0.010	0.004	97.536
Tons per const. Period - Drain/Util/Sub-Grade	0.003	0.004	0.036	0.001	0.001	12.875
Pounds per day - Paving	0.023	0.027	0.253	0.010	0.004	97.527
Tons per const. Period - Paving	0.003	0.004	0.033	0.001	0.001	12.874
tons per construction period	0.013	0.016	0.149	0.005	0.002	51.553

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day
Grubbing/Land Clearing - Exhaust	1.00	1	12.50	40
Grading/Excavation - Exhaust	1.00	1	12.50	40
Drainage/Utilities/Subgrade	1.00	1	12.50	40

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.15	6.66	0.67	0.16	0.09	1624.61
Emission rate - Grading/Excavation (grams/mile)	0.15	5.88	0.69	0.16	0.09	1596.49
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.16	4.67	0.71	0.16	0.09	1558.59
Pounds per day - Grubbing/Land Clearing	0.00	0.18	0.02	0.00	0.00	44.73
Tons per const. Period - Grub/Land Clear	0.00	0.02	0.00	0.00	0.00	5.90
Pound per day - Grading/Excavation	0.00	0.16	0.02	0.00	0.00	43.96
Tons per const. Period - Grading/Excavation	0.00	0.02	0.00	0.00	0.00	5.80
Pound per day - Drainage/Utilities/Subgrade	0.00	0.13	0.02	0.00	0.00	42.91
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.02	0.00	0.00	0.00	5.66

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		5	50.0	6.6	10.4	1.4
Fugitive Dust - Grading/Excavation		5	50.0	10.6	10.4	2.2
Fugitive Dust - Drainage/Utilities/Subgrade		5	50.0	9.2	10.4	1.9

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Bore/Drill Rigs	0.04	0.47	0.49	0.01	0.01	117.82
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.07	0.45	0.79	0.03	0.03	89.69
1.00	1	Crawler Tractors	0.09	0.44	0.91	0.05	0.05	81.43
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1	Excavators	0.04	0.36	0.41	0.02	0.02	73.95
1.00		Forklifts	0.03	0.18	0.28	0.02	0.01	32.88
1.00		Generator Sets	0.01	0.06	0.08	0.00	0.00	9.26
1.00		Graders	0.07	0.46	0.88	0.03	0.03	87.99
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.07	0.39	0.75	0.03	0.03	128.38
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.09	0.78	1.01	0.04	0.04	149.71
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rollers	0.05	0.60	0.65	0.02	0.02	111.04
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rubber Tired Loaders	0.06	0.44	0.74	0.03	0.02	93.29
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	0.6	4.6	7.0	0.3	0.3	975.4
	Grubbing/Land Clearing	tons per phase	0.1	0.6	0.9	0.0	0.0	128.8

Grading/Excavation	Default Number of Vehicles		ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	*Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Bore/Drill Rigs	0.03	0.47	0.43	0.01	0.01	117.57
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0	Cranes	0.06	0.45	0.74	0.03	0.03	89.71
1.00	1	Crawler Tractors	0.08	0.44	0.84	0.05	0.04	81.34
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00	3	Excavators	0.04	0.36	0.36	0.02	0.02	73.93
1.00		Forklifts	0.03	0.18	0.24	0.01	0.01	32.88
1.00		Generator Sets	0.01	0.06	0.08	0.00	0.00	9.26
1.00	1	Graders	0.06	0.46	0.81	0.03	0.02	87.78
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.07	0.39	0.65	0.02	0.02	128.33
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.09	0.78	0.97	0.04	0.03	149.71
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00	2	Rollers	0.05	0.60	0.61	0.02	0.02	111.03
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00	1	Rubber Tired Loaders	0.06	0.44	0.67	0.02	0.02	93.30
	2	Scrapers	2.21	14.51	25.55	1.00	0.92	3216.00
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.49	3.14	4.70	0.31	0.29	669.58
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	3.3	22.3	36.6	1.6	1.4	4860.4
	Grading	tons per phase	0.4	2.9	4.8	0.2	0.2	641.6

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
	1	Air Compressors	0.06	0.42	0.42	0.03	0.03	63.49
1.00		Bore/Drill Rigs	0.03	0.47	0.41	0.01	0.01	117.92
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.06	0.45	0.66	0.03	0.02	89.70
1.00		Crawler Tractors	0.08	0.44	0.76	0.04	0.04	81.32
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Excavators	0.03	0.36	0.32	0.02	0.01	73.94
1.00		Forklifts	0.02	0.18	0.21	0.01	0.01	32.88
1.00	1	Generator Sets	0.01	0.06	0.07	0.00	0.00	9.26
1.00	1	Graders	0.06	0.46	0.78	0.02	0.02	87.70
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.06	0.39	0.57	0.02	0.02	128.26
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.08	0.78	0.92	0.03	0.03	149.71
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Plate Compactors	0.01	0.03	0.03	0.00	0.00	4.31
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Pumps	0.04	0.30	0.31	0.02	0.02	49.52
1.00		Rollers	0.05	0.60	0.59	0.02	0.02	111.03
	1	Rough Terrain Forklifts	0.02	0.25	0.22	0.01	0.01	46.60
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rubber Tired Loaders	0.05	0.44	0.61	0.02	0.02	93.27
	2	Scrapers	2.06	14.51	23.25	0.91	0.83	3215.57
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.44	3.13	4.23	0.27	0.25	669.38
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	3.2	23.3	34.4	1.5	1.4	5023.9
	Drainage	tons per phase	0.4	3.1	4.5	0.2	0.2	663.1

Paving			ROG	CO	NOx	PM10	PM2.5	CO2
Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Bore/Drill Rigs	0.03	0.47	0.35	0.01	0.01	118.21
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Cranes	0.05	0.45	0.59	0.02	0.02	89.68
1.00		Crawler Tractors	0.07	0.44	0.68	0.04	0.04	81.39
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Excavators	0.03	0.36	0.29	0.01	0.01	73.95
1.00		Forklifts	0.02	0.18	0.18	0.01	0.01	32.88
1.00		Generator Sets	0.01	0.06	0.07	0.00	0.00	9.26
1.00		Graders	0.06	0.45	0.73	0.02	0.02	87.55
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Off-Highway Trucks	0.06	0.39	0.48	0.02	0.02	128.25
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Other Material Handling Equipment	0.08	0.78	0.75	0.03	0.03	149.71
	1	Pavers	0.03	0.35	0.31	0.01	0.01	60.23
	1	Paving Equipment	0.02	0.34	0.24	0.01	0.01	53.27
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
1.00	3	Rollers	0.05	0.60	0.54	0.02	0.02	111.03
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
1.00		Rubber Tired Loaders	0.05	0.44	0.54	0.02	0.02	93.28
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	8	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
	2	Tractors/Loaders/Backhoes	0.39	3.14	3.81	0.22	0.21	669.68
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	1.0	8.4	9.6	0.5	0.4	1758.4
	Paving	tons per phase	0.1	1.1	1.3	0.1	0.1	232.1
Total Emissions all Phases (tons per construction period) =>			1.1	7.7	11.6	0.5	0.5	1665.6

Equipment default values for horsepower and hours/day can be overridden in cells C289 through C322 and E289 through E322.

Equipment		Default Values Horsepower		Default Values Hours/day
Aerial Lifts		63	1.00	8
Air Compressors		106	1.00	8
Bore/Drill Rigs	206.00	206	1.00	8
Cement and Mortar Mixers		10	1.00	8
Concrete/Industrial Saws		64	1.00	8
Cranes	270.00	226	1.00	8
Crawler Tractors	165.00	208	1.00	8
Crushing/Proc. Equipment		142	1.00	8
Excavators	168.00	163	1.00	8
Forklifts	142.00	89	1.00	8
Generator Sets	10.00	66	1.00	8
Graders	185.00	175	1.00	8
Off-Highway Tractors		123	1.00	8
Off-Highway Trucks	290.00	400	1.00	8
Other Construction Equipment		172	1.00	8
Other General Industrial Equipment		88	1.00	8
Other Material Handling Equipment	330.00	167	1.00	8
Pavers		126	1.00	8
Paving Equipment		131	1.00	8
Plate Compactors		8	1.00	8
Pressure Washers		26	1.00	8
Pumps		53	1.00	8
Rollers	253.00	81	1.00	8
Rough Terrain Forklifts		100	1.00	8
Rubber Tired Dozers		255	1.00	8
Rubber Tired Loaders	225.00	200	1.00	8
Scrapers		362		8
Signal Boards		20		8
Skid Steer Loaders		65		8
Surfacing Equipment		254		8
Sweepers/Scrubbers		64		8
Tractors/Loaders/Backhoes		98		8
Trenchers		81		8
Welders		45		8

END OF DATA ENTRY SHEET

Attachment 3

Emission Rates of Barges for Construction Material Delivery

Attachment 3 Emission Rates of Barges for Construction Material Delivery

E = EF0 x Fx (1 + D x A/UL) x HP x LF x Hr

Where:

The formular is taken from Emissions Estimation Methodology for Commercial Harbor Craft Operating in California
http://www.arb.ca.gov/msei/chc-appendix-b-emission-estimates-ver02-27-2012.pdf

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period;

EF0 is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new), in gram/horsepower-hour;

F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;

D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;

A is the age of the engine when the emissions are estimated, assume 10 years (model year 2008)

UL is the vessel type and engine use specific engine useful life;

HP is rated horsepower of the engine;

LF is the vessel type and engine use specific engine load factor;

	Pollutants	ROG	CO	NOx	PM10	CO2
Main Engine 3000 horsepower	Zero-hour Emission factors gram/horsepower-hour	0.1700	0.9200	4.5100	0.1100	568.3000
	Deteriorating Factor	0.4400	0.2500	0.2100	0.6700	0.0000
	Age (year)	10.0000	10.0000	10.0000	10.0000	10.0000
	Useful Life (Year)	21.0000	21.0000	21.0000	21.0000	21.0000
	Load Factor	0.8000	0.8000	0.8000	0.8000	0.8000
	Fuel Correction	1.0000	1.0000	0.9480	0.8220	1.0000
	Emissions Per Hour (pounds per hour)	1.0880	5.4473	24.8843	0.6311	3006.9446
Main Engine 50 horsepower	Zero-hour Emission factors	0.2299	3.0900	5.0100	0.2400	568.3000
	Deteriorating Factor	0.4400	0.2500	0.2100	0.6700	0.0000
	Age (year)	10.0000	10.0000	10.0000	10.0000	10.0000
	Useful Life (Year)	23.0000	23.0000	23.0000	23.0000	23.0000
	Load Factor	0.8000	0.8000	0.8000	0.8000	0.8000
	Fuel Correction	1.0000	1.0000	0.9480	0.8220	1.0000
	Emissions Per Hour (pounds per hou	0.0242	0.3021	0.4571	0.0225	50.1157
Emissions Per Hour (pounds per hour)		1.1121	5.7494	25.3414	0.6535	3057.0603

Notes:

1. Source of Zero Hour Emission Factors and Deterioration Factor: California Barge and Dredge Emissions Inventory Database
http://www.arb.ca.gov/msei/california_barge_dredge_emissions_inventory_database_10072011.mdb

2. Age and Userful life are based on Port of Long Los Angeles 2012 emission inventory, tables 4-1 and 4-2, for tug boats, Table 4.4.

3. Load factors are based on USEPA Current Methodologies in Preparing Mobile Source Port Related Emission Inventories, Final Report, April 2009
Table 3-3: EPA Load Factors for Harbor Craft (Page 3-6)
http://www.epa.gov/sectors/sectorinfo/sectorprofiles/ports/ports-emission-inv-april09.pdf
Choose a conservative number 0.8 for both main engines and auxiliary engines

Attachment 4

Emission Rates of the Helicopter for Aerial Herbicide Spray

Attachment 4 Emission Rates of the Helicopter for Aerial Herbicide Spray

Helicopter emissions were calculated using the "Guidance for the Determination of Helicopter Emissions, Swiss Confederation, Federal Department of the Environment, Transport, Energy and Communications (DETEC), March 2009." at

http://www.bazl.admin.ch/experten/regulation/03312/03419/03532/index.html?lang=er

The hourly and Landing/Take Off Cycle (LTO) emission rates are taken from the from the Helicopter Emissions Table at :

http://www.bazl.admin.ch/experten/regulation/03312/03419/03532/index.html?lang=en&download=NHzLpZeg7t,lnp6l0NTU042l2Z6ln1ad1IZn4Z2qZpnO2Yuq2Z6gpJCDeXx5fGym162epYbg2c_JjKbNoKSn6A--

						LTO Emissions					One-hour Operation Emissions				
Code	Aircraft_ICAO	Aircraft_Name	Engine_Name	Max SHP per engine	Number_of_Engines	LTO fuel (kg)	LTO NOx (g)	LTO HC (g)	LTO CO (g)	LTO PM non volatile (g)	One hour fuel (kg)	One hour NOx (g)	One hour HC (g)	One hour CO (g)	One hour PM non vol. (g)
H001	B06	BELL 206L	DDA250-C30P	650	1	23.6525	131.1123	291.1625	372.1083	4.2337	149.4015	1099.3339	664.8895	817.3494	32.2220

Assumptions:

The number of acres to be treated is 411, and each acre requires 15 gallons of herbicide solution, so we have (411 ac) * (15 gal/acre) * (1 tank/100 gal) = 62 tanks to spray .

So there will be 92 takeoff and landing cycles.

Assume in each hour, there are 8 LTOs, and 40 minutes is for opration, and 20 minutes for taking off, landing and loading herbicide.

Assume a helicopter will work for 8 hours to complete the task, a total of 64 LTOs can be done, the additional 2 LTOs are for mobilziation and demobilization.

Daily Emissions (in pounds per day) = (LTO Emissions (grams)* Number of LTO + One-Hour Operation Emissions (grams) * Operation Hours Per Day) / 453.59 (grams per pounds)

	HC (ROG)	CO	NOx	PM10	PM2.5
Emissions Per LTO (grams)	291.1625	372.1083	131.1123	4.2337	4.2337
Number of LTOs Each Hour	8	8	8	8	8
Hourly Operation Emissions	664.8895	817.3494	1099.3339	32.2220	32.2220
Operation Time in an Hour (in hours)	0.666666667	0.666666667	0.666666667	0.666666667	0.666666667
Emissions Each Hour (grams)	2772.5600	3521.7657	1781.7873	55.3507	55.3507
Emissions Each Hour (pounds)	6.1125	7.7642	3.9282	0.1220	0.1220

Estimate greenhouse gas emission for helicopters based on jet fuel consumption rate of 3.13 Kg CO2/ Kg fuel (20.89 lb CO2/gal with density of 0.8 Kg/L)

	Fuel	CO2
Emissions Per LTO (kg)	23.6525	74.0325
Number of LTOs Each Day	8	8
One-hour Operation Emissions (kg)	149.4015	467.6268
Operation Time in an Hour (in hours)	0.666666667	0.666666667
Emissions Each Hour (grams)	288.8213728	904.0109
Emissions Each Hour (pounds)	636.7454591	1993.013287

Appendix H

DWR GHG Emissions Reduction Plan Consistency Determination Form

DWR GHG Emissions Reduction Plan Consistency Determination Form

For Projects Using Contractors or Other Outside Labor

Print Form

This form is to be used by DWR project managers to document a DWR CEQA project's consistency with the DWR Greenhouse Gas Emissions Reduction Plan. This form is to be used only when DWR is the Lead Agency and when contractors or outside labor and equipment are use to implement the project.

Additional Guidance on filling out this form can be found at:
dwrclimatecange.water.ca.gov/guidance_resources.cfm

The DWR Greenhouse Gas Emissions Reduction Plan can be accessed at:
http://www.water.ca.gov/climatechange/CAP.cfm

California Department of Water Resources
1416 9th Steet
Sacramento, CA
95814
dwrclimatechange.water.ca.gov
www.water.ca.gov/climatechange

Project Name:	Prospect Island Tidal Habitat Restoration
Environmental Document type:	EIR
Manager's Name:	Dan Riordan
Manager's email:	Dan.Riordan@water.ca.gov
Division:	Division of Environmental Services
Office, Branch, or Field Division	Mitigation and Restoration Branch

Short Project Description:

Prospect Island Tidal Habitat Restoration Project proposes to restore tidal connectivity to up to 1,600 acres (ac) of currently diked land in Solano County, in partial fulfilment of the 8,000-ac tidal habitat restoration obligations of the 2008 USFWS Delta Smelt Biological Opinion (BiOp), RPA 4, and 2009 NMFS Salmonid BiOp.

The Proposed Project involves repairing a currently leaking levee, dewatering the island, and construction of access roads and ramps. Maintenance pumping will be required to maintain dry conditions for the duration of construction. Once dry, invasive species control, clearing and grubbing, channel excavation, and toe berm / intertidal bench construction will take place within the island. A spur channel connecting Prospect Island to Miner Slough will be dredged to accommodate tidal flows, and two levee breaches will be constructed to hydrologically connect interior Prospect Island with Miner Slough.

Project GHG Emissions Summary

Total Construction Emissions: 6400 $mtCO_2e$

Maximum Annual Construction Emissions: 3600 $mtCO_2e$

☒ All other emissions from the project not accounted for above will occur as ongoing operational, maintenance, or business activity emissions and therefore have already been accounted for and analyzed in the GGERP.

Extraordinary Construction Project Determination

Do total project construction emissions exceed 25,000 $mtCO_2e$ for the entire construction phase or exceed 12,500 $mtCO_2e$ in any single year of construction.

○ Yes - Addition analysis is required, consult with C4

◉ No - Additional analysis not required

Project GHG Reduction Plan Checklist

☒ All Project Level GHG Emissions Reduction Measures have been incorporated into the design or implementation plan for the project. (Project Level GHG Emissions Reduction Measures)

Or

☐ All feasible Project Level GHG Emissions Reduction Measures have been incorporated into the design or implementation plan for the project and and Measures not incorporated have been listed and determined not be apply to the proposed project (include as an attachment)

☒ Project does not conflict with any of the Specific Action GHG Emissions Reduction Measures (Specific Action GHG Emissions Reduction Measures)

Would implementation of the project result in additional energy demands on the SWP system of 15 GWh/yr or greater?

○ Yes ◉ No

If you answered Yes, attach a Renewable Power Procurement Plan update approval letter from the DWR SWP Power and Risk Office.

Is there substantial evidence that the effects of the proposed project may be cumulatively considerable notwithstanding the proposed project's compliance with the requirements of the DWR GHG Reduction Plan?

○ Yes ◉ No

If you answered Yes, the project is not eligible for streamlined analysis of GHG emissions using the DWR GHG Emissions Reduction Plan. (See CEQA Guidelines, section 15183.5, subdivision (b)(2).)

Based on the information provided above and information provided in associated environmental documentation completed pursuant to the above referenced project, the DWR CEQA Climate Change Committee has determined that the proposed project is consistent with the DWR Greenhouse Gas Reduction Plan and the greenhouse gasses emitted by the project are covered by the plan's analysis.

Project Manager Signature:	Daniel R. Mercado	Date: 11/13/2015
C4 Approval Signature:	Matthew Correa	Date: 12/2/2015

Attachments:

☒ GHG Emissions Inventory

☐ List and Explanation of excluded Project Level GHG Emissions Reduction Measures

☐ Plan to update Renewable Energy Procurement Plan from DWR SWP Power and Risk Office